

2024

---

# RESEARCH CATALOGUE



Politecnico  
di Bari



**in** [politecnodibari](#)

**f** [PolibaOfficial](#)

**X** [@PolibaOfficial](#)

**@** [@politecnodibari](#)

**▶** [@PolitecnodiBariOfficial](#)



**Politecnico  
di Bari**

Via Amendola 126/b  
70126 Bari - Italy  
[www.poliba.it](http://www.poliba.it)

## RECTOR'S WELCOME



Politecnico di Bari is an Italian state university for higher education, scientific research and technological transfer in the fields of Engineering, Architecture and Industrial Design. Its researchers are at the top of international rankings for excellence in several flagship areas for both new technologies and typical engineering sciences. Of its five departments, two have been awarded funding by the Italian Ministry of Universities and Research as Departments of Excellence; the DMMM (Department of Mechanics, Mathematics and Management) and the inter-university Department of Physics in conjunction with Bari University. Other Politecnico departments include DEI (Department of Electrical and Information Engineering), ARCOD (Department of Architecture, Construction and Design) and DI-CATECH (Department of Civil, Environmental, Construction, Chemical and Land Engineering).

Established in 1990, Politecnico di Bari is one of three polytechnic universities in Italy and the only one in the central-south area of the country. It is located in Puglia, a region in the heart of the Mediterranean well-known for its climate and natural resources, as well as its drive towards innovation. Politecnico di Bari was formed with the aim of supporting local development from its sites in Bari and Taranto, two cities with enormous potential and

appeal. Overall, there are over 10.000 students enrolled, with an average of around 2.000 graduating students each year. Master's degree graduates boast the highest level of employment in the country.

Another key feature of the Politecnico is its enormous capacity for collaboration with businesses, to encourage technological innovation. The Politecnico currently oversees 15 private/public laboratories in advanced fields such as aerospace, automation, information technology, mobility and energy. In addition, Politecnico di Bari offers a business school for advanced education in management and innovation, has recently established a startup incubator and is an active participant in major national projects set out under the EU's Next Generation fund. Through international cooperation, the Politecnico shares knowledge and best practices for innovation, technological development and the protection of heritage.

Politecnico di Bari is the best place to design the future.

Francesco Cupertino







Politecnico di Bari  
Politecnico di Bari

DICATECH  
DIPARTIMENTO DI INGEGNERIA CHIMICA, AMBIENTALE, DEL TERRITORIO, ENERGETICA E DI CHIMICA

DICAR  
DIPARTIMENTO DI SCIENZE DELL'INGEGNERIA CHIMICA E DELL'INDUSTRIALITÀ

DIEI  
DIPARTIMENTO DI INGEGNERIA ELETTRICA E DELL'INFORMAZIONE

DIMMM  
DIPARTIMENTO DI INGEGNERIA, MATEMATICA E MANAGEMENT

## INTERNATIONAL COLLABORATION

15

### ERASMUS+

International credit mobility programme with over 40 Universities

10

### DOUBLE DEGREES

Ranked 3<sup>rd</sup> in Italy for students satisfaction

+30

### EU HORIZON 2020 FINANCED PROJECTS



22 SPIN OFF



13 PATENTS



+135 RESEARCH GRANTS



Included in the QS WORLD UNIVERSITY RANKINGS

#566 OVERALL RANK in the 2024 Edition

#9 top 10 Italian Best in Architecture and Design ranking





**+2,5 M€**

**SPONSORED RESEARCH  
AND INDUSTRIAL CONSULANCY**



**1200**

**SCIENTIFIC  
PUBLICATIONS**



**67 INDUSTRY-SPONSORED PhD SCHOLARSHIPS (2020-2023)**

## THE POLYTECHNIC IN FIGURES

# 802

**TEACHERS, RESEARCHERS  
AND STAFF**

# 11k

**STUDENTS**

# 5

**DEPARTMENTS**

2 of them sealed excellent  
from ANVUR

around **11.000** undergraduate and postgraduate students of which about **31%** are women about **3.200** students registered every year about **415** enrolled in Research Doctorate courses

## TRAINING OFFER

- 11** Three-year Degree courses
- 16** Master's Degree courses
- 01** Single-cycle Degree course
- 04** Post-Degree courses
- 10** PhD courses
- 01** Post-graduate School

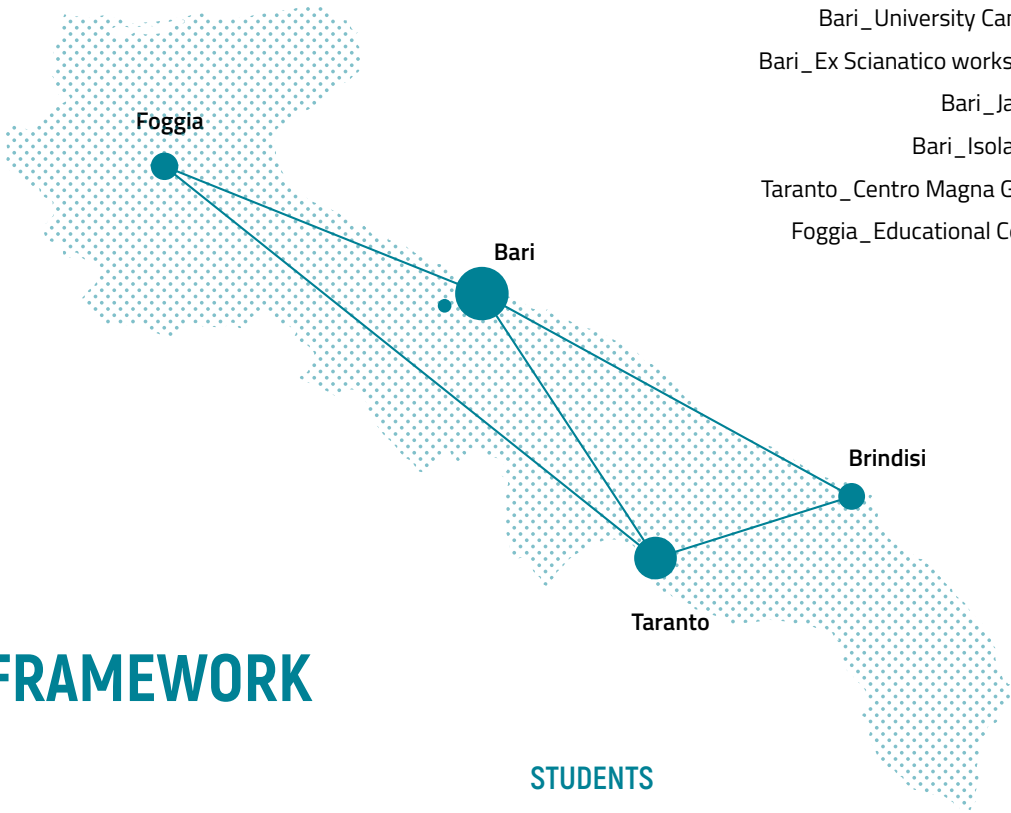
## INTERNATIONALIZATION

- 07** Study courses with double degree agreements
- 05** Study courses delivered in English
- 160** Incoming Erasmus students
- 281** Outgoing PoliBa Erasmus students

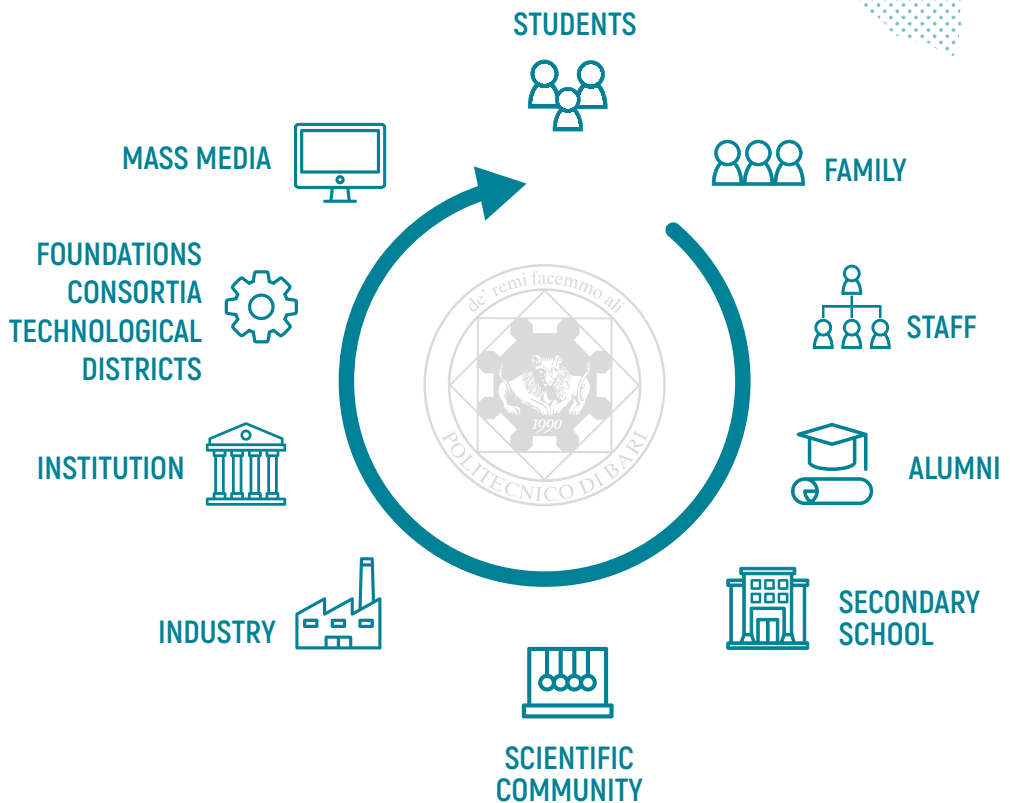
about **1.900** graduates each year, of which more than **1000** within the legal term employment rate at 3 years from the two-year master's degree **93.8%** employment rate at three years from degree single-cycle **93.9%**

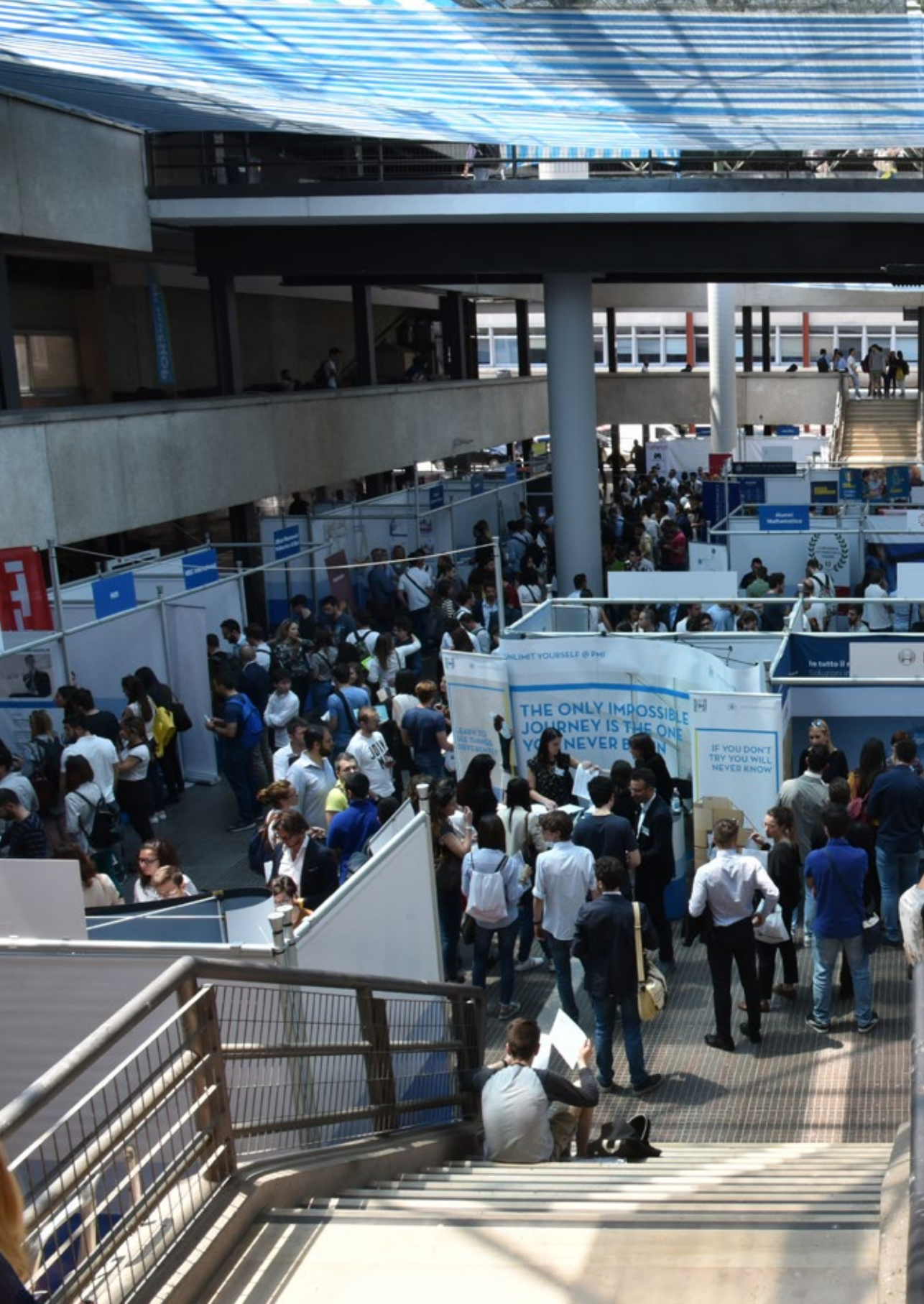
## TERRITORIAL OFFICES

- Bari\_ University Campus
- Bari\_ Ex Scianatico workshops
- Bari\_ Japigia
- Bari\_ Isolato47
- Taranto\_Centro Magna Grecia
- Foggia\_Educational Center



# FRAMEWORK





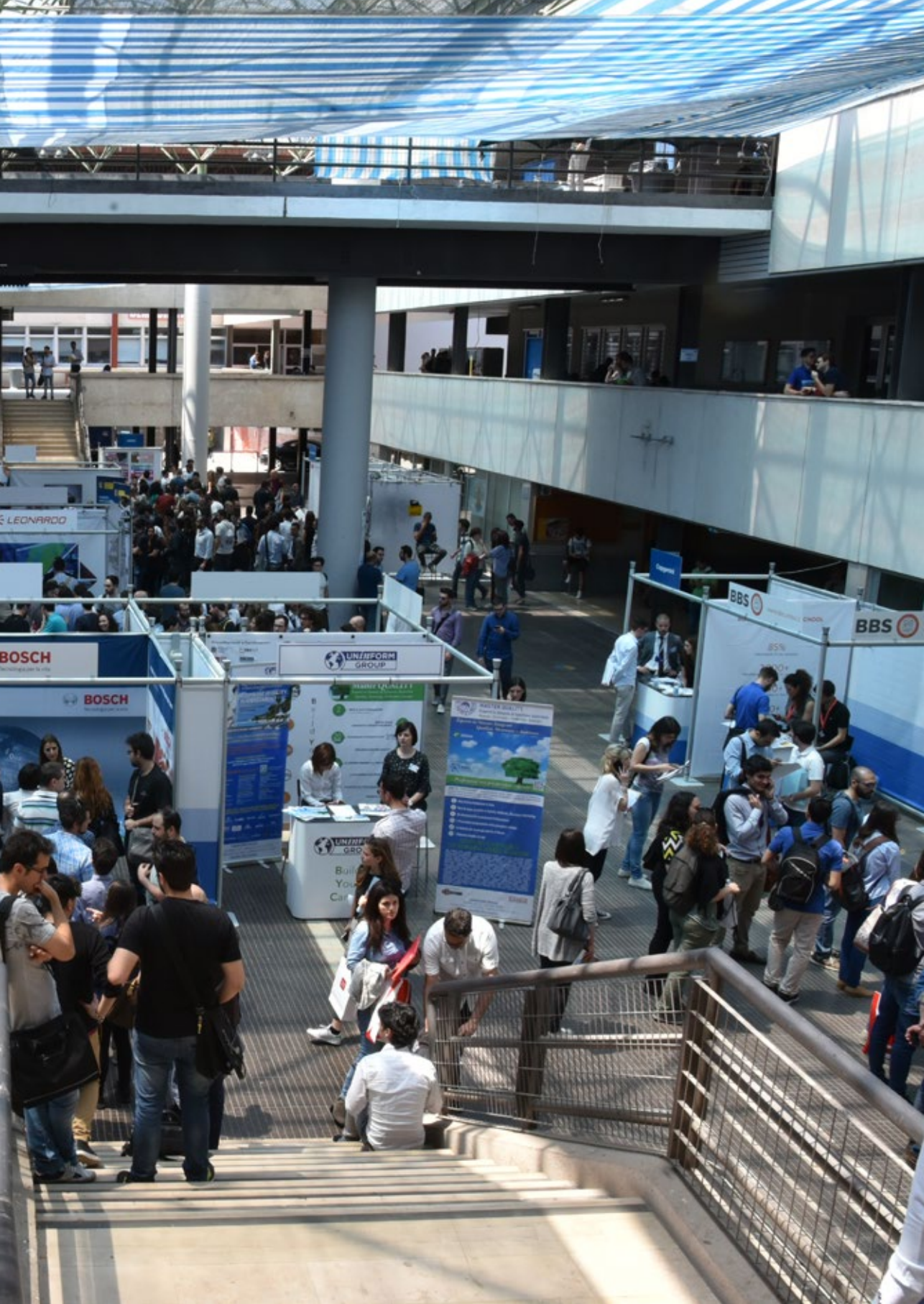
UNLIMIT YOURSELF @ PHI

THE ONLY IMPOSSIBLE  
JOURNEY IS THE ONE  
YOU NEVER BEGIN

IF YOU DON'T  
TRY YOU WILL  
NEVER KNOW

Master Mathematics

In tutto il mondo



LEONARDO

BOSCH

BOSCH

UNIFORM GROUP

UNIFORM GROUP  
Build Your Career

BBS

BBS





# CONTENT



<b>AT A GLANCE</b> .....	20
<b>ARCOD - Architecture, Construction, Design</b> .....	24
<b>DEI - Department of Electrical and Information Engineering</b> .....	26
<b>DICATECH - Department of Civil, Environmental, Land, Building Engineering and Chemistry</b> .....	28
<b>DMMM - Department of Mechanics, Mathematics and Management</b> .....	30
<b>DIF - Department of Physics</b> .....	32
<b>TTEC - Taranto</b> .....	34
<b>Startup LAB</b> .....	35
<b>LABORATORIES</b> .....	37

## **ARCOD**

<b>INTERDISCIPLINARY LABORATORIES</b> .....	41
Building Physics Laboratory .....	42
CO   RO - communicative roots.....	44
DEEP_LAB_DESIGN_DLD.....	45
Design_KIND LAB.....	46
History of Ancient Architecture, Archaeology, and Restoration Laboratory .....	47
INMATEX - Interaction MAterial EXperience Lab .....	49
Official Laboratory of Materials Testing "M. Salvati" .....	50
Museum of Rocks.....	53
Museum of Technology .....	54
Observatory of Real Estate Market .....	55
Survey and Representation Laboratory.....	56
Urban Planning and Sociology Laboratory .....	58

## **DEI**

Advanced Electrotechnics.....	63
Advanced Environmental inFormatic Laboratory (AeFLab) .....	64
Applied Electronics and Microelectronics .....	65
Apulia regional laboratory of characterization of new organic and nanostructured materials .....	66
Artificial Vision Laboratory (AVLAB).....	67
Clean room.....	67
Control and automation.....	68
Control of Computing and Communication Systems Lab (C3LAB) .....	71
Decision and Control Laboratory .....	72
Design of Electronic Integrated Systems Lab (DEISLab).....	74
Digital Electronics Systems and Applications Lab (ELEDIGILAB) .....	75
Electrotechnical Laboratory (ELEC LAB) .....	76
Electrical and Electronic Measurements Research Lab - Bari .....	77
Electrical and Electronic Measurement Lab Magna Grecia Center.....	79
Electrical Machines and Drives.....	80
Electromagnetic Fields and Telecommunications - Magna Grecia Center.....	81
Electronic for Signal Processing Laboratory.....	83
Electronics for Telecommunications.....	85
Industrial Informatics .....	85
Information Systems Laboratory (SisInf Lab) .....	87
Laboratory of Photonics Research Group .....	89
LabZERO.....	90
Optoelectronics Laboratory.....	94
Power Electronics.....	97
Prince - Electrical Energy Systems .....	98
Signal Processing Laboratory .....	99
Telematics Laboratory.....	99

## DICATECH

Applied Geomatics Laboratory (AGlab) .....	105
Coastal Engineering Laboratory (LIC) .....	107
Environmental Technologies Laboratory (ETL) .....	109
Geotechnical Engineering Laboratory .....	111
Hydraulics and Hydraulic Construction Laboratory (H&HC) .....	114
Laboratory for Modeling, Diagnostics and structural inteRventions (MoDiR) .....	116
Laboratory for soft, biological, bio-inspired and meta-materials (LabSoMat) .....	121
Architectural and Urban Modeling Laboratory (MAULab) .....	123
Laboratory of Building Technologies (BT Lab) .....	124
Laboratory of Chemistry (LoC) .....	126
Laboratory of Cognition and Spatial Planning (CoPS) .....	127
Laboratory of Economic, Environmental and Regional Sciences (LEEReS) .....	128
Laboratory of Environmental Geoengineering and Groundwater Hyology (LEGGH) .....	129
Laboratory of Mobility Infrastructures (LaMI) .....	130
Research Platform for Sanitary Engineering and Environmental Monitoring (PRISMA) .....	131
Sustainable Mobility Lab (SML) .....	133

## DIF

ALICE - Laboratory for ultra-thin silicon detectors .....	139
FCC - Laboratory for future circular colliders .....	140
Gaseous Detector Lab .....	141
High Energy photosensors and electronics for space-born and ground-based experiments Laboratory .....	142
Laboratory for ultra-thin silicon detectors .....	142
Mechanical Workshop .....	143
MicroLab: Advancing Ultrashort Pulse Laser Micromachining for Cutting-Edge Devices .....	144
ReCaS - Bari .....	145
Remote Sensing Lab .....	147
Silicon Detectors Laboratory for High Luminosity Colliders .....	148

## DMMM

Advanced Forming & Manufacturing .....	153
Advanced Optical Methods and Structural Optimization .....	155
Advanced Structural Diagnostic Lab .....	156
Business Planning .....	158
Demanufacturing Lab .....	159
E-business .....	160
EMILIA Net Lab. (Experimental Mechanics Integrated Laboratories in Aerospace - Apulia Region Net of Labs) .....	162
Estensimetria (Strain Gauge Testing Lab) .....	163
Flow Simulation and modelling of energy systems .....	164
Geomatics laboratory .....	165
Human Machine Interaction & Performance Enhancement Lab: HIPE Lab .....	166
Hybrid welding .....	168
Innovation Management & Technology Entrepreneurship (IM&TE) .....	169
Interdisciplinary Additive Manufacturing Lab (I AM Lab) .....	171
Knowledge Management Laboratory (KMLab) .....	171
Laboratory for hydraulic pumps and turbines .....	175
Laboratory for Internal Combustion Engines (MACI) .....	176
Laboratory for Rapid Prototyping and Reverse Engineering .....	177
Laboratory for steady state conventional and MILD combustion (LACO) .....	179
Laboratory for the thermo-physical characterization of manufactured polymers .....	180
Laboratory for wave energy conversion devices and Wells turbines .....	181
Laboratory MICROTRONIC - micro-machining and 3D micro-measures for mechanical components .....	182

Laboratory of Computer Numerical Control Machine Tools .....	184
Laboratory of experimental stress analysis (ESA Lab) .....	185
Laboratory of Industrial Systems Engineering (LISE) .....	186
Laboratory of Intelligent Computation for Manufacturing and Production Systems .....	187
Laboratory of Manufacturing Processes by Laser Technologies .....	188
Laboratory of Modelling and Simulation of Mechanical Structures (LabMS <sup>2</sup> ) .....	189
Laboratory of Testing on Innovative Materials and Structures .....	190
Levantine Lab for Sustainable technologies (SESTANTE) .....	191
MATH-LAB .....	193
Mechanical and Thermal Measurements Laboratory .....	194
Metallography and Microscopy (M&M-Lab) .....	195
Mixed Experience Lab (MELAB) .....	197
Modelling and SIMulation of BIOlogical Structures and Processes Lab (SIM-BIOS-Lab) .....	198
Noise and Vibration Laboratory (NVLab) .....	199
Optimization of Manufacturing Processes by Numerical Simulations (ManOnSim) .....	201
Physical Simulation of Manufacturing processes (PhySiMaP-Lab) .....	202
Polimare Lab .....	203
Residual Stress Lab .....	204
Robotic Mobility Lab (RML) .....	205
Robot mechanics Lab .....	206
Structural Diagnostic and Thermal Methods for Experimental Mechanics .....	207
Structural Health Monitoring and Damage Assessment Lab .....	209
TriboDynamics Lab .....	211
Tribology Laboratory (TriboLab) .....	213
Virtual Reality and Reality Reconstruction Lab (VR3Lab) .....	215
Wind Tunnel (GAVE) .....	216
<b>SPIN-OFF COMPANIES</b> .....	<b>221</b>
<b>PATENTS</b> .....	<b>229</b>
<b>PRIVATE - PUBLIC JOINTS LABS</b> .....	<b>237</b>
<b>MAIN RESEARCH PROJECTS</b> .....	<b>247</b>
<b>PNRR</b> .....	<b>253</b>
<b>CATALOG OF RESEARCH</b> .....	<b>257</b>
<b>POLIBA ALUMNI</b> .....	<b>259</b>
<b>BINP</b> .....	<b>261</b>
<b>INDUSTRIAL LIAISON OFFICE</b> .....	<b>263</b>

Since the beginning, the policy of Politecnico di Bari has been distinguished by its focus on the quality of research and education, on the internationalization and on innovation. International exchange activities in the teaching and learning area include several agreements with Institutions abroad, most of all in EU.

The team of Politecnico is dedicated to fulfilling the educational and research mission of University, and to advancing a vision for the future of the University where the tradition of academic excellence is combined with a strong commitment in serving society.

Nowadays the staff of Politecnico is composed of around 402 researchers/professors and 269 members of administrative staff. The total enrollment amounts to around 12.000 undergraduate and postgraduate students. Several facilities are available at the campuses including leisure and sport facilities.

Since 2012, Politecnico di Bari is structured in the following departments:

- ARCOD Department of Architecture, Construction, Design
- DICATEH Department of Civil, Environmental, Land, Building Engineering and Chemistry
- DEI Department of Electrical and Information Engineering
- DMMM Department of Mechanics, Mathematics and Management
- DIF Department of Physics, jointly with the Università di Bari

Politecnico di Bari is also structured in the following two interdepartmental centers:

- TTEC-Taranto;
- Interdepartmental Center "Startup Lab".

Referring to the academic year 2022/2023, the educational offer is articulated in 23 degree courses: Laurea (three years), Laurea Magistrale (two years), Masters and PhD courses.

Politecnico di Bari is therefore an university where education and research combine to meet the actual needs of the society (societal challenges) and, in particular, those of the students. Both basic and applied research activities are carried out in the Departments and in the Research Centres of Politecnico.

They are supported by the Industrial Liaison Office to cover activities from research to market with a new focus on innovation-related activities, such as piloting, demonstration, test-beds, patents, and spin-offs.



POLITECNICO DI BARI



126a





The Department of Architecture, Construction, Design ArCoD, of Politecnico Bari is a centre of excellence that carries out theoretical and applied research on topical issues: on the relationship between city and landscape, in order to define innovative and sustainable settlements and housing models for the contemporary city; on the relationship between the new and the ancient, in order to define principles and innovative techniques for the restoration, reconstruction and enhancement of archaeological and architectural heritage; on the relationship between architecture and construction, in order to reinforce the structural concept of formal research into architecture.

The Department carries out theoretical and applied research on topical issues in the field of design: on the relationship between problem solving and sense making processes in the territorial context, in order to contribute to social innovation, economic progress and environmental protection, to implement knowledge and enhancement of tangible and intangible cultural heritages.\*

These researches are aimed to preserve and enhance the Heritage, assumed to be a problematic field, but at the same time an identity one, of Euro-Mediterranean area. They are carried out in the degree courses (Architecture and Industrial Design), Departmental Research Laboratories, the School of Specialization in Architectural Heritage and the Landscape and Ph.D. "Architecture: Innovation and Heritage".

The choice of application themes matches the requests coming from the local Institutions (Apulia Region, Metropolitan City, Superintendence Authorities, Regional Agency for the Home, Albanian Agency for Territory, Superintendence Authority

of the Greek Monuments) and stakeholders in the production world (Architects' Order, National Association of Building Contractors).

Close and successful collaboration with all these stakeholders allows graduates of the Department's degree courses to get closer to jobs and professions with better up-to-date knowledge experiences in respect of the development field of the Heritage 'new economy' (architectural, urban and landscape) and Design.

#### Web site and contacts

<http://www.dipartimentoioicar.it/>

#### Department chair

Carlo Moccia  
carlo.moccia@poliba.it  
tel: +390805963834

#### Administration Manager

Rosanna Devito  
rosanna.devito@poliba.it  
tel: +390805963811  
darcod.poliba@legalmail.it

#### Staff

Professors: 59  
Technical and administrative: 16  
Post Doctoral Research Fellows: 16  
PhD Students: 57

#### PhD Course

Design for Heritage: Knowledge and landscape;  
Heritage Planning: Knowledge, Tradition and Innovation;  
Sustainability Engineering and Civil & Industrial Building.





The Department of Electrical and Information Engineering (DEI) was established in 1982 to foster, coordinate, manage research/training and education/technology transfer activities in electrical and information engineering.

The Department is chaired by Gennaro Boggia and its staff includes 73 full time tenured researchers, 33 junior researchers, 18 technical and administrative, and many PhDs and PostDocs.

DEI includes 12 Scientific Research Areas and more than 20 Laboratories: Computer Science, Control Systems Engineering; Converters, Electrical Machines and Drives; Electrical and Electronic Measurements; Electrical Energy Systems; Electrical Engineering; Electromagnetic Fields; Electronics; Medical Systems Engineering; Numerical Analysis; Operations Research; Telecommunications.

The Department provide 3 PhD courses, 12 Master and Bachelor Degrees in Electrical and Information Engineering, with numerous international Master and Bachelor Double Degrees with renowned international Universities. DEI collaborates with prestigious Universities/Research Centers and large companies/SMEs in the world.

#### Web site and contacts

[Http://dei.poliba.it/](http://dei.poliba.it/)

#### Department chair

Gennaro Boggia  
gennaro.boggia@poliba.it  
tel: +390805963621

#### Department Deputy Chair:

Mario Carpentieri  
mario.carpentieri@poliba.it  
tel: +390805963590

#### Administration Manager

Antonello Fortunato  
antonello.fortunato@poliba.it  
tel: +390805963703  
deidir@poliba.it  
dei.poliba@legalmail.it

#### Keywords

Automation  
Computer Science  
Electrical Engineering  
Electronics  
Information and Communication  
Medical Systems Engineering  
Technology

#### Staff

Professors: 111  
Technical and administrative: 18  
Post Doctoral Research Fellows: 28  
PhD Students: 154

#### PhD courses

Electrical and Information Engineering,  
Smart and Sustainable Industry,  
Autonomous Systems



The Department of Civil, Environmental, Land, Building Engineering and Chemistry aims at achieving shared goals using a model aimed at promoting modern and interdisciplinary research.

The presence of large research infrastructures and expertise is strategic, with an impact testified by a large network of relationships with public and private actors.

This plays a crucial role in developing new engineering solutions with large impact at national and international level.

The overall objective of the Department is to develop interdisciplinary research actions in defining and constructing new interpretative models, respecting the overall criteria of the land planning, land conservation, protection and management of the natural resources, development of environmentally sustainable processes, as in the design and management of new infrastructures and buildings as well as in the rehabilitation of existing ones. Our mission is, in line with the priorities of the European agenda:

To promote a holistic approach to the scientific research.

To focus more on the research objectives.

To valorise the development sectors in which Italy and Apulia can maintain and strengthen a leading position and promote sustainable economic growth.

**Web site and contacts**

<http://www.dicatech.poliba.it/>

**Department chair**

Leonardo Damiani  
leonardo.damiani@poliba.it  
tel: +390805963202

**Administration Manager**

Biagio D'Aquino  
biagio.daquino@poliba.it  
tel: +390805963203  
amministrazione.dicatech@poliba.it  
dicatech.poliba@legalmail.it

**Keywords**

Civil engineering  
Environment and natural resources  
Infrastructures  
Building engineering  
Transportation & Sustainable Mobility  
Management of Civil Infrastructures  
Chemistry

**Staff**

Professors: 95  
Technical and administrative: 26  
Post Doctoral Research Fellows: 37  
PhD Students: 87

**PhD Courses**

Risk and environmental,  
territorial and building development;  
Sustainable Territory Management  
(Consortium with UNIBA- Headquarters: Uniba);  
Change management in civil engineering infrastructures  
(industrial PhD with AQP SpA)



The Department brings together scientific expertise in the context of Mechanical Engineering, Management, and Mathematics.

The mission of Department is to pursue excellence in research and teaching in the following fields: Biomimetics and tribology of surfaces; Collective Intelligence; Complex Flow Simulation; Dynamics and control of vibrations; Energy Efficiency and Renewable Energy; Nonlinear differential equations; Combinatorial Geometry and Applications; Innovation management; Sustainable Management; Innovation in Industrial Plant Engineering; Contact friction mechanics; Micromachining, Additive Manufacturing and Reverse Engineering, Sustainable Production; Mathematical models in material science and quantum systems; Mechanical design for materials and structures; Industrial Augmented Reality; Robotics; Digital Enterprise Strategy and Models; Innovative Materials and Technologies; Innovative mechanical transmissions; Unità di Ricerca INDAM; Welding and Laser Manufacturing.

The research topics are carried out by 25 research groups of the Department in more than 40 Laboratories, including four networks of laboratories (EMILIA, MICROTRONIC, TISMA, and Trasforma).

The DMMM has been selected by the Italian Ministry of Education, University and Research as a Department of Excellence for the two consecutive five years periods 2018-2022 and 2023-2027 respectively with a special ministerial funding of about 20million euros. The Department provides 3 Ph.D. courses (Mechanical and Energy Engineering, Management Engineering, Aerospace Science and Engineering) four Bachelor of Science degrees (Mechanical Engineering, Management Engineering, Aerospace Engineering Systems and Industrial and

Naval Engineering System), four Master of Science degrees (Mechanical Engineering, Management Engineering, Energy Engineering and Aerospace Engineering), and offers several Double Degrees with internationally renowned Universities.

#### Web site and contacts

[Http://dmmm.poliba.it/](http://dmmm.poliba.it/)

#### Department chair

Giuseppe Carbone  
giuseppe.carbone@poliba.it  
tel: +39080 596 3488/3688

#### Department Deputy Chair

Iliaria Filomena Giannoccaro  
ilaria.giannoccaro@poliba.it  
tel: +39080 596 3867

#### Administration Manager

Vitantonio Martino  
vitantonio.martino @poliba.it  
tel: +39080 596 3529  
dmmm.poliba@legalmail.it

#### Keywords

Aerospace, Energy and Engines  
Experimental Mechanics  
Mechanical and Mechatronic Design  
Management  
Mathematics  
Structural Diagnostic  
Technologies and Plant Design

#### Staff

Professors: 116  
Technical and administrative: 21  
Post Doctoral Research Fellows: 45  
PhD Students: 114

#### PhD Course

Mechanical and Energy Engineering,  
Management Engineering, Aerospace Science  
and Engineering



The Department of Physics “Michelangelo Merlin” in 1948 (formerly referred to as “Istituto di Fisica”) and since 1995 it is shared between the University and Politecnico di Bari.

The inter-university nature makes the DIF the only example existing in Italy among Physics departments.

The Department hosts the local branches of the following national research institutions: the National Institute of Nuclear Physics (I.N.F.N.); the Institute of Photonics and Nanotechnologies (IFN), the Institute of Atmospheric Pollution Research (IIA) and the Institute for Plasma Physics and Technologies (Nanotech) of the CNR (National Research Council). It also hosts the data center “RECAS” and the joint-research LAB PolySense in collaboration with THORLABS GmbH.

The Department has about 76 faculty members and 28 staff units, including both administrative and technical staffs. In the department there are 30 active laboratories and 1 library.

The main research topics, carried out by the 19 research groups of the Department consist in Nuclear and Sub-nuclear and astroparticle Physics, Physics of Matter, Optical Sensing, distributed Computing technology. The Inter-university Department of Physics represents an ideal laboratory where fundamental research and technological know-how strictly interact with each other.

In 2022 DIF has received the qualification by Italian Ministry of H.E. as “Excellent Department” with five years founding.

#### Web site and contacts

[Http://www.uniba.it/ricerca/dipartimenti/fisica](http://www.uniba.it/ricerca/dipartimenti/fisica)

#### Department chair

Roberto Bellotti  
roberto.bellotti@uniba.it  
tel. +390805443203

#### Department Deputy Chair

Antonio Marrone  
antonio.marrone@uniba.it  
tel: +390805443463

#### Administration Manager

Vito Tritta  
vito.tritta@uniba.it  
tel: +39 080 544 3197  
direzione.fisica@pec.uniba.it

#### Keywords

Nuclear, sub-nuclear and astroparticle physics  
Optical Sensing  
Physics of Matter  
Big Data Computing  
Theoretical Physics  
Medical physics

#### Staff

Professors: 21  
Technical and administrative: 28  
Post Doctoral Research Fellows: 3  
PhD Course: Physics





**DIPARTIMENTO INTERATENEO DI FISICA "M. Merlin"**



Interdepartmental Center “Magna Grecia” was established in 2012 in Taranto, in the same campus that hosted for several years the II Faculty of Engineering of Politecnico di Bari.

The mission of the Center, which encompasses all five departments of Politecnico di Bari, includes:

- To strengthen, coordinate and support interdisciplinary research and third mission activities on environmental remediation and industrial regeneration (with a specific focus on aerospace activities), which are the main challenges that affect the area of Taranto as well as many other areas in the world;
- To contribute to the dissemination of the research findings achieved in the Centro
- To offer technical and logistic support for the graduated and undergraduated courses given in Taranto
- To host labs and scientific equipment used to carry out both teaching and research activities.

#### Main labs:

- Electrical and Electronic Measurement Lab
- Electromagnetic Fields and Telecommunications Lab
- Environmental Chemistry/Technologies Lab
- Geomatics Lab
- Geotechnical Engineering Laboratory
- Hydraulics and Maritime Hydraulics Lab
- Interdisciplinary Additive Manufacturing Lab
- Knowledge Management Lab
- Competence Center on Business Process Management Transportation and Mobility Planning Lab

The Center is open to scholars from other Italian and foreign universities as well as to public and private organizations.

#### Web site and contacts

[Http://www.uniba.it/ricerca/dipartimenti/fisica](http://www.uniba.it/ricerca/dipartimenti/fisica)

#### Chair

Gianluca Percoco  
gianluca.percoco@poliba.it

#### Deputy Chair

Domenica Costantino  
domenica.costantino@poliba.it

#### Administration Manager

Cosimo Scarnera  
cosimo.scarnera@poliba.it

#### Keywords

Environmental remediation  
Industrial regeneration  
Circular economy  
Aerospace technologies  
Sustainable development  
Sustainable cities and communities

The StartUp Lab is aimed at supporting research, innovation and technological transfer activities by the Polytechnic Università di Bari. In particular, the StartUp Lab has the following objectives:

- fostering the creation of innovative entrepreneurial ideas, with a focus on the opportunities emerging from the digital economy; in this context, StartUp Lab is involved in the activities of the Contamination Lab "DigiLab", where a cultural melting pot of individuals takes place, involving different competence domains and experiences;
- developing innovative entrepreneurial activities, supporting teams in finding their successful way to the market, in particular embracing the PoliBa Factory projects in the field of manufacturing (MARS) and creative and digital communities (CROWD), as well as in the Health sector (H-HUB);
- providing education paths different from Engineering traditional courses, addressed at developing creativity, team working, soft skills, and management issues, by combining the academic view with the experience of practitioners, professionals, managers, startupers and entrepreneurs;
- facilitating the access to grant opportunities and the dissemination of the results coming from the aforementioned activities.

At present, the Center is participated by 3 Departments, namely DMMM, DEI, and DICATECH.

### Keywords

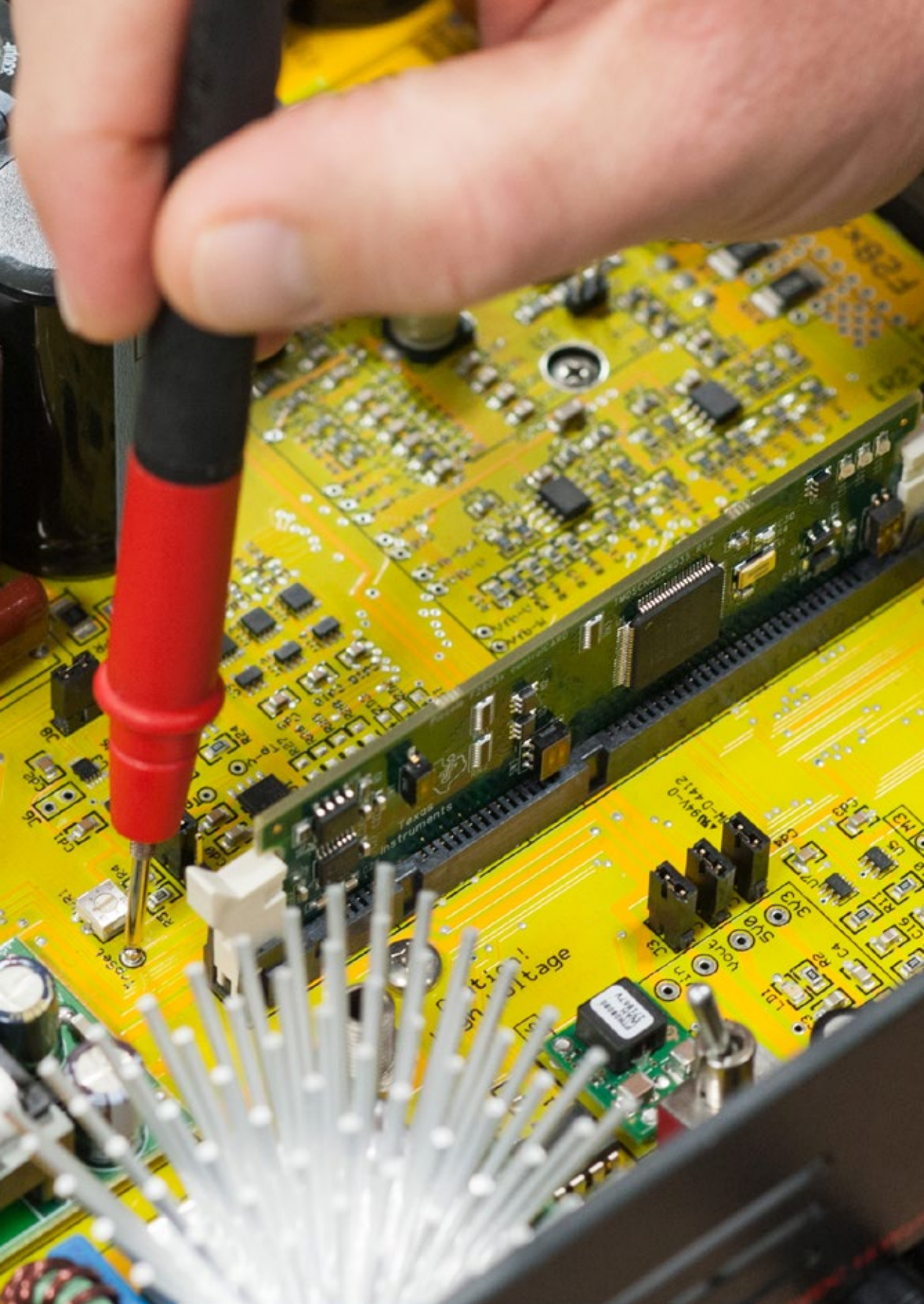
Entrepreneurship

### Innovation

Technology management Business

### Contacts

Claudio Garavelli  
claudio.garavelli@poliba.it



# LABORATORIES

The vital core of research activities in Politecnico di Bari is carried out in its thematic laboratories. These laboratories provide the necessary facilities and machineries for the development of innovative solutions in several research areas. The laboratories cooperate constantly with various national and international research institutions as well as different industrial partners.

Currently, Politecnico di Bari has more than 60 laboratories located in its research departments.

## ARCOD

- Building Physics Laboratory
- CO|RO - communicative roots
- DEEP\_LAB\_DESIGN\_DLD
- Design\_KIND LAB
- History of Ancient Architecture, Archaeology, and Restoration Laboratory
- INMATEX - INteraction MAterial EXperience Lab
- Official Laboratory of Materials Testing "M. Salvati"
- Museum of Rocks
- Museum of Technologies
- Observatory of Real Estate Market
- Survey and Representation Laboratory
- Urban Planning and Sociology Laboratory

## DEI

- Advanced Electrotechnics
- Advanced Environmental inFormatic Laboratory (AEFLAB)

- Applied Electronics and Microelectronics
- Apulia regional laboratory of characterization of new organic and nanostructured materials
- Artificial Vision Laboratory (AVLAB)
- Clean room
- Control and automation
- Control of Computing and Communication Systems Lab (C3LAB)
- Decision and Control Laboratory
- Design of Electronic Integrated Systems Lab (DEISLab)
- Digital Electronics Systems and Applications lab (ELEDIGILAB)
- Electrotechnical Laboratory (Elec Lab)
- Electrical and Electronic Measurements Research Lab - Bari
- Electrical and Electronic Measurements Research Lab - Magna Grecia Center
- Electrical Machines and Drives
- Electromagnetic Fields and telecommunications - Magna Grecia Center
- Electronic for signal processing laboratory
- Electronics for Telecommunications
- Industrial Informatics
- Information Systems Laboratory (SisInf Lab)
- Laboratory of Photonics Research Group
- LabZERO
- Optoelectronics Laboratory
- Power Electronics

## LABORATORIES

- Prince - Electrical Energy Systems
- Signal Processing Laboratory
- Telematics Laboratory

### DICATECH

- Applied Geomatics Laboratory (AGlab)
- Coastal Engineering Laboratory (LIC)
- Environmental Technologies Laboratory (ETL)
- Geotechnical Engineering Laboratory (GEL)
- Hydraulics And Hydraulics Constructions (H&HC)
- Laboratory for Modeling, Diagnostics and structural inteRventions (MoDiR)(MoDIR)
- Laboratory for soft, biological, bio-inspired and meta-materials (LabSoMat)
- Architectural and Urban Modeling Laboratory (MAULab)
- Laboratory of Building Technologies (BT Lab)
- Laboratory of Chemistry (LoC)
- Laboratory of Cognition and Spatial Planning (CoPS)
- Laboratory of Economic, Environmental and Regional Sciences (LEEReS)
- Laboratory of Environmental Geoengineering and Groundwater Hyology (LEGGH)
- Laboratory of Mobility Infrastructures (LaMI)
- Research Platform for Sanitary Engineering and Environmental Monitoring (PRISMA)
- Sustainable Mobility Lab (SML)

### DIF

- ALICE - Laboratory for ultra-thin silicon detectors
- FCC - Laboratory for future circular colliders
- Gaseous Detector Lab
- High Energy photosensors and electronics for space-born and ground-based experiments Laboratory
- Laboratory for ultra-thin silicon detectors
- Mechanical Workshop
- MicroLab: Advancing Ultrashort Pulse Laser Micromachining for Cutting-Edge Devices
- ReCaS -Bari
- Remote Sensing Lab
- Silicon Detectors Laboratory for High Luminosity Colliders

### DMMM

- Advanced Forming & Manufacturing
- Advanced Optical Methods and Structural Optimization
- Advanced Structural Diagnostic Lab
- Business Planning
- Demanufacturing Lab
- E-business
- EMILIA NET LAB (Experimental Mechanics Integrated Laboratories in Aerospace - Apulia Region Net of Labs)
- Estensimetria (Strain Gauge Testing lab)

## LABORATORIES

- Flow Simulation and modelling of energy systems
- Geomatics laboratory
- Human Machine Interaction & Performance Enhancement Lab: HIPE Lab
- Hybrid welding
- Innovation Management & Technology Entrepreneurship (IM&TE)
- Interdisciplinary Additive Manufacturing Lab (IAM Lab)
- Knowledge Management Laboratory (KMLab)
- Laboratory for hydraulic pumps and turbines
- Laboratory for Internal Combustion Engines (MACI)
- Laboratory for Rapid Prototyping and Reverse Engineering
- Laboratory for steady state conventional and MILD combustion (LACO)
- Laboratory for the thermo-physical characterization of manufactured polymers
- Laboratory for wave energy conversion devices and Wells turbines
- Laboratory MICROTRONIC - micro-machining and 3D micro-measures for mechanical components
- Laboratory of Computer Numerical Control Machine Tools
- Laboratory of experimental stress analysis (ESA Lab)
- Laboratory of Industrial Systems Engineering (LISE)
- Laboratory of Intelligent Computation for Manufacturing and Production Systems
- Laboratory of Manufacturing Processes by Laser Technologies
- Laboratory of Modelling and Simulation of Mechanical Structures (LabMS2)
- Laboratory of testing on innovative materials and structures
- Levantine Lab for Sustainable technologies (SESTANTE)
- MATH - LAB
- Mechanical and Thermal Measurements Laboratory
- Metallography and Microscopy (M&M - Lab)
- Mixed Experience Lab (MELAB)
- Modelling and SIMulation of BIOlogical Structures and Processes Lab (SIM-BIOS-Lab)
- Noise and Vibration Laboratory (NVLab)
- Optimization of Manufacturing Processes by Numerical Simulations (ManOnSim)
- Physical Simulation of Manufacturing processes (PhySIMaP-Lab)
- Polimare Lab
- Residual Stress Lab
- Robotic Mobility Lab (RML)
- Robot mechanics Lab
- Structural Diagnostic and Thermal Methods for Experimental Mechanics
- Structural Health Monitoring and Damage Assessment Lab
- TriboDynamics Lab
- Tribology Laboratory (TriboLab)
- Virtual Reality and Reality Reconstruction Lab (VR3Lab)
- Wind Tunnel (GAVE)

# ARCOD

Department of Architecture, Construction, Design



**City-Territory-Landscape\_Knowledge and Project****Academic disciplines for italian university research and teaching involved:**

Architectural and urban design (ICAR/14),  
 Urban and landscape planning (ICAR/21),  
 Architectural technology (ICAR/12) and  
 Building physics and building energy systems  
 (ING-IND/11)

**Heritage\_Knowledge and Project****Academic disciplines for italian university research and teaching involved:**

Architectural and urban design (ICAR/14),  
 Drawing (ICAR/17),  
 Architectural history (ICAR/18) and  
 Architectural restoration (ICAR/19)

These two incoming laboratories will contribute to improving the training offer and making the courses provided by the department more attractive. They will also contribute to strengthening the scientific research by offering a 'unique' service to the public institutions that govern cities and territories, through specific Third Mission activities. They will indeed operate at the service of the other Department's laboratories, already existing and in the process of being established.

**The laboratory City-Territory-Landscape\_Knowledge and Project "Blu/GreenCity"** is a multidisciplinary research laboratory that involves the disciplines of Architectural and urban design (ICAR/14), Urban and landscape planning (ICAR/21), Architectural technology (ICAR/12) and Building physics and building energy systems (ING-IND/11) on the themes of Blue Growth and Green Growth Strategies applied to the contemporary Mediterranean city, with reference to the targets of the ecological transition.

**The laboratory Heritage\_Knowledge and Project "Design for Heritage"** is a multidisciplinary research laboratory made up of teachers and researchers of Architectural and urban design (ICAR/14), Drawing (ICAR/17), Architectural history (ICAR/18) AND Architectural restoration (ICAR/19), with the aim of producing knowledge and innovation on the issues of conservation and enhancement of the architectural and landscape heritage.

**Contacts**

Carlo Moccia  
 carlo.moccia@poliba.it

### Competencies and research activities

The laboratory is active in three different fields:

#### Acoustics

The acoustics section of the lab has been supporting several research and measuring activities along the years.

Measurement and characterization of sound field of indoor spaces by means of innovative recording techniques. The lab is equipped with two omnidirectional sound sources and several microphones (including a 32-channel microphone array, two B-format microphones, a binaural dummy head, two pairs of binaural microphones, and many others having variable or fixed polar pattern) to obtain 3D sound maps and any other acoustic parameter. All instruments and measurement setups are complying with ISO 3382, UNI 12352 standards. The Lab is also equipped with sophisticated simulation tools including acoustic ray-tracing tools (CATT Acoustics) and wave-based numerical methods (MATLAB, COMSOL), as well as with tools to perform measurements scaled-down physical models.

Material characterization in terms of sound absorption, sound insulation, and non-acoustical properties like flow resistance and dynamic stiffness. Measurements can be carried out, depending on the property to be measured, using small samples (e.g. to measure surface impedance and sound absorption in a standing wave tube), or using larger samples to be tested in the reverberant chamber. The lab is equipped with two side chambers where measurements of sound insulation properties may be also carried out. Measurements complying with ISO 354, ISO 10534-2, ISO 9052-1, and ISO 9053-1 standards can be performed. Numerical simulation of material behavior is also possible.

Building and environmental acoustics. On-site measurements complying with Italian regulations in terms of environmental noise pollution (DM

16/3/98), and building acoustics (DM 5/12/97, ISO 16283).

Virtual reproduction of sound field and listening tests. The lab is equipped with an anechoic listening room where different playback configuration can be tested (multichannel surround, stereo-dipole binaural, etc.) in order to reproduce sound fields and carry out listening experiments and comparison among different acoustic features. The room may also be used for the characterization of sound power level of sound sources according to ISO 3745, while reverberant chamber can be used for measurements according to ISO 3744 standard.

#### Thermo-physical characterization of materials

The research in this field has a long term tradition in characterizing building materials in terms of heat transmission, water vapor permeability and heat storage. In addition to certification activities for third parties the Lab has been experimenting on different self-developed low environmental impact composite materials including unfired clay materials, panels made of different by-products as agro-wastes, textile waste and sheep wool.

The laboratory is equipped with a climatic chamber, and instruments to measure thermal conductivity and thermal capacity measurements, as well as to determine hygric properties, water vapour permeability, moisture buffer value, sorption capacity. In terms of other material performances, the lab is equipped with a gas pycnometer to determine bulk porosity and true density according to ASTM D4892 standard. An instrument to determine the PSD (pore size distribution) is also available, together with the equipment to perform accelerated ageing tests. Infrared cameras are also available, together with thermal flux meters to perform on-site characterization of material behavior according to ISO 9869.

Numerical simulation of hygrothermal behaviour of the materials is also possible by means of dedicated software.

### Energy efficiency in buildings, indoor environment quality

The laboratory is equipped to perform on-site characterization of thermal, visual, acoustic, comfort conditions together with air quality assessment. Several large scale surveys have been carried out in the past. Multiple sensors for thermal comfort assessment, illuminance and luminance meters, CO2 meters and VOC and particulate analyzers are available. Measurements complying with ISO 7730, EN 12464-1, and EN 15251 can be carried out. In terms of energy efficiency it is possible to perform analyses and simulations of existing buildings as well as of new designs using different tools including complex dynamic simulators of the whole building behavior, as well as numerical tools (FEM) to model more detailed aspects. The lab is active in designing innovative building components like smart windows and high performance building envelopes. The lab is also active in terms of studying and optimizing the interaction between the building and devices like smart windows, smart thermostats, air quality meters and other IoT-based sensors in order to optimize energy performance. A fully functional scale model of a "sensing" room with automated systems is available for research purposes.

### Laboratory services

The laboratory offers certified measurements and scientific consultancy services for third parties in relation to the main activities described above.

### Recent research projects

- 2023-oggi: PRIN 2022 "METAWAVE - New METAmaterial Window for simultaneous Acoustic, Ventilation and Energy performance"

- 2021-2022: progetto SCH-APP "Un sistema di Schlieren portatile per l'analisi dell'efficacia di Dispositivi di Protezione Individuale", a valere sull' Avviso FISR 2020
- 2020-2023: "AWeSOMe: Agricultural Waste as Sustainable 0-km building MatErial" finanziato nell'ambito dell'INTERREG IPA-CBC Italia-Montenegro-Albania
- 2019-2023: PRIN 2017 "SUSTAIN/ABLE: riqualificazione e miglioramento strutturale ed energetico degli edifici esistenti, impiegando soluzioni innovative e sostenibili"
- 2018-2022: progetto SE4I – Smart Energy Efficiency & Environment for Industry, finanziato nell'ambito del PON ARS Prot. n. 1735 del 13/07/2017 "Avviso per la presentazione di progetti di ricerca industriale e sviluppo sperimentale nelle 12 aree di specializzazione individuate dal PNR 2015-2020"

### Collaborations with companies and institutions

- Associazione Regionale dei Cori Pugliesi
- Bari Port Authority
- CNR (ITC, NANOTEC, STIIMA)
- Conferenza Episcopale Italiana
- COOP Estense
- De Carlo s.p.a.
- Diocesi Bari-Bitonto
- Diocesi di Grosseto
- ENEA
- ENEL
- Ferramati
- Fondazione "Paolo Grassi"
- Fraunhofer Institut

### Competencies and research activities

CO|RO is a research laboratory that pertains to the field of multimedia visual communication and information design and aims to represent complex knowledge in order to increase knowledge and dissemination.

In a more specific way, the laboratory designs “maps of meaning” for the understanding of cultural, social, economic and academic territorial realities.

The visualization of known or emerging data of these realities therefore constitutes a narrative stratagem to examine the ways how these realities modify and change.

Information Design is usually expressed through two complementary descriptive models: data visualization which presents the data with a technical-analytical depth, and infographics which gives those data a descriptive value based on a “figurative language” generated to be as accessible as possible.

Both examine the quantitative and qualitative properties of the information being examined, and unlock its potential popularizing power by designing visual codes and lexicons from which to extract meanings that otherwise would not be identifiable.

The theme of territory is the framework in which tangible and intangible capital produces constant flows of data, such that it constitutes “information landscapes” for which it is necessary to identify “access routes” to decode content and experience.

CO|RO activities are developed with analog and digital tools and follow a design scale that, from basic design to interaction design, maps specific

data, information, practices, and meanings onto multiple graphic-visual planes. In detail, services are offered for:

- transmedia communication projects
- cartographic sense-making
- storytelling map
- cartographic interfaces
- data visualization studies
- infographic studies
- community maps

### Contact person

Vincenzo Crisallo  
vincenzo.crisallo@poliba.it

### Competencies and research activities

DEEP\_LAB\_DESIGN\_is a research laboratory in the field of design that carries out critical-speculative and meta-design activities to implement the knowledge and valorization of tangible and intangible cultural heritage. These aims are part of the broader field of investigation on the profound transformations of knowledge for the artefacts and services project on the relaunch of territories. Projects that deal with the care and protection of territories need to be supported by development practices whose methods, theories and practices need to be investigated. Cultural-territorial fields are in fact concrete drivers of social innovation, economic progress and environmental protection and for this reason they are included in the network of common and shared interests addressed by institutional and scientific actors. Infact the laboratory gives support actions for second level training and doctoral research.

Training and research are increasingly complementary in recognizing the fluidity of professions relating to cultural services and in interpreting the growing role of digital technologies to provide answers to people, communities and businesses. In this direction, one of the aims of DEEP\_LAB\_DESIGN is to contribute to proposing and supporting integrative teaching initiatives to train a designer as a skills integrator.

The laboratory, therefore, in addition to institutional governance, is aimed at cultural design oriented companies, cultural and creative industries, service centers, territorial promotion agencies, trade associations, foundations, public and private cultural bodies.

Due to its purposes and characteristics, the DEEP\_LAB\_DESIGN\_DLD laboratory supports the follow-

ing laboratories in the design area: INMATEX-Interaction MAterial Experience (laboratory of materials as tools to reactivate the perceptual-sensory characteristics of surfaces); DESIGN.KIND (laboratory for creative and process development processes in the digital field) and CO|RO (visual communication and information design laboratory for the territory).

The functions of the laboratory include interdisciplinary desk research activities for the knowledge of cultural heritage and the valorization of territories conducted through investigations, analyzes and specific proposals which also use infographic and interactive documents developed with digital tools. In detail, we offer services for:

- strategic planning
- cultural communication plans for institutions and communities of citizens
- Ideas for cultural activities and events
- Analysis and research for the knowledge of tangible and intangible cultural heritage
- Design driven cultural training projects
- Territorial animation projects
- Educational and didactic service projects for the knowledge of the territories
- Cultural networking projects
- Audience analysis

#### Contact person

Rossana Carullo  
rossana.carullo@poliba.it

Rosa Pagliarulo  
rosa.pagliarulo@poliba.it

Vito Cascione  
vito.cascione@poliba.it

### Competencies and research activities

The laboratory aims to establish a synergic connection between education, research and the third mission for the areas of Industrial Design that refer to the methodologies and applications developed in the digital environment.

Instrumentation, software, equipment and consumables offer support to research applications that require experimental tests both in the virtual and physical fields.

The laboratory, in synergy with the wider FabLab Poliba system, aims to consolidate the research lines concerning product and process innovation in the field of digital standards, valid for the industry and for the so-called craftsmanship 2.0.

### Collaborations with companies and institutions:

- FabLab Bitonto
- Apulia Maker
- Crea 3d
- PiMar
- Romano Marmi
- Marmi strada
- Base Protection
- Natuzzi

### Contact person

Annalisa Di Roma  
annalisa.diroma@poliba.it

Alessandra Scarcelli  
alessandra.scarcelli@poliba.it

**Competencies and research activities**

The Laboratory has technical and scientific expertise developed over more than 20 years, having worked in the field of ancient architectural history, ancient architectural surveying, archaeological sites, and data processing. Furthermore, it organizes its activities along research lines focused on understanding the construction history of monumental buildings, diagnosing structural pathologies, and identifying degradation phenomena of historical architectural materials.

It was established by bringing together several researchers from the Polytechnic Università di Bari who shared similar educational backgrounds and common cultural interests. The study of antiquity in its various forms, with a particular focus on architectural and urban issues, constitutes the primary field of investigation. However, this research activity does not overlook the historical and artistic aspects that are indispensable in a comprehensive research endeavour that extends beyond the analysis of technical characteristics or mere documentation of evidence.

The laboratory has active agreements and relationships with the following Research and Conservation Institutions in Italy and abroad:

- Ephorate of Antiquities of Dodecanese
- Ephorate of Antiquities of Lesbos, Lemnos
- Ephorate of Antiquities of Samos and Ikaria
- Department of Antiquities of Libya
- Soprintendenza Nazionale per il Patrimonio Culturale Subacqueo di Taranto
- Parco Archeologico e Paesaggistico della Valle dei Templi di Agrigento
- Parco archeologico di Pompei
- Parco archeologico di Ostia Antica
- Scuola Archeologica Italiana di Atene
- Direzione Regionale Musei Emilia-Romagna
- Centro di Studi per la Storia dell'Architettura (CS-SAR)
- Freie Universität Berlin
- Università degli Studi di Catania, Dipartimento di Scienze Umanistiche
- Università degli Studi di Roma, Sapienza, Dipartimento di Scienze dell'Antichità
- University of Crete
- Association Ouvrière des compagnons du devoir et du tour de France
- As well as the following companies:
- Pimar Italian Limestone, Melpignano (LE)
- Atelier Romeo, Trani
- InResLab, Monopoli (BA)
- Arkeo Restauri, Favara (AG)
- Neos Restauri, Altamura (BA)
- Geoatlas, Altamura (BA)
- Apollodoro Studi e Ricerche, Roma

The laboratory's research results can rely on the following editorial seat:

- Thiasos – Rivista di Archeologia e Architettura Antica
- QuAD – Quaderni di Architettura e Design
- Cronache di Archeologia

- Bollettino del Centro di Studi per la Storia dell'Architettura

The laboratory it's equipped with:

- Workstations, laptops, color scanners, printers.
- Specific software for processing data acquired through the aforementioned equipment, including photo rectification software, topographic data recording software, hygrometric chart analysis software, surveying and representation software.
- Software for surface modeling and computer modeling.
- Electronic editing software.
- Digital cameras.
- Two total stations (including a Leica TS30 Total Station), GNSS (Leica G16 receiver combined with a CS20 controller), Leica D510 Laser Distance Meter, Disto-Draw application for Android, Leica tri 100 tripod, stadimeters, ranging rods, and everything necessary for surveying ancient architecture and archaeological sites.
- Digital hygrometers.
- Modular sonic equipment with handheld PC (Mod. CMS-LF-P) consisting of data acquisition unit with Bluetooth technology, dedicated software, handheld PC with battery and related cables, 55 KHz transducer Rx with 5m cable, Instrumented Hammer, Data-Sonic Transformation Software, "Tomo-Tool-FP" processing software.
- Multi-frequency Georadar Hi Mod system.
- Georadar Ris MF Hi-Mod I system consisting of: Dad Fastwave multichannel unit, battery kit, Dual F 400-900 MHz Hi-Mod antenna, dedicated cart,

encoder and PC support, K2 Fastwave cables and software, GRED-HD processing software, dedicated notebook.

- Testo 875i V1 thermal camera (IR resolution 160 × 120 pixels), equipped with Super-Resolution module (IR 320 × 240 pixels), accompanied by an environmental thermo-hygrometer.

#### Contact person

Monica Livadiotti  
monica.livadiotti@poliba.it

Antonello Fino  
antonello.fino@poliba.it



### Competencies and research activities

DEEP\_LAB\_DESIGN is a research laboratory in the field of design that carries out critical-speculative and meta-design activities to implement the knowledge and valorization of tangible and intangible cultural heritage. These aims are part of the broader field of investigation on the profound transformations of knowledge for the artefacts and services project on the relaunch of territories.

Projects that deal with the care and protection of territories need to be supported by development practices whose methods, theories and practices need to be investigated. Cultural-territorial fields are in fact concrete drivers of social innovation, economic progress and environmental protection and for this reason they are included in the network of common and shared interests addressed by institutional and scientific actors. Infact the laboratory gives support actions for second level training and doctoral research.

Training and research are increasingly complementary in recognizing the fluidity of professions relating to cultural services and in interpreting the growing role of digital technologies to provide answers to people, communities and businesses. In this direction, one of the aims of DEEP\_LAB\_DESIGN is to contribute to proposing and supporting integrative teaching initiatives to train a designer as a skills integrator. The laboratory, therefore, in addition to institutional governance, is aimed at cultural design oriented companies, cultural and creative industries, service centers, territorial promotion agencies, trade associations, foundations, public and private cultural bodies.

Due to its purposes and characteristics, the DEEP\_LAB\_DESIGN\_DLD laboratory supports the follow-

ing laboratories in the design area: INMATEX-Interaction MAterial Experience (laboratory of materials as tools to reactivate the perceptual-sensory characteristics of surfaces); DESIGN.KIND (laboratory for creative and process development processes in the digital field) and COIRO (visual communication and information design laboratory for the territory).

The functions of the laboratory include interdisciplinary desk research activities for the knowledge of cultural heritage and the valorization of territories conducted through investigations, analyzes and specific proposals which also use infographic and interactive documents developed with digital tools. In detail, we offer services for:

- strategic planning
- cultural communication plans for institutions and communities of citizens
- Ideas for cultural activities and events
- Analysis and research for the knowledge of tangible and intangible cultural heritage
- Design driven cultural training projects
- Territorial animation projects
- Educational and didactic service projects for the knowledge of the territories
- Cultural networking projects
- Audience analysis

#### Contact person

Rossana Carullo  
rossana.carullo@poliba.it

Vincenzo Cristallo  
vincenzo.cristallo@poliba.it

Annalisa Di Roma  
annalisa.diroma@poliba.it

### Competencies and research activities

Laboratorio Ufficiale Prove Materiali "M. Salvati", Official Laboratory of Materials Testing, was established by law (Law 553, 01.07.1961); since 1983, it took the name of the founder Michele Salvati.

The Laboratory, one of the largest and best equipped in the South of Italy for static and dynamic tests on structural materials and on structures, has two large test rooms each one equipped with a bridge crane and a concrete slab 1 m thick. In particular, the bigger room has a testing surface of about 500mq and a working height of 15m, while the smaller room has a testing surface of about 350mq and a working height of 9m. Both are served by large driveway gates; another driveway gate lets the access to the room beneath the slab. The whole laboratory area, including offices and several testing rooms, is of 2400mq. This allows for a wide range of tests on materials, structural models and 1:1 scaled structures. The technical staff of the Laboratory is highly specialized in experimenting on materials and structures, both by destructive and non-destructive tests, for in-situ and laboratory applications. The experience and the skills of the technical staff allow for a prompt conception and design of testing procedures and strategies in case of demands coming both from private companies or from research projects purposes.

### Service:

#### For third parties:

The institutional activity of Laboratorio "M. Salvati" consists of materials and structures tests and of structural monitoring on behalf of third parties. This activity declared to be of public utility according to Law 1086, 05.11.1971, is aimed at

controlling the requirements prescribed by law on structural aspects of constructions, and at assessing the calibration of testing machines and instruments belonging to private laboratories (licensed by Ministry of Public Works).

#### For teachings:

Laboratorio "M. Salvati" supports the teaching activities of professor belonging to the Dicar Department, such as tests, exercises, and lectures in the laboratory; B.Sc., M.Sc., and Ph.D. thesis on mainly experimental issues.

#### For research:

Laboratorio "M. Salvati" supports experimental activities and research projects requiring experimental analyses on materials and structures, and/or the development and the validation of new experimental techniques.

### Facilities

- Universal testing machines with a load capacity of 50, 300, 600 and 1000 kN for tests on stone materials, cementitious conglomerate, hydraulic binders, steel beams for concrete, prestressed concrete and metal carpentry, on pavement materials Press with a load capacity of 3000 and 5000 kN for tests on stone materials, cementitious conglomerates, on structural elements in full scale.
- Electromechanical universal testing machines under displacement control and for thermomechanical tests and fatigue testing machines with a capacity of 50 kN, equipped with a video extensometer
- Tribometer, Charpy's pendulum, bend-straight-

ening and relaxation on steel.

- Machines for granulometric analyses of aggregates
- Hydraulic jack and equipment for coring in situ
- Testing equipment for concrete and mortars (muffle furnace, aging tanks, and cabinets, setting and hardening tests etc.).

#### Contrast modular structures.

- Hydraulic power unit for the movement of dynamic actuators and shaking tables.
- Equipment for in-situ tests on structures (test, check and monitoring): deformometers, comparators, clinometries, deflectometers, etc.
- Calibration check for testing machines, pressure gauge and displacement comparators and transducers with equipment conforming to SIT standard.
- Contact ultrasonic tests, ultrasonic immersion tests and laser ultrasonic tests with device for scanning samples
- Sonic and ultrasonic tests for masonry and concrete.
- Flat jack
- Lockin active thermography
- Georadar 3D
- Radar interferometer for contactless distance structural monitoring
- Dynamic identification tests with seismic accelerometers
- Control units for structural monitoring
- Vibrodyne for structures

#### Software

- Matlab, Mathematica, Comsol, Abaqus, SolidWorks, Straus7, ARTEMIS software.

#### Main research projects:

- Progetto PON\_02 "MASSIME – Sistemi di sicurezza meccatronici innovativi (cablati e wireless) per applicazioni ferroviarie, aerospaziali e robotiche" (2013-2015)
- Progetto della Regione Puglia Rete di Laboratori "Laboratorio per lo sviluppo delle fonti rinnovabili e dell'efficienza nei distretti energetici: Progetto ZERO (Zero EmissionResearch Option)" (2014-2017)
- Progetto ReLuis2, Area Tematica 2, Linea 3: "Innovazione Tecnologica in Ingegneria Sismica", Task 2: "Sviluppo ed analisi di nuove tecnologie per l'adeguamento sismico" (2010-2013);
- 7° Programma Quadro. Capacities Specific Programme Research Infrastructure. Progetto SERIES. Proposal P03-0034: "Assessment of the seismic behaviour of flat-bottom silos containing grain-like materials". Prove da svolgersi presso il laboratorio EQUALS di 7° Programma Quadro RST (call FP7/PEOPLE/2001/NIGHTS). Project UNIFEDERLAB. Unità "Vibration" (2011)
- 7° Programma Quadro. Capacities Specific Programme Research Infrastructure. Progetto SERIES. Proposal P03-0034: "Seismic behaviour of structural systems composed of cast-in-situ concrete walls" (2010-2012)
- European Territorial Cooperation Programme Greece-Italy 2007-2013. INTERREG III/A. Project title: "Structural Monitoring of ARTistic and his-

torical BUILDing Testimonies", Responsabile scientifico D. Foti (2012-2015)

- PRIN 2010-2011 "Dinamica, Stabilità e Controllo di Strutture Flessibili" (2013-2016)
- Progetto PON\_01 "STEM-STELO: Sistemi e Tecnologie per la realizzazione di Macchine per lo Sviluppo dei Trasporti Eccezionali e della Logistica di progetto" (2012-2015)
- PRIN 2008 "Strutture leggere in materiale multiscala nell'ingegneria civile: rigidità e resistenza, assemblaggio e replicabilità industriale" (2010-2012)
- Progetto Strategico della Regione Puglia "Ricerca e sviluppo di metodologie per la meccanica sperimentale e la diagnostica strutturale" (2006-2011)
- Progetto Strategico della Regione Puglia "SISMA - Strutture Innovative e Sperimentazione di Materiali Avanzati" (2006-2011).

**Collaborations with companies and institutions:**

- University of Minnesota, Minneapolis, USA
- University of California at Berkeley, USA
- Universidad de Alicante, Spagna
- University of Arizona, USA
- University of Bristol, UK
- Università di Napoli
- Università di Salerno
- Università di Messina
- Università di Catania

**Contact person**

Mario Daniele Piccioni  
mariodaniele.piccioni@poliba.it

Francesco Paparella  
francesco.paparella@poliba.it

**Website**

<https://www.youtube.com/watch?v=MyScscdKBZ8>

### Competencies and research activities

Rock Museum includes more than 3000 rock samples collected by the Department's teachers over many years of research are on display and constitute a unique collection. The origin of the samples is different: regional, national and international. there are also unique rock specimens of geological and paleontological importance. Part of the exhibition is also dedicated to topographical instrumentation belonging to the history of Italian topography. An integral part of the museum is a paper library with the complete collection of geological cartography of Puglia.

### Competencies and research activities

The Museum of Technology, actually under construction, shows the evolution of Civil Engineering in the last Century, through a collection of instruments of common use. In the exhibition area, laboratory and field instrument will be catalogued, with a short description of their utility and their methods of use. The instruments, collected in the laboratories of the department, are actually obsolete and have only a historical value. Most of the equipment are IT or optically based, but there are also significant examples of tools operating on other physical principles. The collection shows the working style of Civil Engineers in the last Century.

### Competencies and research activities

The Poliba Center for Real Estate is a data processing and professional center for real estate following the Anglo-Saxon type of centers for real estate inserted in the area of territorial planning. It was introduced in DAU Department Council in 1998 on the initiative of the professors. Agostino Liuni and Maurizio d'Amato, amongst the laboratories of the old DAU Department. Subsequently, with protocol 5858 of 12.15.2009 the Real Estate Market Observatory now Poliba Center for Real Estate became a member of a network of inter-university laboratories called LEEReS based at the University of Foggia. The laboratory explores the mathematical and statistical processing of real estate data and information. For this reason, collaborations were developed with SUNIA for the processing of real estate information on the residential rental market which led to a meeting on public residential construction for several years. The research is focused on the mathematical and statistical methods of Mass Appraisal. Other research lines are the implementation of methodologies for real estate valuation and risk premium. The laboratory has carried out applications on procedures such as cyclical capitalisation, which later entered the International Valuation Standards (since 2027) and Rough Set Theory for mass appraisal purposes. In the professional field, the laboratory has organized various workshops and seminars for educational purposes regarding real estate valuation standards. In particular, the Manual of Real Estate Valuation (MOSI) of the Italian Cadastral Agency, the ABI Guidelines on real estate valuation and the Assoimmobiliare Guidelines on real estate valuation. In the qualification processes, the Poliba Center for Real Estate Laboratory is linked on the page of the Italian Institute of Real Estate Valuation as the national op-

erational headquarters of the prestigious Institute. Poliba Center for Real Estate is the place where exams are carried out to obtain the prestigious European qualification of REV real estate valuers (Recognized European Valuer). the Laboratory was invited to the most important national Italian Real Estate fair - Expo Italia Real Estate, free of charge, to disseminate its best practice dissemination and training activities.

### Competencies and research activities

The research that has been developed within the Survey and Representation Laboratory for over twenty years has the aim of studying and documenting regional, national and international heritage using methodologies and tools relating to the representation and the reproducibility in the fields of architecture, engineering, design, landscape, cultural heritage, archaeology and creative cultural industries.

The subject area therefore concerns the geometric-descriptive-configurative, graphical-visual-synesthetic, information-computational domains including the related historical, epistemological, semantic, technological and applicative aspects.

The laboratory is active in the following different research fields:

- surveying as a process of morphological and thematic knowledge oriented towards critical interpretation;
- modelling, including informative modelling, prototyping and visual communication;
- applications to support the realisation process at the various scales, from the formation of the design idea, to its executive definition, to the management of the entire life cycle of products, including digital ones;
- the survey and drawing of architecture and the ancient and contemporary city, with particular attention to the city and architecture of the nineteenth and twentieth centuries and the minor centres of the regional territory;
- the survey and drawing of architecture and fortified systems;
- the survey and drawing of sacred and monumental buildings, with a focus on Apulian Re-

naissance churches, Salento Baroque churches and Apulian cathedrals;

- the survey and drawing of the regional monumental and archaeological heritage;
- the survey and drawing of historical furniture products and contemporary design.

The Laboratory supports the Degree Theses of the CdLM in Architecture and the CdL in Industrial Design, the Specialisation Theses of the "School of Specialisation in Architectural and Landscape Heritage" and the activities and research of the students of the Ph.D. "Design for Heritage: Knowledge and Innovation Ph.D." and "Heritage Project: Knowledge, Tradition and Innovation".

Some research activities are conducted in collaboration with the Spin-off AESEI s.r.l. Architectural & Engineering Survey of Environment and Infrastructure.

The research was carried out on the basis of specific framework agreements and conventions with various bodies and institutions, including the Segretariato regionale del Ministero della Cultura per la Puglia; Soprintendenza Archeologia, Belle Arti e Paesaggio for the Metropolitan city of Bari; Soprintendenza Archeologia, Belle Arti e Paesaggio for the Provinces of Brindisi and Lecce; Municipality of Bari; Municipality of Conversano; Municipality of Adelfia; Municipality of Monte Sant'Angelo; Municipality of Acquaviva delle Fonti; Municipality of Canosa di Puglia; Castle of Bari; Castle of Gioia del Colle; Castle of Trani.

The Laboratory collaborates in various research projects and international exchanges with



the following universities or research organisations: Universidad Nacional de Bogotá, Colombia (2023); Universidad de La Salle in Bogotá, Colombia (2022/23); Institute of Albanian Studies in Tirana, Albania (2023); Universidad Pontificia Bolivariana, Colombia (2017/18, 2019/20 and 2021/22); University of Montenegro (2022); Université de Blida, Algeria (2007, 2017 and 2018); University of Sarajevo, Bosnia-Herzegovina (2018); Matrouh Governorate, Siwa Oasis, Egypt (2009).

The laboratory is equipped with the following equipment: Faro CAM2 Focus Laser Scanner; digital cameras; Leica TCR 805 Power Total Station; Nikon C100 Total Station (for educational use); Leica System 500 GPS (base and rover); optical and laser levels, Salmoiraghi NA 2020 Mechanical Optical Autolevel; laser distance meters; stadia, poles, tripods, reflecting prisms, and everything needed for instrumental and direct surveying; Lupo Repro stand for reproductions equipped with lamps and diffusers.

The laboratory is also equipped with software dedicated to surveying and representation and software for modelling surfaces and creating computer models.

#### Contact person

Paolo Perfido (Scientific Manager)  
paolo.perfido@poliba.it

Valentina Castagnolo  
valentina.castagnolo@poliba.it

Anna Christiana Maiorano  
christiana.maiorano@poliba.it

Domenico Pastore  
domenico.pastore@poliba.it

Gabriele Rossi  
gabriele.rossi@poliba.it

### Competencies and research activities

The Urban Planning Laboratory is a center of excellence in research on methodologies and problems of the governance of the city and of contemporary territories. Moreover, the Dicar Laboratory itself carried out a scientific partnership with the Arca Puglia Centrale (then IACP Bari and Bat) on the occasion of the PRIN (Research Projects of National Interest) of the MIUR "La Città Pubblica" as a Design Laboratory.

The production of Guidelines for the sustainable redevelopment of urban outskirts financed in 2005 by MIUR. Research that gave life to two publications; respectively AA.VV. (2009), *Public City, Guidelines for urban redevelopment*, Mondadori, Milan and that of the Local Research Unit of the Polytechnic of Bari; Martinelli, N. (edited by) (2009), *For an Atlas of the Public City of Bari, Adda, Bari* the latter with a partial financial contribution to the publication of the same IACP Bari and Bat.

Moreover, the same research group carried out an experience in the field as requested by the MIUR for the research in question collaborating with the Municipality of Bari and with the IACP Bari and Bat conducting the District Laboratory on the occasion of the PIRP of S. Marcello.

### Services

It is equipped with technical and scientific skills that have been working for more than 15 years in the construction of knowledge systems on a geo-referenced basis deriving from descriptive-interpretative models through highly qualified expertise (planners, landscape architects, researchers and operators in the CAD, GIS, TLR environment, DSS) and for the processing of data acquired from dif-

ferent types of sources (cartographic and alphanumeric).

It is equipped with workstations able to manage spatial data, on a vector and raster basis, large format color scanners, printers and high resolution large format plotters.

It is equipped with software for digital image processing and software for the management of local information systems and relational databases.

#### Contact person

Nicola Martinelli  
nicola.martinelli@poliba.it

#### Technical Staff

Silvana Milella  
silvana.milella@poliba.it



**Headquarters of the new rectorate of the Polytechnic Università di Bari.**  
Requalification of S.A.T. (Sala Alta Tensione) at the "E. Quagliariello" Campus.



# DEI

Department of Electrical and Information Engineering

### Competencies and research activities

The scientific activity concerns the following two main topics of the Electrical Engineering:

Micromagnetism and Spintronics;

Modelling, diagnostics and reliability of renewable energy sources.

#### The first research topic studies:

- Magnetic materials modelling.
- Design of Spin-Transfer Torque (STT) MRAM and nano-oscillators. Design of nanodevices spin-orbit torque based.
- Linear and nonlinear dynamics of magnetic excitations in magnetic films, multilayers, and finite-size samples: spin waves, solitons, skyrmions.
- Applications of linear and nonlinear spin waves in microwave signal processing.
- Design of hybrid CMOS-STT-MRAM circuits. CUDA Applications.

The second research topic studies:

- Modelling of grid-connected and stand-alone renewable energy sources. Smart-grids and micro-grids.
- Penetration of RES in power systems. Statistics for monitoring the performance of RES.
- Nondestructive techniques for diagnostics of RES. ICT for energy

#### Collaborations with institutions and companies:

- since 2001, with the theoretical group of Giovanni Finocchio, Università di Messina, Italy.
- since 2002, with the experimental group of Er-

manno Cardelli and Pietro Burrascano, Università di Perugia, Italy.

- since 2003, with the theoretical group of Luis Torres and Luis Lopez-Diaz, University of Salamanca, Spain.
- since April 2005, with the experimental group of Dan Ralph, University of Cornell, Ithaca, NY, USA.
- since 2008, with the experimental group of Giovanni Carlotti and Gianluca Gubbiotti, Università di Perugia, Italy.
- since November 2010, with the theoretical group of Andrei Slavin, Oakland University, Rochester, MI, USA.
- since 2013, with the theoretical group of Adel Mellit, Renewable Energy Laboratory, Jijel University, Algeria.
- since 2013, with the theoretical group of Loredana Cristaldi, Politecnico di Milano, Italy. since 2013, with the theoretical group of Alessandro Massi Pavan, University of Manchester, UK.
- since 2013, APIS Ltd, Spinoff, Bari, Italy.
- since 2015, with the experimental group of Johan Åkerman, Royal Institute of Technology, Stockholm, Sweden.

#### Contact person

Mario Carpentieri  
mario.carpentieri@poliba.it

Silvano Vergura  
silvano.vergura@poliba.it

**Competencies and research activities**

The AeFLab researchers work in the field of information systems with specific emphasis to environmental application (pollutant and odors, particulate and water, e-nose and e-tongue). Another field of interest is that of web semantic and common language disambiguation. In the previous activities there are more willingly applied artificial intelligence paradigms. AeFLab is also registered as a Living Labs laboratory of Apulia Region.

**Collaborations with companies and institutions:**

- ASI centro di geodesia spaziale di Matera
- Autorità portuale di Taranto
- Centro Internazionale Alti Studi Universitari - Università di Bari- Fasano (Br)
- Chapter italiano dello IEEE Biometrics Council
- Chapter italiano dello IEEE System Council
- CINI - Consorzio Interuniversitario Nazionale per l'Informatica
- CNR Bari, Pisa e Roma
- International Association for Pattern Recognition
- Kanagawa Institute of Technology - Chen
- Omnitech Rome
- myHermes S.r.l.
- National Technical University of Athens – Dimitrios A. Tsamboulas
- Politecnico di Milano
- Politecnico di Torino
- Robotics Institute, Carnegie Mellon University - Mel Siegel
- Scuola Superiore S.Anna di Pisa
- SITE, University of Ottawa - Emil Petriu
- Space Software Italia - Taranto
- SST - Lab. University-Industry joint telecommunication research laboratory
- Telespazio - Roma e Matera
- Universidade Da Coruña - Fernando Peña
- Università di Bari
- Università di Milano
- Università di Pisa
- University of Alberta - Witold Pedrycz

**Contact person**

Vincenzo Di Lecce  
vincenzo.dilecce@poliba.it



### Competencies and research activities

- Design of multichannel mixed-signal integrated circuits (ASIC) for the read-out of solid-state detectors used in high energy physics experiments and medical imaging applications.
- Prototyping (via access to the european consortium EURO PRACTICE) and characterization of integrated circuits.
- Design and realization of hardware/firmware systems based on programmable devices (FPGA).
- Characterization of solid-state detectors for physics experiments and medical imaging applications (Silicon Photomultipliers).

### Collaborations with companies and institutions:

- INFN
- CERN - Geneva
- Johannes Gutenberg Universitat - Mainz (PRISMA lab.)
- Brookhaven National Laboratories, Upton (NY, USA)
- SLAC Stanford, Menlo Park (CA, USA)
- Fbk-IRST – Trento
- Infineon Technologies, Villach (Austria)
- National Semiconductors, Munich (Germany)
- ST Microelectronics, Agrate Brianza
- ITEL, Ruvo di Puglia
- IAS, Brindisi

### Contact person

Cristoforo Marzocca  
cristoforo.marzocca@poliba.it

**Competencies and research activities**

The laboratory is equipped with spectrometric Ellipsometer, micro-controlled surface Profilometer, system for the deposition of thin films made of Spin coater, UV lamp and heating plate, instrumentation for the characterization of thin films made of polarizing microscope including a BF /DF optical Kit .

Modelling, fabrication and characterization of active/passive photonic crystal devices, linear and nonlinear for applications in sensor technology and telecommunications systems.

Modelling and characterization of plasmonic nanostructures for applications in sensors and photovoltaics. Design, fabrication and characterization of polymer waveguides for biomedical and industrial sensor applications. Design and characterization of active photonic devices based on III-V-N semiconductor.

**Collaborations with companies and institutions:**

- National Nanotechnology Laboratory (NNL), CNR Istituto di Nanoscienze – Lecce (Italy)
- Centro di nanotecnologie bio-molecolari, Istituto Italiano di Tecnologia (IIT) – Arnesano – Lecce (Italy)
- Department of Biomedical Sciences, Università di Foggia (Italy)
- Electromagnetic Fields and Photonics Group – Università di Brescia (Italy)
- Institute of Inorganic and Plasmas Methods, IM-IP-CNR (Italy),
- Microphotonics Group – St. Andrews University (UK)

- Department of Materials Science, University of Patras (Greece)
- National Research Council - Charles M. Bowden Research Center - Huntsville AL (USA)
- LAAS-CNRS, Toulouse (France)
- MERMEC GROUP – Monopoli (Italy)
- Centro Laser – Valenzano (Italy)
- SOMACIS pcb industries – Castelfidardo (Italy)
- CINECA (Consorzio Interuniversitario Calcolo Parallelo) – Bologna (Italy)
- AEGIS Technologies Group Inc. – Huntsville - AL (USA)

**Contact person**

Vincenzo Petruzzelli  
vincenzo.petruzzelli@poliba.it

### Competencies and research activities

Design, construction, engineering and installation of smart vision systems aiming to automate industrial processes (Industry 4.0, quality controls, ...), perform diagnostics (monitorings and inspections, even 3-D, of products and infrastructures, non-destructive testing, ...), and provide security (job security, personal identification, smart video-surveillance, ...).

### Collaborations with companies and institutions:

Apulia Intelligent System

#### Contact person

Francescomaria Marino  
francescomaria.marino@poliba.it

### Competencies and research activities

Clean room in class 100-1000 equipped with chemical hood, thermostat oven for ion exchange, spin coater and DC - AC sputtering equipment.

Design, fabrication and characterization of integrated optical devices by sputtering, ion-exchange, spin-coating techniques.

Design and characterization of plasmonic nanostructures for applications in sensors, photovoltaics, near field enhancement.

Design and characterization of beam steering from subwavelength apertures in metal substrates. polymeric sensors to biomedical and industrial applications.

Design and characterization of optical intercon-  
Clean room in class 100-1000 equipped with Clean room in class 100-1000 equipped with chemical hood, chemical hood, thermostat oven for ion exchange, spin coater and DC - AC sputtering equipment. Design, fabrication and characterization of integrated optical devices by sputtering, ion-exchange, spin-coating techniques. Design and

characterization of plasmonic nanostructures for applications in sensors, photovoltaics, near field enhancement.

Design and characterization of beam steering from subwavelength apertures in metal substrates. polymeric sensors to biomedical and industrial applications. Design and characterization of optical interconnecting devices for chip multiprocessor architectures. Design and characterization of III-V-N of semiconductor active photonic devices 40 and photonic crystals for laser applications.

### Collaborations with companies and institutions:

- National Nanotechnology Laboratory (NNL), CNR Istituto di Nanoscienze – Lecce (Italy)
- Centro di nanotecnologie bio-molecolari, Istituto Italiano di Tecnologia (IIT) – Arnesano – Lecce (Italy)
- Department of Biomedical Sciences, Università di Foggia (Italy)

## Clean room

- Electromagnetic Fields and Photonics Group – Università di Brescia (Italy)
- Institute of Inorganic and Plasmas Methods, IM-IP-CNR (Italy),
- Microphotonics Group – St. Andrews University (UK)
- Department of Materials Science, University of Patras (Greece)
- National Research Council - Charles M. Bowden Research Center - Huntsville AL (USA)
- LAAS-CNRS, Toulouse (France)
- MERMEC GROUP – Monopoli (Italy)
- Centro Laser – Valenzano (Italy)
- SOMACIS pcb industries – Castelfidardo (Italy)
- CINECA (Consorzio Interuniversitario Calcolo Parallelo) – Bologna (Italy)
- Aegis Technologies Group Inc. – Huntsville - AL (USA)

### Contact person

Vincenzo Petruzzelli  
vincenzo.petruzzelli@poliba.it

## DEI

## Control and automation

### Competencies and research activities

The purpose of the laboratory is the deepening, enhancement and dissemination of scientific research carried out with various Italian and international partners, both private and public.

In particular, the areas in which the laboratory operates are the following:

- Discrete event systems: Petri nets, Critical observability, Identification, Opacity.
- Modeling and control systems for industrial applications: manufacturing and process systems, coordination of agent and sensor networks, fault detection and recovery, problems relating to the areas of logistics, production and distribution,

## Control and automation

scheduling and planning problems, flow management of work.

- Management and control of complex systems: intelligent transportation systems, road and rail traffic, modal and multimodal logistic systems, transport of dangerous goods; management of electric mobility, Smart Cities and smart buildings; modeling and management of healthcare systems.

Other ICT applications and Decision support systems in various application environments (transportation, logistics, production, building management, healthcare systems) with minimal or reduced human intervention.

### Methodologies:

- Optimization, Simulation;
- Models to maximize the efficiency of technological products and processes;
- Reduction of alternatives and choices especially when they are innumerable Smart solutions and Decision Support Systems.
- Advanced algorithms and ICT applications able to predict and solve imminent situations and in various contexts applied.

### European projects:

- INEA CEF "FENIX, A European Federated Network of Information eXchange in Logistics", 2019-2022. Euros 800.000,00
- EU Adriatic-Ionian Programme INTERREG V-B "FUTURE 4.0 ManuFactUring educaTion and training governance model for IndUstry 4.0 in the Adriatic-Ionian aREa", 2018-2019.
- EU H2020 "ELVITEN, Electrified L-category Ve-

hicles Integrated into Transport and Electricity Networks", 2017-2020.

- EU H2020 "AEOLIX, Architecture for EurOpean Logistics Information eXchange", 2016-2019.
- EU H2020 "optiTruck, optimal fuel consumption with Predictive PowerTrain control and calibration for intelligent Truck", 2016-2019.
- EU H2020 "NEMO, Hyper-Network for electro-Mobility", 2016-2019.
- EU CIP-ICT-PSP-2013-7, COoperative loGISTICS for sustainable mobility of goods- CO GISTICS. Jan 2014- June 2017.

### National projects:

- Smart Cities and Communities and Social Innovation Pilot, "Applications post Directive 2010/65 in Italian port realities of the Suite MIELE to support the Authority to optimize the interOperability in the intermodAlity of city-port flows- ASMARa" 2014-2017.
- PON 2007-2013 -"RES NOVAE - Reti, Edifici Strade: Nuovi Obiettivi Virtuosi per l'Ambiente e l'Energia" Regioni Obiettivo Convergenza Campania, Puglia, Calabria, Sicilia - Asse II, 2013-2015.
- PON "Mechatronic innovative safety systems (wired and wireless) for railway, aerospace and robotic applications (MASSIME)", 2013-2015
- PON "LAMRECOR - Logistica Avanzata per la Mobilità di Persone e Merci: Modelli Matematici e Sperimentazioni per Nuovi Protocolli di Recapito della Corrispondenza", 2013-2015.
- PRIN 2007 prot. 2007ZMZY5T "Decision models for design and management of logistic networks characterized by high interoperability and infor-

## Control and automation

mation integration”, September 22, 2007, September 22, 2000.

- PRIN 2005 prot. 2005092439 “Analysis, optimization, and coordination of logistic and production systems” September 2005, September 2007.
- “Medical applications for the next future (NEX-MEDIA);” 2012-2014.
- “Modelling and control of logistic systems characterized by high information integration”, September 2008- September 2009, “Fondazione Caripuglia”.

### The laboratory collaborates with the following research groups:

- MengChu Zhou (New Jersey Institute of Technology, Newark, USA) on the subject of control and management of distributed production systems.
- Research group led by A. Giua from the Università di Cagliari on the topic of fault detection and identification of Discrete Event systems;
- Università di Trieste, operational research group of Walter Ukovich for logistics studies in various application fields;
- Università di Genoa, research group of R. Minciardi, S. Sacone, R. Sacile for studies on the transport of dangerous goods
- École Normal de Cachan, France, Jean-Jacques Lesage for studies on health systems;
- Laboratory of Knowledge and Intelligent Computing (KIC), Dept. of Informatics and Communications Technology, Artological Educational Institute of Epirus, Artas, Greece
- Autamarocchi (development of fleet and vehicle management systems)
- Colussi S.p.A. (optimization of the distribution logistics system)
- OM Forklifts S.p.A. (solutions for warehouse logistics, planning and management of production processes)
- Teorema Engineering s.r.l. (intermodal logistics)
- Intermodal Terminal of Trieste - Ferneti S.p.A. (intermodal logistics)
- Bertoli Safau Steelworks (production scheduling and planning)
- Insiel Mercato (organization and management of health systems)
- Policlinico di Bari (organization and management of health systems)
- Insiel FVG (intermodal logistics, management of transport of dangerous goods)
- AMIU - Bari (methodologies and algorithms for the rationalization of a solid urban waste collection system)
- Eurocontrol (air traffic management)
- Municipality of Bari (urban mobility)
- Autovie Venete, Insiel FVG (transport of dangerous goods)

### Contact person

Maria Pia Fanti  
mariapia.fanti@poliba.it

**Competencies and research activities**

The Control of Computing and Communication Systems Lab (C3Lab) focuses on the analysis and control of network systems. The main research activities are set in the following fields:

- Virtual Reality/Augmented Reality, 360 immersive video streaming
- Adaptive video streaming
- Web Real-Time Communication (WebRTC)
- SDN control planes
- Control and orchestration of CDN
- Server overload control, SIP overload control
- Congestion control
- Secure cyber-physical Control systems
- Control of such systems involves:
  - nonlinear control
  - switching control
  - time-delay system control
  - optimal control
  - robust control

**Awards:**

“Cisco Award 2013” funded by the “Cisco University Research Program” for the project “Architecture for Robust and Efficient Control of Dynamic Adaptive Video Streaming over HTTP”.

Principal Investigator: Saverio Mascolo;

“Google Faculty Research Award 2014” for the project “Congestion control algorithm for Web real-time communication (WebRTC)”.

Principal Investigator: Saverio Mascolo.

**Collaborations with companies and institutions:**

- Google inc
- Telecom Italia
- University of Wuerzburg
- University of New Mexico
- Università di Napoli Federico II
- Telecom ParisTech (Institut Mines-Télécom)
- Telecom SudParis (Institut Mines-Télécom)
- Consortium for the Research in Automation and Telecommunication (CRAT)

**Contact person**

Saverio Mascolo  
mascolo@poliba.it

### Competencies and research activities

The D&C Lab has as its major objectives, the promotion of the results obtained in the field of the scientific research - achieved in collaboration with private and public partners, in a regional, national, and international context- and the advancement of technology transfer of these research results.

The area of interest for the research is the scientific disciplinary sector of Automation (09/ G1).

The staff of the laboratory provides research services and technology transfer in the following macro-areas:

- Automation
- Control and Re-engineering of Production Processes
- Control Systems Engineering
- Decision Support Systems
- Discrete Event Systems
- Distributed and Decentralized Control Techniques
- Energy Management and Scheduling
- Fault Detection and Recovery
- Industry 4.0
- Intelligent Transportation Systems
- Intermodal and Multimodal Transport Management
- Logistics Management
- Multi-criteria Decision Making
- Predictive Control Strategies
- Railway traffic control
- Robotics
- Smart Cities and Smart Buildings

### Collaborations with companies and institutions:

D&C Lab has collaborated with entities of different nature, such as private companies, public administrations and Municipalities, and other relevant research actors, both national and international.

### Institutions:

- BANQUE CENTRALE DU LUXEMBOURG - a study on the application of multi-criteria decision methods to public procurement tenders;
- ENEA – Research project RAFAEL on the techniques for the critical infrastructure risk management and forecast in South Italy;
- Municipality of Bari - Research projects (1) RES NOVAE definition of energy scheduling techniques in the smart home; (2) UCCSM: an urban control center for the energy management of Smart Cities at a regional level.

### Research Centers and Universities:

- Aix-Marseille University;
- CENTRO RICERCA FIAT - Research project Pico-e-Pro for the control of production process in the context of Industry 4.0;
- Chalmers University;
- Cracow University of Technology;
- Delft University of Technology;
- École Centrale de Lille;
- Hamburg Helmut Schmidt University;
- Manchester University;
- Tsinghua University;



## Decision and Control Laboratory

- New Jersey Institute of Technology;
- Università di Cagliari.
- Université de Nancy.
- CANNILLO S.R.L. - Research project on integrated logistics to support the activities of procurement, distribution and supply of goods, within the cold chain;
- DIVELLA S.P.A. - Research project on warehouse logistics and management;
- DREAM PROJECT S.P.A. - Research project on the management and automation of the company internal logistics;
- ENEL DISTRIBUTION - Research projects (1) RES NOVAE definition of energy scheduling techniques in the smart home; (2) UCCSM: an urban control center for the energy management of Smart Cities at a regional level;
- FERROVIE DEL SUD EST E SERVIZI AUTOMOBILISTI S.R.L - Research project on offline and real-time trains scheduling;
- GTS (GENERAL TRANSPORT SERVICE) S.P.A. - Research project on the management and automation of intermodal transport;
- IBM - Research project RES NOVAE an urban control center for the energy management of Smart Cities;
- MACNIL GRUPPO ZUCCHETTI - Research project on the management and automation of urban mobility of passengers;
- NICOLA VERONICO S.R.L. - Research project on Vehicle Routing for the Optimization of Hazardous Waste Collection;
- OM CARRELLI ELEVATORI S.P.A. - Research project on the analysis and optimization of logistics.
- PLANETEK - Research project on the management and automation of urban mobility of passengers;
- PRIMADONNA S.P.A. - Research project on the implementation of an automated warehouse;
- SIMNT S.R.L. - Research project UCCSM realization of an urban control center for the energy management of Smart Cities at a regional level;
- TERA S.R.L. - Research projects: (1) RES NOVAE definition of energy scheduling techniques in smart homes; (2) UCCSM realization of an urban control center for the energy management of Smart Cities at a regional level;
- TANGARI S.R.L. - Research project on the management and automation of the company internal logistics.

### Contact person

Mariagrazia Dotoli  
mariagrazia.dotoli@poliba.it

**Competencies and research activities**

The Design of Integrated Systems Laboratory (DEIS Lab) has been involved in several national and international research projects, gaining multi-disciplinary background knowledge aiming to import them to the field of applied electronics. It is node of the Embedded Systems and Smart.

Manufacturing Lab of the Italian Interuniversity Consortium (CINI).

The cardinal skills stem from decades of experience, and concern:

- Design of Analog and Mixed Signal Integrated Electronic Circuits
- Design of silicon detectors, sensors
- Sensor Interfaces
- Testing of analog and mixed-signal ICs and Design-for-Testability (DfT)
- Implementation of Wireless Sensors Network (WSN)
- WSN for real-time environmental monitoring (Healthcare and Wellbeing, Food safety and certification fields)
- Design of ERS MEMS Vibrational Electrostatic Energy Harvester
- Design of Remotely Powered Wireless Systems
- Design and development of Pre-Impact Fall Detection and Gait Analysis digital platform (FPGA, Microcontroller) based on bio-signals
- High Performance SVM classifier for Microcontroller and FPGA implementation
- Design and Implementation of Brain-Computer Interfaces
- Bare-Metal Microcontroller Programming
- Bio-signals Processing and Feature Engineering
- Computer vision on ROS for Robot Source Localization and Mapping
- PCB prototyping for ATO systems
- IC electronics for Brain Machine Interface

**Collaborations with companies and institutions:**

- University of California at Berkeley, US
- Berkeley Wireless Research Center, US
- Ecolè Polytechnique fédérale de Lausanne
- University of Glasgow, UK
- Scuola Superiore Sant'Anna di Pisa – Istituto di Biorobotica
- CERN (Geneva)
- Istituto Nazionale di Fisica Nucleare (INFN)
- Consiglio Nazionale delle Ricerche
- Università di Bologna
- Università di Roma La Sapienza
- Azienda Ospedaliera Universitaria Policlinico di Bari - Scienze mediche di base, neuroscienze e organi di senso
- Rete Ferroviaria Italiana – Settore Ricerca e Sviluppo
- ST Microelectronics srl
- NXP Semiconductors HTC (Eindhoven NL)
- SITAEL
- EXPRIVIA spa
- CNRS
- TMA Grenoble

## Design of Electronic Integrated Systems Lab (DEISLab)

- Confindustria
- Confagricoltura
- Distretto Agroalimentare Regionale

### Contact person

Daniela De Venuto  
daniela.devenuto@poliba.it

### Website:

<http://dei.poliba.it/DEIS/index.html>

DEI

## Digital Electronics Systems and Applications Lab (ELEDIGILAB)

### Competencies and research activities

Digital design with programmable logic devices especially FPGA and microcontrollers. Modelling of CNT-based digital devices. App development for embedded systems.

Research fields: high performances digital medical devices, wearable medical devices, telemedicine, home care, domotics.

### Collaborations with companies and institutions:

Policlinico di Bari - Cardiology division

### Contact person

Agostino Giorgio  
agostino.giorgio@poliba.it

### Competencies and research activities

Currently, the main scientific activity of the Electrotechnical Laboratory concerns the following two topics:

- modelling of devices based on piezoelectric materials;
- shape optimization of piezoelectric energy harvesters excited by environmental or flow induced vibrations.

With reference to the first topic, the research activity includes the modelling of piezo-material hysteretic nonlinearities through phenomenological and physic based approaches.

Model numerical simulations are carried out by means of Finite Element and Single Degree of Freedom approximations of the devices under investigation. A new test bench to research the effects of vibration induced harvesting systems has been recently realized and is now operative.

Among other key activities in the lab, research on numerical meta-heuristic optimization is conducted both from a theoretical and practical point of view.

Optimization has been widely used in the last few years in the lab as a tool for computer aided engineering, for example for the definition of the best characteristics of the piezo-electric components for energy harvesting. The laboratory is equipped with measurement tools for experimental validation activities; two Work Stations; tools for generating controlled vibrations on light bending beams (brushless BLDC vibration motor with eccentric rotating masses).

A new wind tunnel for the experimental tests of fluid structure interaction in energy harvesting applications has been recently acquired.

### Collaborations with companies and institutions:

Since 2017, with the Stefan Seelecke and his "intelligent Material Systems Lab" (iMSL) research group. Saarland University, Saarbrücken, Germany.

### Contact person

Giuseppe Acciani  
giuseppe.acciani@poliba.it

### Competencies and research activities

The Laboratory of Electrical and Electronic Measurements is equipped with a large variety of generic and specialized instruments: from basic ones (digital oscilloscopes, arbitrary waveform generators, power supplies, etc.) for low frequency applications, to advanced ones for signal generation and analysis up to the gigahertz range of frequencies. Advanced thermal imaging diagnostic instruments and a midsized (about 250 liters) climatic chamber are also available.

The following is a non-exhaustive list of skills of the research group members:

- ADCs (Analog to Digital Converters) error modeling and correction;
- Design and prototyping of PC-, microcontroller- and DSP-based mixed signals Data Acquisition (DAQ) and processing systems;
- Industrial circuits, PLC programming and machines diagnostic for faults prevention;
- Wireless Sensor Networks (WSN) design and prototyping;
- Mains signals (both high voltages and high currents) sensing, digitization and DSP-based numerical processing for real-time energy quality assessment for the alternative energies market;
- Marine water purity measurements for early detection of *Ostreopsis Ovatae* algae eutrophication and other man-related pollution phenomena;
- Energy harvesting and energy monitoring from renewable sources;
- Characterization of UAVs (Unmanned Aerial Vehicles) and of their sub-systems for health status assessment, reliability and pre-flight check;
- Time Domain Reflectometry measurement system and waveform analysis;
- Cross-platform and web-based Rapid Application Development for ATE Systems (Automated Test Equipment) with Microsoft Visual Studio, Embarcadero RAD Studio, Android Studio, Eclipse, etc.
- Hardware and Software design of SCADA/HMI Systems for industrial automation;
- PCB design for mixed signals circuits with industrial standard EDA Tools (Altium Designer, Eagle CAD, KiCAD, etc.);
- Firmware development and debugging for a large variety of industry-standard 8-/16-/32-bits microcontrollers and DSPs (Microchip AVR/dsPIC/PICmicro, ARM Cortex-Mx, Texas Instruments C6748, etc.);
- Statistical techniques for measurement uncertainty assessment and instrument calibration.

The Lab continuously works with important Italian companies in order to carry out technology transfer projects and to cooperate with international scholars for advanced scientific research.

### Collaborations with companies and institutions:

- MER MEC S.p.A. - Monopoli
- SITAEL S.p.A. - Mola di Bari
- MASMEC S.p.A. - Bari
- SIPAL S.p.A. - Torino
- Altanet S.r.l. - Altamura
- ApuliaBiotech - Bari
- DPM Elettronica S.r.l. - Foggia

- Nardò Technical Center – Porche Engineering - Nardò (LE)
- Centro Studi Componenti per Veicoli S.p.A.(CVIT) - Gruppo BOSCH –
- Modugno (BA)
- Low Frequency Measurement Group – Politecnico di Torino
- Departamento de Electrónica, Automática y Comunicaciones - Universidad
- Pontificia Comillas Madrid

**Contact person**

Francesco Adamo  
francesco.adamo@poliba.it

**Website:**

<http://misure.poliba.it>

**Competencies and research activities**

The Electrical and Electronic Measurement Lab activities have led to valuable results in terms of technology transfer, in the field of applied science and manufacturing accomplished through national and international Research projects.

Main area of investigation includes the study, design, development and characterization of innovative sensors and instrumentation for scientific/ industrial applications and the development of algorithms for medical imaging.

This Lab is equipped with instrumentation for measurement and generation of electrical quantities up to the gigahertz range of frequencies and thermal imaging. A metrology room with controlled temperature and humidity is also available.

The following is a non-exhaustive list of skills of the research group members:

- Smart instruments for measurements on components and systems;
- Analysis and measurement on distorted electrical signals, in stationary and/or transient condition;
- Model identification, parameters estimation and characterization of electrical machines, equipment, apparatus and electrical drives;
- Measurement of non electrical quantities through electronic and electro optical sensors;
- Environmental monitoring and Remote
- Sensing;
- Assessment of industrial pollution;
- Reliability of measurement using statistical quality control techniques;

- Measurements and electronic instrumentation in the biomedical field;
- Image processing for noise reduction on medical images;
- Development and characterization of components and sensors for the aerospace industry.

**Collaborations with companies and institutions:**

- Cittadella della carità - Taranto
- Leonardo SpA– Land& Naval Defence Division-Taranto
- ILVA SpA – Taranto
- Vestas Italia srl -Taranto
- Mermec –Monopoli
- MASMEC Biomed – Modugno (BA)
- Alenia Aermacchi -Grottaglie (TA)
- Ospedale Taranto Nord "G. Moscati"- Dipartimento di Radiologia
- Ospedale Santissima Annunziata - Taranto- Dipartimento di Radiologia
- Arsenale Militare di Taranto
- Comune di Taranto
- Provincia di Taranto
- Confindustria Taranto
- Autorità Portuale - Taranto
- Universidad Politecnica de Valencia

**Contact person**

Anna Lanzolla  
anna.lanzolla@poliba.it

**Website**

<http://misure.poliba.it>

**Competencies and research activities****ELECTRICAL DRIVES FOR ROBOTICS AND INDUSTRIAL AUTOMATION**

- Evolutionary Algorithms for identification and control
- Control techniques for mobile robots and industrial manipulators

**MORE ELECTRIC AIRCRAFT**

- Design of electrical machines power converters and control algorithms for a more efficient use of energy on-board the more electric aircrafts

**ADVANCED CONTROL TECHNIQUES FOR ELECTRICAL DRIVES**

- Control of induction motor drive in the field weakening region
- Sensorless control of electrical drives
- Application of fuzzy and sliding-mode control to electrical drives
- Fractional-order control for industrial electrical drives

**FAULT DIAGNOSIS OF ELECTRICAL MACHINES**

- Evolutionary Algorithms for identification and control
- Artificial Intelligence-based techniques for fault diagnosis of electrical machines
- On-line fault diagnosis of electrical machines

**Collaborations with companies and institutions:**

- University of Nottingham, UK
- Politecnico di Torino
- Università di Brescia
- Università di Firenze
- University of Aalborg, Denmark
- Christian-Albrechts-Universität, Kiel, Germany
- Curtin University, Perth, Australia
- Universidad Politécnica de Cartagena, Spain
- Universidad de Castilla La-Mancha, Albacete, Spain

**Contact person**

Silvio Stasi  
silvio.stasi@poliba.it



**Competencies and research activities**

The research activities of Electromagnetic Fields and Telecommunications Laboratory at Magna Grecia Center in Taranto are performed by the Microwave and Optical Engineering (MOE) group (<http://moe-group.poliba.it/service.htm>).

They are pertaining to the following main topics:

- Microwave
- Design, fabrication and characterization of antennas and microwave devices for aerospace and communication;
- substrate integrated waveguide devices (SIW);
- measurement of electromagnetic compatibility, electromagnetic exposure investigation, bio-compatibility.
- Microwave applicators for thermal ablation medical therapy.
- Modelling of accelerating cavities for proton linear accelerators (LINAC) for medical
- protontherapy.

**Lab microwave facilities:**

- LPKF ProtoLaser U3 for Rapid PCB Prototyping;
- StarLab Antenna Test Station (SL18), 800 MHz to 18 GHz, automated anechoic chamber;
- LPKF Electroplating of Through-Holes;
- LPKF MultiPress S: Press for Producing Multi-layers (up to 8 layers);
- R&S ESU EMI Test Receiver;
- R&S ENV216 two-line V-network for disturbance voltage measurements on single-phase

- EUTs;
- other instrumentation such as E.M. field power meters;

**Narda Area Monitor System 2600:**

- Remote Monitoring of Electromagnetic Fields;
- a number of wide band antennas covering the RF-MW range;
- Optical spectrum analyzers Agilent N5224A PNA 10 MHz to 43.5 GHz;
- Rohde Schwarz FSH3; Agilent FireFox VNA, Microwave Signal Generators;
- Dielectric probe kit SPEAG for dielectric constant measurement 10MHz-50GHz;
- Weller soldering station.

**Optics**

Design, fabrication and characterization of fiber lasers. Modelling of photonic crystal fibers (PCF), for near infrared (NIR) and medium infrared (MID-IR) applications.

Modelling of innovative materials and rare earth doped optical devices in optical fiber and in planar optics; nonlinear device modelling; optical microresonators; design, fabrication and characterization of optical devices for environmental monitoring and biomedicine.

**Lab main optical facilities:**

- Splicer GPX PTR Fiber Optic Glass Processing Unit;
- PTR PTR Fiber Optic Recoater Fiber Optic Recoater; Ytterbium fiber Lasers CW
- 30 W and CW 100 W;

- Infrared Chamber;
- EDFA ;
- UV-VIS Ocean Optics spectrometers;
- equipped optical benches;
- Nanoscan M2 beam quality measurement.

### Collaborations with companies and institutions:

- Somacis
- ITEL
- Emitech
- Neetra
- RTM
- Quanta System
- INFM
- Centro Laser
- EniTecnologie
- OPTEL
- IFN-CNR MERMEC
- PLANETEK
- SITAEL
- District of Manduria (TA)
- District of Statte (TA)
- District Volturino (FG)
- MISE – Bari
- Università di Bari - Francia
- UMR-CNRS - Institut de Physique de Rennes (IPR) – France
- Institut de Recherche en Ingénierie Moléculaire et Matériaux Fonctionnels,
- UMR CNRS - Le Mans - France
- Laboratoire de Physique de l'Université de Bourgogne - France
- Physics Dep. Shiraz University, Shiraz – Iran
- The Institute for Photonics & Advanced Sensing (IPAS), Centre of Expertise in
- Photonics (CoEP) University of Adelaide - Australia
- University of Tokyo – Giappone
- Mesures Physiques Department
- IUT Institut Universitaire de Technologie du Mans – Francia
- INFM – Lecce
- CNR-FSA – Trento
- IROE-CNR - Firenze Politecnico di Milano
- Politecnico di Torino

### Contact person

Francesco Prudenzano  
francesco.prudenzano@poliba.it

### Competencies and research activities

The ESP Lab is equipped with hardware and software resources both to make experimental work in the field of electronic devices, circuits, systems and to develop procedures for digital applications.

The staff of the laboratory provides research services and technology transfer in the following macro-areas:

Sensor design for digital radiography.

In the field of X-ray detection application, semiconductors characterized by high atomic mass and resistivity have been adopted to fabricate detectors with high X-ray sensitivity. These features are valuable in especially applications, such as in medical field. Both pixel matrix and micro-strip prototypes of GaAs X ray detectors have been analyzed and designed. The device behavior has been modeled taking into account trapping and generated carrier phenomena. The obtained numerical simulations confirm the electrical behavior of the device which has been verified in the ESP Lab.

Analysis and design of broadband multistage interconnection networks and of switching elements for multistage networks Basic structure of a B-ISDN is the interconnection matrix. Researchers of ESP Lab have studied various switching matrixes taking into account both architectures and routing/control algorithms. Both Electronic and electro-optic switching elements for MINs (Multistage Interconnection Networks) and GSNs (Generalized Shuffle Networks) have been designed.

### Procedure development for real-time one-dimensional signals

The study of biological signals is a difficult task

because of their non-stationary behavior. For real-time detection of acute heart pathologies, real-time procedures have been developed for the localization of characteristic points in ECG and ICG signals. Both the obtained sensitivity and the positive predictivity have shown the validity of the implemented methods and their high noise immunity degree.

### Procedure development for automated processing of digital images

Computer Aided Detection (CAD) analysis is valuable in supporting physicians for pathology detection since it improves the diagnosis sensitivity and specificity. CAD system normally operates as an automated second opinion or as a double reading system that indicates lesion locations and types of possible abnormalities. ESP Lab. researchers have developed automated CAD systems able to localize and detect both single microcalcification and microcalcification clusters in mammographic images. The obtained performance show the method validity.

### Analysis and design of biomedical/environmental data capture and storage systems

In particular, RFID systems, adopting active tag, can be integrated with other wireless devices to realize portable networks such as PAN or data network in vehicles. Researchers of ESP Lab. have designed and analyzed various systems for custom applications using RFID devices.

Analysis and synthesis of complex digital circuits

Specifications of a modern digital system are often so complex to need a detailed characterization of both the functionality sets and the memories

between which data are transferred, according to a well-defined synchronization. The distribution of tasks between various devices composing the system can differ according to both the functional blocks disposable in the design libraries and the design requirements such as area occupancy, data throughput, cost, latency, low power dissipation. In the ESP lab., various complex circuits have been analyzed and synthesized adopting different methodologies.

### Contact person

Maria Rizzi  
maria.rizzi@poliba.it

### Collaborations with companies and institutions:

- Faculty of Engineering, Science and Medicine - Department of Health Science and Technology
- Center for Sensory
- Motor Interaction
- Aalborg University (Denmark);
- IMEC
- NES/Wireless
- Leuven (Belgium)
- Infineon Technologies GmbH
- Villach (Austria)
- STMicroelectronics
- Bluetooth BU
- Zaventem (Belgium)
- SST lab
- Masmec S.p.A.
- El.Mo
- MASVIS S.r. L.

**Competencies and research activities**

- RF, microwave and mm-wave component and circuit design - hybrid and ASIC developments.
- TLC system design and integration for personal communications, industrial and medical applications.
- Integrated sensors wireless unit development for environmental monitoring.
- Collaborations with companies and institutions:
  - Texas Instruments Europe

- Conexant
- Galileo Avionica, SELEX (now Leonardo)
- SEASTEMA (FINCANTIERI)
- GST

**Contact person**

Gianfranco Avitabile  
gianfranco.avitabile@poliba.it

**Competencies and research activities**

The laboratory hosts Apulian Bioengineering s.r.l., a spin-off company and innovative start-up founded in March 2019. The In2Lab research activities mainly focus on Electronic and Information Bioengineering and ICT solutions for Industry 4.0:

- Industrial Informatics and Real World Applications
- Medical Informatics and Biometric Applications
- Human Computer Interaction and Human Machine Interaction
- Image Processing and Artificial Vision
- Machine Learning and Soft Computing Applications
- Intelligent Computer Aided Diagnosis, Prognosis,

Rehabilitation and Therapy from biomedical data and signals

- Robotics and Domotics
- Virtual and Augmented Reality
- Bioinformatics and Systems Biology
- Safety and Security
- Bioengineering
- Artificial Intelligence

**Collaborations with companies and institutions:**

- Apulian Bioengineering S.R.L. ([www.apulianbioengineering.com](http://www.apulianbioengineering.com))
- Comau S.P.A.
- Protom Group S.P.A.

## Industrial Informatics

- R.I. S.p.A.
- Cupersafety S.R.L.
- Kinema S.R.L.
- Mespo S.N.C.
- Forte S.R.L.
- LMA S.R.L.
- NEWS S.R.L.
- AMT Services S.R.L.
- Item Oxygen S.R.L.
- Consorzio CETMA
- IRIS S.n.c.
- BioResult S.R.L.
- Masmec S.p.A.
- Trait d'Union S.R.L.
- eResult S.R.L.
- SER & Practices S.R.L.
- Graphiservice S.R.L.
- Media Broadcast Communication s.a.s.
- Fotolito 38 S.R.L.
- Quorum Italia S.R.L.
- Bautech S.R.L.
- Escoop European Social Cooperative
- Laboratorio di Analisi Cliniche Pignatelli S.R.L.
- Agiler srl
- Ena Consulting S.R.L.
- Orizzonti Consulting S.R.L.
- Code Architects S.R.L.
- Murgia Sviluppo S.C.A.R.L.
- Giuseppe Laterza and Figli S.p.A.
- Medica Sud S.R.L.
- Cardio on line Europe S.R.L.
- Intact Health Care
- Paperleap S.R.L.
- Mosaico Digitale S.R.L.
- Ligi Tecnologie Medicali S.p.A.
- Molino Casillo Group
- Scuola Superiore Sant'Anna di Pisa - Tecip Institute
- Scuola Superiore Sant'Anna di Pisa - Biorobotics Institute
- Dipartimento SMBNOS (Università degli Studi di Bari)
- Dipartimento DETO (Università degli Studi di Bari)
- Dipartimento di Ingegneria dell'Innovazione (Università del Salento)
- Consiglio Nazionale delle Ricerche CNR - IMM
- Università degli Studi di Foggia - Ospedali Riuniti
- IRCCS Istituto Tumori Giovanni Paolo II di Bari
- Casa Sollievo della Sofferenza - IRCCS - San Giovanni Rotondo
- RNBIO: Rete Nazionale di Bioinformatica
- Biosistema S.C.A.R.L.
- Co.Re.Ma.R. Puglia.

### Contact person

Vitoantonio Bevilacqua  
vitoantonio.bevilacqua@poliba.it

The research activities of the Information Systems Lab (SisInf Lab) have been evolving over the years around a common nucleus: intelligent systems and intelligent data management.

All the aspects related to Artificial Intelligence as well as those referring to Software Engineering and Industrial Informatics are part of the background knowledge of professors, Ph.D. students and research assistants working with SisInf Lab. This led to the presentation of new and innovative solutions in the fields of automated reasoning, big data analysis, formal verification of software systems, recommender systems and Internet of Things, just to cite a few.

Putting together different souls of computer science to propose smarter and smarter software solutions, algorithms and architectures is the main mission of SisInf Lab and this is made possible thanks to a strong set of competencies.

### Competencies and research activities

- Artificial Intelligence
- Smart Manufacturing
- Industry 4.0
- Machine Learning
- Big Data Analysis
- Information Systems
- Personalized Information Access
- Recommender Systems
- Information/Resource Retrieval
- Web of Things
- Semantic Web
- Knowledge Graphs
- Knowledge representation
- Automated reasoning
- Non-standard reasoning
- Opportunistic Reasoning
- Smart Automotive
- Model Checking
- Adaptive Architectures
- Collaborations with companies and institutions:
- HP Labs (Palo Alto)
- IBM
- Corvallis S.p.A.
- Exprivia S.p.A.
- Reply
- Engineering
- TxT e-solutions
- Fincons
- University of Oxford
- Knowledge Media Institute - The Open University
- Alpen-Adria-Universität Klagenfurt
- Universidad Autonoma de Madrid
- Universitat Pompeu Fabra Barcelona
- University of London, Birkbeck College
- Athabasca University
- Poznan University of Economics
- DOCOMO Euro-Labs Munich

- ISTI-CNR Pisa
- University of Michigan
- Poznan University of Economics
- Technical University of Crete
- Erasmus University of Rotterdam
- Gdansk University of Technology
- EURECOM
- National University of Ireland aux Fonctionnels,  
UMR

**Contact person**

Eugenio Di Sciascio  
eugenio.disciascio@poliba.it

**Website**

<http://sisinflab.poliba.it>



### Competencies and research activities

The Photonics Research Group was formed by V. Passaro in 2004. It is mainly involved in modelling, design and technology of photonic devices and sensors in group IV materials (silicon and compounds, germanium, carbide, tin), non linear integrated optical devices for fast signal processing, wavelength conversion, amplification, sensing, etc., fiber optic sensors and design of fiber optic passive optical networks for telecommunication systems.

Since 2004 the group has been published more than 100 papers in peer-reviewed international journals and more than 100 papers in book chapters and international conference proceedings.

### Collaborations with companies and institutions:

The group has established prestigious collaborations with several national and international research groups, especially from:

- University of Surrey
- University of Southampton
- University of Glasgow
- Russian Academy of Sciences
- Università di Trento
- Universidad de Valencia
- Universidad Politecnica de Valencia
- Mcquarie University
- University of Massachusetts at Boston
- National Institute of Optics at Pozzuoli
- National Institute of Nuclear Physics at Bari.

### Contact person

Vittorio Passaro  
vittorio.passaro@poliba.it

### Competencies and research activities

LabZERO is a multidisciplinary laboratory located at Politecnico di Bari and ENEA Research Center Brindisi. The mission of LabZERO is to enable strategic cooperation with enterprises and promote multidisciplinary research for the development of innovative technologies in the areas of energy efficiency and renewable energy sources in both urban and industrial sectors. Research and experimentation activities in LabZERO make use of simulation tools and technologically advanced equipment, in order to reduce the risks of applied research and support product innovation in the path "from concept to market".

The laboratory provides innovative solutions for fast prototyping, for the certification of materials and the development of complex systems, in the fields of energy efficiency, energy conservation, sustainable manufacture, smart grids and smart cities.

LabZERO activities are based on the coordinated work of four research units: three units at Politecnico di Bari (DEI, DMMM, DICAR), and one at ENEA Research Center in Brindisi. It is part of the Apulian applied research system and aims to the integration with other R&D networks and industrial clusters.

A main strength of the LabZERO is the collaboration with entities of different nature. In fact, LabZERO works in close cooperation with about fifty stakeholders such as industrial developers, public territorial bodies, public administrations and Municipalities, and relevant research actors.

#### The main research activities of LabZERO concern:

- Power system analysis and control
- Smart grid and storage technologies and applications
- Fast prototyping of electro-mechanical equipment and devices for smart city and home automation.
- Hardware-in-the-loop (HIL) and power-hardware-in-the-loop (PHIL) applications
- Prototyping and testing of components for smart grids and microgrids
- Medium and low voltage distribution automation
- Advanced protection systems
- Electrical Vehicles infrastructures, smart charging and Vehicle to Grid (V2G)
- Design and test of micro wind turbines
- Sustainable manufacturing, de-manufacturing by cryogenics and recycling of waste of electric and electronic equipment (WEEE)
- High performance building material characterization
- Non-destructive tests for the mechanical characterization of materials and structures
- Smart materials and devices for the thermoelectric generation from waste heat or solar energy.
- Solar heating & cooling
- Industry 4.0
- Smart Manufacturing & Smart Farming
- Main available pieces of equipment are:
  - A microgrid test facility
  - Real time digital simulator (RTDS)
  - RTDS Interface to IEC 61850 equipment

## LabZERO

- 4-quadrants programmable power source with multiple AC and DC power output configurations
- 4-quadrants controllable Battery Energy Storage Systems
- An experimental biomass externally fired combined cycle plant
- An innovative open-air wind tunnel
- Cryogenic testing device
- Gas pycnometer and gas sorption analyzer
- Laser-ultrasonic test bench

### The laboratory has been involved in different industrial projects on:

- Technical scientific agreement with Università degli Studi di Bari and ARPA Puglia (Agenzia Regionale per la Prevenzione e la Protezione Ambientale) for research and consulting activities in the field of efficiency and energy saving.
- Technical scientific contract with Università degli Studi di Bari and ARPA Puglia (Agenzia Regionale per la Prevenzione e la Protezione Ambientale) for technical advice on energy performances of buildings in a scientific and technological park
- Contract with BOSCH S.p.A. for a training course on electrical safety
- Cryogenic technologies for WEEE de-manufacturing (granted by MISE)
- Design and prototyping of a public illumination system integrated with urban mobility and IoT services in partnership with an industrial cluster of ten SMEs (Niteko srl leader)
- Design and prototyping of a home energy management system, or energy router, and cloud control tools for smart grids in residential and tertiary applications in partnership with an industrial cluster of nine enterprises (Fincons SpA leader)
- Feasibility study for the integration and optimization of energy and material resources to increase efficiency and competitiveness and develop a smart industrial energy district in the industrial area of Brindisi (partner Confindustria Brindisi-ASI)
- Smart grids applications on power distribution systems (with AMET S.p.A., the electric distribution company for the city of Trani)
- Software applications for gas distribution grids (developed for the natural gas distributor in the city of Bari, Retegas Bari S.p.A.)

### Main services:

- Fast prototyping of electrical equipment & systems
- Design and testing of control boards through hardware-in-the-loop (HIL)
- Design and testing of power components through power-hardware-in-the-loop (PHIL)
- Testing and setting of electrical protection systems
- Power quality measurement and immunity tests
- Measurements of low-frequency electromagnetic fields
- Dielectric strength tests on cables
- Main measurements from electrotechnical laboratory
- Main lighting measures

### Measurements for grounding system

- Short circuit analysis
- Power system simulation, analysis and control of complex transmission, distribution and industrial grids
- Operator Training Simulator for the training of operators in industrial as well as transmission power systems
- Design and verification in substation automation
- Communication and network integration tests with IEC 61850 devices
- Communication tests of the I/O list in SCADA applications under IEC 61850 protocol
- Testing of micro wind power turbines
- Mechanical characterization of materials through laser and nanosonic interferometry
- Thermal cycles testing of materials using a climatic chamber
- Cryogenic and demanufacturing techniques for recycling exhausted PV panels Thermal diffusivity, specific heat, thermal conductivity measurements Measurement and characterization of thermo-electrical parameters of thin film materials
- Modeling and simulation of materials, components and devices

### Collaborations with companies and institutions:

- Washington State University
- University of Illinois Urbana-Champaign
- École Polytechnique Fédérale de Lausanne
- Università degli Studi di Bari

- ALI6 S.r.l.
- AMET S.p.A.
- Applicat S.r.l.
- ARPA Puglia (Agenzia Regionale per la Prevenzione e la Protezione Ambientale)
- BOSCH S.p.A.
- Blue H R&D SRL
- CETMA (Centro di Ricerche Europeo di Tecnologie Design e Materiali)
- CIAB (Consorzio Informatica Artigiani Bari)
- Città Metropolitana di Bari
- CNA Bari (Confederazione Nazionale dell'Artigianato e della Piccola e Media Impresa)
- Comune di Bari
- Comune di Bitetto
- Comune di Capurso
- Comune di Cellamare
- Comune di Margherita di Savoia
- Comune di Polignano a Mare
- Comune di Palo del Colle
- CONFAPI Bari e BAT (Confederazione italiana della piccola e media industria privata)
- Confindustria Brindisi
- Costellazione Apulia
- Confindustria Puglia
- Dgs S.p.A.
- Dyrecta Lab S.r.l.
- Elfim S.r.l.

## LabZERO

- EMI S.r.l.
- EV Charging
- Fincons S.p.A.
- Garofoli S.p.A.
- GEM ICT – Research & development S.r.l.
- Ginex Gaetano
- I-Com
- Indice7
- InResLab S.c.a.r.l.
- Italian Cutting System S.r.l. (ICS)
- Kad3 S.r.l.
- Mediterranean Design Network S.r.l.
- Niteko S.r.l.
- Nomisma Energia
- Provincia di Taranto
- ReEnergy Projects 1 S.r.l.
- Retegas Bari S.p.A.
- Ricerca sul Sistema Energetico - RSE S.p.A.
- SIC Divisione Elettronica S.r.l.
- So.Co.In. / System S.r.l.
- STC S.r.l.
- Tera S.r.l.
- UPI Puglia

### Contact person

Massimo La Scala  
massimo.lascalea@poliba.it

### Website

<https://research.poliba.it/labs-networks/labzero>

### Competencies and research activities

The research fields of the laboratory are modelling, design, fabrication and characterization of optoelectronic and photonic waveguiding components and devices for a wide spectrum of applications such as inertial navigation, biochemical sensing, optoelectronic modulation, optoelectronic beam-forming and steering, optoelectronic signal processing and so on.

The main current research topic are:

- Modelling, design, and optical characterization of miniaturized optoelectronic gyros for aerospace. In the framework of a well-established collaboration with the Italian Space Agency (ASI) and the European Space Agency (ESA), we are developing optoelectronic gyros based on the integrated optical technologies. We are working towards the demonstration of the first fully integrated photonic gyro-on-a-chip in InP technology.

Two demonstrators of the sensing element, a low-loss ring resonator with radius  $\approx 13$   $\mu\text{m}$  and a spiral resonator with length  $\approx 60$   $\mu\text{m}$ , have been already fabricated/characterized in cooperation with the Fraunhofer Institute for Telecommunications, Heinrich-Hertz-Institute, and the Institute for Photonic Integration, TU of Eindhoven, respectively. The cavities show a Q-factor close up to one million. Recently a very innovative approach for enhancing the Q-factor of the ring resonators for gyros applications up to 10<sup>9</sup>, with a calculated gyro resolution in the order of 0.001°/h, has been envisaged in the framework of an ESA funded project.

This approach was patented in 2014 (patent number EP056933). In the framework of a coop-

eration agreement between the ESA and the Optoelectronics Laboratory on optical gyroscopes based on ring resonators and photonic crystals, a PhD fellowship has been funded. In cooperation with LioniX International B.V., the photonic crystal ring resonator has been designed and manufactured. The research activity includes also the development of the readout electronics for resonant optical gyros. In cooperation with Sitael, a FPGA-based readout board has been designed, manufactured, and tested.

- Biosensors based on photonic/plasmonic micro-cavities and hybrid photonic/plasmonic nanotweezers for future medicine. We are currently investigating an electro-photonic approach for the analysis and the monitoring of susceptibility at the single-bacterium level for the development of new drugs. Our method employs optical tweezers based on photonic crystal cavities for the trapping of individual bacterium. The susceptibility testing is carried out by impedance measurements.

We are currently investigating a plasmonic biosensor for protein biomarkers detection. We have designed, fabricated and characterized a novel cavity that combines a photonic crystal nanobeam cavity with a plasmonic bowtie antenna. Furthermore, we have recently demonstrated the strong efficiency of the hybrid cavity as a nanotweezer for optical trapping, with long time trapping ( $\approx$ several minutes) and very low optical power (in the order of  $\mu\text{W}$ ).

A multi-analyte biosensing platform with ultra-high resolution ( $\approx 0.2$  ng/mL) has been recently designed for the detection in the human serum of a wide range of biomarkers, e.g. those

allowing the lung cancer early diagnosis. The platform is based on a new configuration of planar ring resonator. The very strong light-matter interaction enabled by the micro-cavity allows a record limit-of-detection of 0.06 pg/mm<sup>2</sup>, five times better than the state-of-the-art.

- Integrated microwave photonics. Aiming at improving the performance of the currently available Synthetic Aperture Radar payloads, especially in terms of size, weight and power consumption, several photonic-based functionalities of the radar system, e.g. the generation of chirped waveform that the radar sensor transmits, the beamforming, and the direct (without down conversion) A/D conversion of the radar echo, have been investigated. In particular, we have recently designed an optoelectronic oscillator with ultra-high spectral purity and a photonic sub-system for linearly chirped microwave waveform generation having a large time-bandwidth product.

Furthermore, several resonant delay lines have been designed for beamforming/beam-steering networks. Two graphene-based chip-scale resonant delay lines have been designed. The basic building block of both the devices is a couple of two vertically stacked ring resonators with a graphene/alumina graphene capacitor placed between the rings.

Furthermore, a 1D photonic crystal made by a graphene capacitor pattern has been designed, demonstrating the highest figure of merit at the state-of-the-art, to our knowledge. We are currently working on a photonic-based reconfigurable front-end and a switching matrix for TLC payloads.

### Collaborations with companies and institutions:

Selected collaborations with Universities and research centers:

- Fondazione Bruno Kessler (FBK), Italy
- Fraunhofer Institute for Telecommunications, Heinrich-Hertz-Institut, Berlin, Germany
- Istituto Italiano di Tecnologie (IIT), Lecce section, Italy
- National Council of Research, Italy
- Technical University of Eindhoven, Institute for Photonic Integration, The Netherlands
- Technische Universität München (TUM), Institute for Nanoelectronics, Germany
- Technoscience, Parco Scientifico e Tecnologico Pontino, Roma, Italy
- University of California Santa Barbara, Optoelectronics Research Group, USA
- University of Glasgow, Nanophotonics and Optoelectronics Research Group, UK
- University of Southampton, Silicon Photonics Group, UK
- University of St. Andrews, Microphotonics and Photonic Crystals Group, UK
- University of York, Photonics Research Group, UK
- Zhejiang University, Micro-Satellite Research Center, China

### Selected collaborations or contacts with companies:

- Aerospace Apulian District
- Alcatel-Lucent, France/Italy

## Optoelectronics Laboratory

- Center for Integrated Photonics (CIP), Ipswich, UK
- CGS, Italy
- Consorzio Nazionale Interuniversitario per le Telecomunicazioni (CNIT)
- El.En., Calenzano, Florence, Italy
- EvenTech, Riga, Latvia
- GEM Elettronica, San Benedetto del Tronto, Italy
- HighTech XL, Eindhoven, The Netherlands
- Institute of Technology Antoine de Saint Exupéry, France
- Leonardo
- LioniX International B.V., Enschede, The Netherlands
- Mechatronics Apulian District
- MerMec, Monopoli, Italy
- Planetek Italia
- Sitael, Mola di Bari, Italy
- Technobis Group, The Netherlands
- Thales Alenia Space, Italy
- Thales Research and Technology, France

### Contact person

Caterina Ciminelli  
caterina.ciminelli@poliba.it

### Website

<http://dei.poliba.it/optoelectronics>



### Competencies and research activities

- MORE ELECTRIC AIRCRAFT  
 Design of electrical machines power converters and control algorithms for a more efficient use of energy on-board the more electrical aircrafts
- MULTILEVEL CONVERTERS: MODULATION AND CONTROL  
 PI-based and passivity-based control of H-Bridges multilevel converters  
 Back-to-back drives for traction systems  
 Multilevel modulations and their implementation on FPGA systems
- POWER CONVERTERS FOR DISTRIBUTED POWER GENERATION SYSTEMS  
 Three-phase step-up inverters  
 Anti-islanding methods  
 Synchronization and control methods for distributed power generation systems in different grid conditions.
- POWER QUALITY ASSESSMENT CRITERIA AND ACTIVE COMPENSATION SYSTEMS  
 New power quality assessment criteria for non-linear loads  
 Predictive, fuzzy and fuzzy-predictive controls of active filters  
 Optimal tuning of active power filters via genetic algorithms and Nelder-Mead method
- THREE-PHASE ACTIVE RECTIFIERS  
 LCL-filter design and passive/active damping of control loops  
 Back-to-back drive with reduced energy storage  
 Fuzzy-sensorless control for low-cost micro-controllers

### Collaborations with companies and institutions:

- University of Nottingham, UK
- Politecnico di Torino
- Università di Brescia
- Università di Firenze
- University of Aalborg, Denmark
- Christian-Albrechts-Universität, Kiel, Germany
- Curtin University, Perth, Australia
- Universidad Politécnica de Cartagena, Spain
- Universidad de Castilla La-Mancha, Albacete, Spain

#### Contact person

Silvio Stasi  
 silvio.stasi@poliba.it

- Competencies and research activities
- Definition and the implementation of forecasting procedures.
- Operation planning and real-time operation procedures.
- Monitoring and the control of single devices through local controllers or actuators.
- Real-time response functions of inverters.
- Tests of islanding conditions feeding simulated and real loads.
- Development of control logic for storage devices and electric vehicles in V2G configuration.
- Mode transition management.
- Fault system protection.

#### Collaborations with companies and institutions:

- ABB S.p.A. - Power System Division – Genova
- Autorità Portuale del Levante - Bari
- Terna Rete Italia S.p.A. - Roma
- Guastamacchia S.r.l. – Ruvo di Puglia (BA)
- Terni Energia S.p.A. - Terni
- TCT S.r.l. – Brindisi
- ST Microelectronics – Catania
- Enel S.p.A. - Roma
- Somprogest
- Rienergia
- AQP

#### Contact person

Enrico Elio De Tuglie  
enricoelio.detuglie@poliba.it

**Competencies and research activities**

In the Signal Processing Laboratory, the main expertise is in Remote Sensing (design of Earth Observation satellite systems as Synthetic Aperture Radar, Doppler Altimeter and Multispectral sensors), in machine learning (supervised/unsupervised classification, regression) and in multivariate Signal Processing applied to engineering problems and to other fields (physics, chemistry, biology, medicine).

**Collaborations with companies and institutions:**

- Università di Bari
- Politecnico di Milano
- Airbus Germany
- Thales Alenia Italia
- European Space Agency
- Italian Space Agency
- CNR-Bari
- University of Sheffield
- Aresys srl-Italy

**Contact person**

Pietro Guccione  
[pietro.guccione@poliba.it](mailto:pietro.guccione@poliba.it)

**Competencies and research activities**

Telematics Lab is a research laboratory at the Department of Electrical and Information Engineering (DEI) of Politecnico di Bari. Our mission is the research on the most relevant technologies in the area of telecommunication networks.

**Currently, the main themes of our research are:**

- IoT and Industry 4.0
- Network Security
- 5G Systems
- Information Centric Networking

- Network Softwarization
- Nano networks
- Internet models and network measurements

### Telematics Lab is (or has been) involved in the following recent projects:

- H2020 GUARD GUARD: A cyber-security framework to GUArantee Reliability and trust for Digital service chains. Years 2019–2021 (36 months).
- PRIN project no. 2017NS9FEY: Realtime Control of 5G Wireless Networks: Taming the Complexity of Future Transmission and Computation Challenges. Years 2020–2022 (36 months)
- Pre-commercial trials of 5G technology using spectrum in the 3.6 GHz–3.8 GHz range - Area Milano, funded by MISE. Years 2017–2021 (48 months)
- PON projects funded by the Italian MIUR: Pico&Pro (ARS01\_01061), AGREED (ARS01\_00254), FURTHER (ARS01\_01283), RAFAEL (ARS01\_00305)
- Apulia Region Research Project: E-SHELF (OSW3NO1), INTENTO (36A49H6)
- H2020 FANTASTIC 5G: Flexible Air iNTerfAce for Scalable service delivery wiThin wireless Communication networks of the 5th Generation. Years 2015–2017 (24 months)
- H2020 BONVOYAGE: From Bilbao to Oslo, inter-modal mobility solutions, interfaces and applications for people and goods, supported by an innovative communication network. Years 2015–2018 (36 months)
- H2020 SYMBIOTE: symbiosis of smart objects across IoT environments. Years 2016–2018 (36 months)
- International cooperation
- A de-verticalized machine-to-machine platform for smart building applications". Galileo 2015–2016 (12 months)
- COST Action IC0703 Data Traffic Monitoring and Analysis (TMA): theory, techniques, tools and applications for the future networks
- RES NOVAE: reti edifici strade nuovi obiettivi virtuosi per l'ambiente e l'energia. Years 2012–2015 (36 months). Funded by National Operative Program – Research and Competitiveness 2007–2013.
- DSS: Decision Support System for emergency management in marine environments. Years 2011–2013 (36 months). Funded by National Operative Program – Research and Competitiveness 2007–2013
- ERMES: Enhance Risk Management through Extended Sensors. Years 2011–2013 (36 months). Strategic Projects - funded by Apulia Region

### Collaborations with companies and institutions:

- 8Bells
- ATOS
- Azkar – Dachser Trasportes
- Experis
- Fiware foundation
- Fluidtime
- Forth
- Gruppo Maggioli
- Huawei
- Intel

## Telematics Laboratory

- Intracom S.A. Telecom Solutions
- Italtel
- JIG
- Law and Internet Foundation
- Macnil
- MC2innovations
- Minds&SparksNAVIGO
- Networks
- Nokia
- Orange
- Poznań Supercomputing and Networking Center
- Samsung
- Sensing and Control
- Sequans
- Sintef
- SM-Optics
- Technion – Israel Institute of Technology
- Telecom Bretagne
- TIM
- Trenitalia
- Ubiwhere
- Unidata
- Vipnet
- Vodafone
- WINGS
- Wobcom

### Contact person

Gennaro Boggia  
gennaro.boggia@poliba.it

Luigi Alfredo Grieco  
alfredo.grieco@poliba.it

### Website

<http://telematics.poliba.it>

A collaborative robotic arm for industrial applications.



# DICATECH

Department of Civil, Environmental, Land,  
Building Engineering and Chemistry



### Competencies and research activities

ERC 2nd Level Code

PE10 Earth System Science

ERC 3rd level Code

PE8\_3 Civil engineering, architecture, maritime/hydraulic engineering, geotechnics, waste treatment

PE10\_14 Earth observations from space/remote sensing

### Research Activities

Services and research activities (institutional and funded) provided within the lab focus on the following Geomatics themes:

- extraction of 2D/3D geometric primitives from satellite/aerial/UAV VHR data to update Technical/Thematic Cartography.
- multi-temporal (change detection) classification of satellite data acquired by means of optic sensors with medium and high spatial, radiometric and spectral resolution to produce thematic maps (land use/land cover, vegetation, thermal anomalies, archaeological traces, etc.);
- development and customization, through open and proprietary programming languages, of specific algorithms for processing 2D/3D data aimed at improving qualitative and quantitative standards (geometry, accuracy and precision) of results;
- pre/post-processing and structuring of complex 3D cartographic objects, obtained by means of laser technologies for aerial (LIDAR) and Terrestrial LASER Scanning, UAV systems (structure from motion and photogrammetric restitution) aimed generating altimetric models for environmental modelling (DTM, DMS, DEM, etc.);
- development and implementation of WebGIS systems (FLOSS and proprietary software) for interactive analysis, representation and sharing of Big 2D/3D geospatial data according to OGC standard through ad hoc WMS/WFS-T services;
- Accuracy testing on geospatial data produced by third parties (technical cartography, LU/LC classification accuracy, specific land cover extraction);
- Stability testing of WebGIS systems and services implemented by third parties

### Collaborations with companies and institutions:

- Corvallis S.p.A.
- Autorità di Bacino della Puglia
- SIPAL S.p.A.
- ARPA Puglia
- University of Almeria (Spagna)
- Corvallis S.p.A.
- Autorità di Bacino della Puglia
- SIPAL S.p.A.
- ARPA Puglia
- University of Almeria (Spagna)
- Cyprus University of Technology (Cipro)
- Technical University of Lodz (Polonia)
- Latvia University of Life Sciences and Technology (Lettonia)
- Centre for Advanced Mediterranean Agronomic Studies - CIHEAM
- Istituto di Metodologie per l'Analisi Ambientale (IMAA) del Consiglio Nazionale delle Ricerche

## Applied Geomatics Laboratory (AGLab)

- University of Warmia and Mazury (Polonia)
- Eratosthenes Centre of Excellence (ECoE)
- ASSET Regione Puglia
- University of Bucharest, Faculty of Geography (Romania)
- Regione Puglia, SEZIONE GESTIONE SOSTENIBILE E TUTELA DELLE RISORSE FORESTALI E NATURALI
- ACCORDO con ASSET Regione Puglia - STUDIO E GESTIONE DEL MONITORAGGIO GEOMATICO IN TEMPO REALE DELL'AREA IN FRANA DEL VERSANTE OCCIDENTALE PRESSO L'ABITATO DI CHIEUTI (FG) - Responsabili: Eufemia Tarantino e Alberico Sonnessa
- ACCORDO con Regione Puglia - RES4SEAL (REMOTE SENSING FOR SEA LITTER) - Responsabile scientifico: Eufemia Tarantino

### Some projects:

- GreenhouseSat "Object-based horticultural crop under greenhouse identification using stereo imagery of WorldView-3 satellite and Landsat 8 time-series"
- STIMARE "Strategie Innovative, Monitoraggio ed Analisi del Rischio Erosione"
- CONVENZIONE DI RICERCA SIPAL-DICATECH-Cantiere tecnologico per infrastrutture Civili e Militari" Responsabile Eufemia Tarantino
- AIM: Attrazione e Mobilità Internazionale "Definizione di un sistema integrato di monitoraggio per la definizione della influenza dei SOD sui ROD in centri storici"
- Sentinel-GH (RTI2018-095403-B-I00; MAPEADO DE INVERNADEROS E IDENTIFICACION DE CULTIVOS HORTICOLAS PROTEGIDOS MEDIANTE ANALISIS DE IMAGEN BASADA EN OBJETOS Y SERIES TEMPORALES DE IMAGENES DE SATELITE) - Spagna
- BRAINS TO SOUTH 2018 "EO4SDG - Earth Observation for Sustainable Development Goals: Big Data analytics for monitoring global land changes phenomena" - Responsabile scientifico Andrea Nascetti
- WIN-RIESCO - From vines to WINes: managing Risks to Enhance Sustainability and Continuity - PRIN 2022 PNRR: PROGETTI DI RICERCA DI RILEVANTE INTERESSE NAZIONALE – Responsabile scientifico Unità locale: Alessandra Capolupo
- COASTLINE - HORIZON-MSCA-2022-SE-01 - Responsabile scientifico: Alessandra Capolupo

### Contact Person

Eufemia Tarantino  
eufemia.tarantino@poliba.it

### Competencies and research activities

The Coastal Engineering Laboratory (LIC) of the Department of Civil, Environmental, Land, Building Engineering and Chemistry of Politecnico di Bari was designed for advanced research and technical support to the Public Administration in coastal territorial management.

The mission of the laboratory is to provide facilities for researchers, PhD and MSc-students, as well as to perform practical work and demonstrations to support of teaching activities in university. It also has the potential for physical-experimental research in the fields of Maritime and Environmental Hydraulics.

The laboratory has a total surface area of 30,000 m<sup>2</sup>, a laboratory area of 12,000 m<sup>2</sup> and an office area of 500 m<sup>2</sup>.

The major experimental facilities at the LIC are:

Two tanks used for three-dimensional physical models for maritime and coastal engineering research. The coastal model basin is 100 m long, 50 m wide and 1.2 m deep, while the offshore model basin is 50 m long, 30 m wide and 3 m deep. The coastal model facility is equipped with a wave maker.

Two wave channels, which are 2.4 m wide, 50 m long and 1.2 m deep. They are equipped with a wavemaker.

Very large flume for sea currents.

The channel is 15 m long, 4 m wide and 0.4 m deep. Positive and negative buoyant jet systems. The abovementioned channel includes a buoyant jet thermal-hydraulic system with process-computers.

The LIC has many advanced equipment and instrumentation for morphological and hydraulics analysis, such as: bottom propellers, Acoustic Doppler Velocimeter (ADV), Vessel-Mounted Acoustic Doppler Current Profiler (VM-ACP), micro whirls flow meters, pressure gauges, bottom profiler, densimeter, ultrasonic wave height meter, high-precision GPS transceivers, spectrometer, LDV (Laser Doppler Velocimeter) system, laser scanner, drone. The LIC is also equipped with software and data acquisition systems for the study of the wave climate hindcasting and forecasting, wave propagation, storm and swell activity inside harbors, solid transport, beach evolution, circulation currents and pollutant diffusion.

For the field sea monitoring the LIC has installed a system in the Canale Navigabile of the Mar Piccolo of Taranto (Italy) for the monitoring of sea currents and waves. Another system has been installed in the Mar Grande of Taranto (Italy) for the monitoring of sea currents, waves, water quality and weather. The LIC also hosts equipment of the colleagues of the mechanical engineering department of Politecnico di Bari, such as a wind tunnel and an experimental apparatus to determine the performance of pumps and turbines.

The LIC staff includes many researchers, technicians and students whose work makes the laboratory a reference point in the field of Hydraulics, Maritime and Environmental Hydraulics. The LIC promotes relationships and cooperation with international universities and research institutions.

## Coastal Engineering Laboratory (LIC)

### Collaborations with companies and institutions:

- Italian University Ministry with Research Projects of National Interest
- European Union for research projects
- Co.N.I.S.Ma. – National Inter-University Consortium for Marine Sciences
- Basin Authority of Arno
- Basin Authority of Apulia
- Municipality of Mola di Bari
- Municipality of Bari
- Apulian Aqueduct
- Province of Massa Carrara
- The Marche Region
- Apulia Region
- Port System Authority of the Ionian Sea
- Port Authority of Bari
- Regional Agency for Environment Prevention and Protection - Apulia
- Company Impresub Diving Marine Contractor S.r.l.
- Company Price Water House Coopersgm
- Company Coastal Protection Systems s.r.l.
- Company Edil Impianti S.r.l.
- Company Marconsult S.r.l.
- Genova
- Sviluppo Italia – Roma
- National Research Council

### Contact person

Michele Mossa  
michele.mossa@poliba.it

### Website

[http://www.michelemossa.it/sottopag.php?id=2&id\\_pag=15AppliedGeomaticsLaboratory\(AGlab\)](http://www.michelemossa.it/sottopag.php?id=2&id_pag=15AppliedGeomaticsLaboratory(AGlab))

[www.poliba.it/lic](http://www.poliba.it/lic)

[www.iahrmedialibrary.net](http://www.iahrmedialibrary.net)

### Competencies and research activities

The “Environmental Technologies Laboratory” (ETL) works on environmental engineering issues of the 09/D1 “Materials Science and Technology” sector, with particular reference to (i) solid waste management, (ii) remediation of contaminated sites and (iii) air emissions control.

The ETL consists of (i) a chemical section, (ii) a technological section and (iii) a pilot technological platform.

A variety of research activities are offered by the laboratory in terms of (i) pollutants measurements, (ii) experimental tests at bench and pilot scale as well as (iii) environmental monitoring.

The measurement of pollutants concerns the determination of (i) elemental composition of aqueous solutions by means of ICP-OES, (ii) organic pollutants (PAH, PCB, Total Hydrocarbons) through GC-MS, (iii) hydrocarbon (butane, hexane) by means of GC-FID, (iv) pesticides, phenols and PAHs through HPLC with UV-VIS and fluorescence detectors, (v) carbon, hydrogen and sulfur content on solid/liquids samples by means of the CHS analyzer, (vi) the heating value of combustion of solid/liquid substances through the Mahler calorimeter bomb, (vii) the TOC (Total Organic Carbon) of aqueous solutions as well as (viii) the biological stability of biomass with the Respirometric Dynamic Index (RDI) and Biochemical Methane Potential (BMP).

The experimental tests cover numerous technologies for environmental protection, such as (i) tribo-electrostatic separation, (ii) mechano-chemical, (iii) stabilization/solidification, (iv) soil and sediment washing, (v) reactive capping, (vi) thermal treatments such as pyrolysis, gasification and in-

cineration as well as (vii) biological treatments by means of automated bioreactors.

The environmental monitoring activities concern (i) the measurement of odor emissions by means of an integrated system combining several technologies (already on the market), such as ODOR PREP, ODOR TEL, SENSIGENT MSEM32, and (ii) a real-time monitoring of fine particles through the Optical Particle Counter (OPC) system.

The laboratory also has an impressive experimental platform located in the Taranto wastewater treatment plant over an area of about 500 m<sup>2</sup>. The Pilot Technology Platform includes the following pilot-scale equipment: (1) 1 t/h stabilization/solidification; (2) 1 t/h soil washing; (3) 0.5 t/h ultra-grinding; (4) 10 kg/h pyrolysis.

### Some projects:

**2021 - to date:** “SWAP - Sustainable solid WASTE management and Policies”, funded by UE under the framework Call for Proposals 2020 - EAC-AO2-2019-CBHE - CBHE-JP - Capacity Building in higher education;

**2019 - to date:** “MultiFunctional polymer composites based on groWn matERials (MI-FLOWER)”, funded by MIUR under the framework PRIN 2017;

**2022 - to date:** “Joint technologies for WEEE-cycle closure” funded by Italian Ministry of the Environment;

**2023 - to date:** “Sustainable technologies for the circular management of beach litter” funded by Italian Ministry of the Environment;

**2015 - 2017:** “Activities for the implementation of interventions for the reclamation and requalifica-

## Environmental Technologies Laboratory (ETL)

tion of the Mar Piccolo of Taranto” signed in December 2014 between the Polytechnic Università di Bari and the Extraordinary Commissioner for the urgent reclamation and requalification interventions of Taranto;

**2023 - to date:** “Agreement for the remediation of Brindisi national interest site” funded by ASSET Puglia.

### Collaborations with companies and institutions:

Typically, research activities are conducted at pilot/ industrial scale by means of appropriate collaboration with public institutions as well as major industry players, among which:

- Acquedotto Pugliese SpA
- AMIU Puglia SpA
- AMIU Taranto SpA
- Appia Energy Srl
- ARPA Puglia
- ASECO SpA
- ASSET Puglia
- CAL.ME. SpA
- CISA SpA
- CNR
- Comune di Bari
- Comune di Presicce
- Comune di Taranto
- Eco.Impresa Srl
- ENEL Produzione SpA
- ENI SpA

- Ferramenta Pugliese Snc
- ILVA Amministrazione Straordinaria SpA
- IRIGOM SpA
- ISPRA
- Italcave SpA
- Manduria Ambiente SpA
- Progetto Ambiente Bacino Lecce Due Surl
- Progetto Ambiente Bacino Lecce Tre Surl
- Progetto Gestione Bacino Bari Cinque Srl
- Regione Puglia
- SJS Engineering srl

### Contact person

Michele Notarnicola  
michele.notarnicola@poliba.it

### Competencies and research activities

Advanced research in the hydromechanics of soils and rocks has been carried out in the geotechnical laboratory GEOTECH@Poliba, since more than forty years ago. The research activities addressed to the fundamental characterization of the laws of mechanical and hydraulic behaviour of natural and reconstituted soils have been carried out in the laboratory thanks to the presence of apparatus and instruments which have been further developed with time according to the most advanced testing standards across the international geotechnical research community.

GEOTECH@Poliba includes both the experimental laboratory in Bari and one in Taranto headquarters of Politecnico di Bari. Both the laboratories include an area for the soil characterization performed through the measurement of geotechnical index properties of soils and the indexes of the soil state as well as the carbonate and organic content of the materials. The apparatus and the equipment present in both the laboratories allow the performance of element test on geomaterials specimens of variable sizes under either stress controlled or strain controlled.

In several of the apparatus the specimens are tested under axisymmetric loading and deformation conditions (n°6 triaxial apparatus; n°3 stress-path apparatus; n°20 oedometers and consolidometers cells); however, the laboratory is also equipped for tests under plain strain conditions (n°4 direct shear boxes, n°2 Bromhead ring shear). All the apparatus for the mechanical testing allows to reach medium to high pressures (maximum capacity of the stress

path apparatus 10Mpa; maximum capacity of the oedometer apparatus 20Mpa), in order to investigate the soil behaviour, from the low to the high pressures which may cause the evolution in the soil microstructure affecting the material hardening rules. Given the hydromechanical coupling in soils all the apparatus for the mechanical testing are also equipped with systems for the control and the monitoring of the pressure and the volume of the water present in soil pores.

The "stress-path" apparatus are also equipped with instrumentation for the measurement of the shear stiffness at very small strains (in the elastic range), such instrumentation includes local strain gauges and bender elements. Recently the laboratory has been extended for the performance of research specifically addressed to the characterization of the hydromechanical behaviour of partially saturated soils on one side and of the hydro-mechanical behaviour of contaminated soils on the other. For the partially saturated soils the laboratory is equipped with advanced apparatus for the measurement and the control of matric suction in soils and the characterization of the soil retention properties and hydraulic conductivity function.

A hall of the laboratory has been devoted to the characterization of contaminated soils and to this purpose it's equipped with chemical hoods for safe handling of such materials and also oedometer cells and triaxial pedestals designed against the corrosion caused by soil contaminants. Most of the testing system are either designed in house or assembled according to research purposes.

### Running Projects:

**2023 - 2028** Progetto europeo LIFE-2022-SAP-ENV. Titolo del progetto: GREENLIFE4SEAS: GREEn ENgineering solutions: a new LIFE for SEdiments And Shells. Partenariato: 9 partners europei tra Università, Enti di ricerca, Istituzioni pubbliche e imprese specializzate in trattamenti dei terreni. Ruolo nel progetto: Principal Investigator del progetto. Budget di progetto: € 3 930 225, 56.

**2023 -2024** - Avviso pubblico Regione Puglia, n. 3/ FSE/2021 "RIPARTI: assegni di Ricerca per riPARTire con le Imprese", POC Puglia 2014-2020, rivolto alla selezione delle Università pubbliche e private riconosciute dall'ordinamento nazionale aventi sede legale in Puglia e degli Enti Pubblici di ricerca, di cui all'art. 22 della L. 240/2010, aventi sede amministrativa o operativa nel territorio regionale pugliese, per il finanziamento di Assegni di ricerca finalizzati all'innovazione delle imprese private pugliesi (Bollettino Ufficiale della Regione Puglia n. 135 del 29-10-2021). La ricerca dal titolo: SMART-SEAS Sustainable MAterials by Recycling and Treating SEdiments And Shells è stata ammessa al finanziamento sulla base di bando competitivo con revisione tra pari per il finanziamento di 18 mesi di un assegno di ricerca professionalizzante (circa € 35.000). Responsabile scientifico per il Politecnico di Bari.

**2024 – 2026.** PI nel Progetto PRIN 2022 PNRR dal titolo "S.I.S.M.A. - Seismically induced slope movements acceleration" (totale € 240.000).

**2022 – 2026.** PNRR – M4C2: Centro Nazionale HPC, Big Data & Quantum Computing. Spoke 5: Environment & Natural Disasters. Spoke Leader: Università degli Studi di Bari. Responsabile Scientifico per l’Affiliato Politecnico di Bari allo Spoke: ssa Federica Cotecchia. Affiliati allo Spoke: 8 partner

nazionali tra enti di ricerca e università. Politecnico di Bari è leader del Work Package 5: "Multi-hazard estimation of engineering and geophysical parameters and losses", e co-leader del Work Package 3 "Modelling of disaster-inducing processes". Budget dello Spoke 5 allocato al Politecnico di Bari: €889,556.25.

**2023 – 2026** Progetto finanziato su "Fondi di Innovazione" del Centro Nazionale HPC, Big Data & Quantum Computing. Titolo progetto: "HaMMon: Hazard Mapping and vulnerability". Spoke proponente: Spoke 3: "Astrophysics & Cosmos Observations"; Leading Partner: UnipolSai Assicurazioni S.p.A. 15 partner tra enti di ricerca, università e aziende. Politecnico di Bari è leader del Work Package 5: "Assess future evolution of risk related to slow-moving landslides due to evolving climate Provide vulnerability assessment criteria for damage induced on structures by slow- moving landslides. Assessment of seismic fragility and losses for the building stock". Budget allocato al Politecnico di Bari: €57,500.

**2023 – 2026** Progetto finanziato su "Fondi di Innovazione" del Centro Nazionale HPC, Big Data & Quantum Computing. Titolo progetto: "Weather4Energy". Spoke proponente: Spoke 0: "Supercomputing Cloud Infrastructure"; Leading Partner: Illumia. 9 partner tra enti di ricerca, università e aziende. Politecnico di Bari partecipa al Work Package 5: "Modelling of high temperature & hydrogeological events in terms of correlation between triggering weather variables and expected phenomenon". Budget allocato al Politecnico di Bari: € 57,500.

**2023 – 2026** Progetto finanziato su "Fondi di Innovazione" del Centro Nazionale HPC, Big Data & Quantum Computing. Titolo progetto: "Weath-



## Geotechnical Engineering Laboratory

er4Energy". Spoke proponente: Spoke 0: "Supercomputing Cloud Infrastructure"; Leading Partner: Illumia. 9 partner tra enti di ricerca, università e aziende. Politecnico di Bari partecipa al Work Package 5: "Modelling of high temperature & hydrogeological events in terms of correlation between triggering weather variables and expected phenomenon". Budget allocato al Politecnico di Bari: € 57,500.

### Collaborations with companies and institutions:

- Italcementi-Heidelberg Group.
- Commissario Straordinario per gli interventi urgenti di bonifica, ambientalizzazione e riqualificazione di Taranto.
- Italian University Ministry with Research Projects of National Interest.
- National Research Council (CNR).
- Regional Agency for Environment Prevention and Protection - Apulia Region.
- Imperial College London.
- City University of London.
- Newcastle University.
- University of Cambridge.
- University Strathclyde Glasgow.
- Delft University of Technology.
- UPC. Universitat Politècnica de Catalunya.
- Université Grenoble-Alpes.
- ETH Zurich.
- University of Malta.
- Friedrich-Alexander-Universität-Erlangen-Nürnberg - Institute for Multiscale Simulation.
- City University of Hong Kong - Department of Architecture & Civil Engineering.
- Lund University (Sweden).
- University of West Attica.

### Contact person

Federica Cotecchia  
federica.cotecchia@poliba.it

### Competencies and research activities

The Laboratory of Hydraulics and Hydraulic Constructions has a surface area of approximately 2,000 m<sup>2</sup>, to which support units are annexed: mechanical laboratory, electrical-electronic laboratory, data acquisition, calculation and processing sections, and image restitution and processing.

The laboratory's power supply circuit consists of two underground, intercommunicating tanks, a pumping station divided into two lines that feed a two-level hanging reservoir from which the same number of loop networks, arranged around the perimeter of the laboratory with central shunts, depart.

The network of collection channels, which flanks the distribution network, ends in the underground tanks. Therefore, the laboratory has two separate supply circuits originating from the reservoir tanks, in which a weir system ensures a constant level: the low-pressure circuit, with a maximum flow rate of about 350 l/s and a head load of approximately 8 m and the high-pressure circuit, with a maximum flow rate of about 150 l/s and a head load of 17 m. A booster circuit is connected to the low-pressure circuit, allowing it to operate with a maximum head of 90 m and a maximum flow rate of 90 l/s.

Furthermore, the laboratory has calibration tanks for volumetric measurements of significant flow rates. Among the equipment of particular interest are the variable-slope channel 0.8 m wide and 30 m long with a variable inclination between 0° and 12° that allows the study of rapid currents; the 350 m long DN 50 equipment test circuit for the study of cavitation and the control of varied motion phenomena with a capacity of 10 l/s and 500 kPa head the valve test circuit with a capacity of 90 l/s and

900 kPa of head that feeds two parallel lines of DN 100 and DN 200 for the study of cavitation phenomena in control and regulating organs; Physical model for hydraulics behavior of dam intake, discharge, power pipelines and turbines in Hydroelectric plants, equipped with flow - pressure - vibration meter and transducers; the laser anemometer capable of measuring two velocity components in backscatter mode and a laser blade with a power of 5 watts.

The activities carried out by the Laboratory of Hydraulics and Hydraulic Constructions concern research, teaching, and consulting in Hydraulic Engineering. The teaching activity supports the lessons in hydraulics, hydrology, and hydraulic and maritime constructions taught in the civil and environmental engineering, PhD, and master's courses at the Politecnico di Bari.

Research activities are performed through the development and implementation of physical and mathematical modelling (both theoretical and numerical), also in collaboration with other national and international researchers.

In addition to the equipment and installations already in the laboratory and the laboratory's power supply network, temporary experimental equipment for specific objectives is designed and implemented as required. This equipment can also be used at other laboratories.

The laboratory has all the necessary instruments for measuring and processing the main hydraulic parameters of interest (levels, pressures, velocities, and flow rates).

## Hydraulics and Hydraulic Construction Laboratory (H&HC)

### Collaborations with companies and institutions:

- Acquedotto Pugliese S.p.A. (AQP)
- Regione Puglia
- Riva Calzoni S.p.A.
- F. Nencini S.r.l.

### Contact person:

Alberto Ferruccio Piccinni  
albertoferruccio.piccinni@poliba.it

### Competencies and research activities

The MoDir Laboratory is a specialized facility dedicated to advanced research in the areas of Earthquake Engineering, Structural Modeling, analysis and Design, with particular reference to the seismic safety of the existing urban building stock, specialized and strategic structures (schools, hospitals); industrial facilities (silos); critical infrastructures (bridges, viaducts) and to related intervention and retrofitting activities (ND diagnostics, Structural Health Monitoring, modeling analysis, design). Research activities and applications are carried out both at the territorial scale and at the detailed scale of the individual building converge in the laboratory.

The laboratory, located in the “Ernesto Quagliariello” Campus of the Polytechnic Università di Bari, at the 1st floor of the Department Dicatech, in the section “Earthquake and Structural Engineering”, is a supporting infrastructure for both numerical and computational research and applications, as well as for nondestructive diagnostics and structural monitoring, thanks to the equipment of hardware, specialized software, and field equipment for in situ nondestructive diagnostics.

As part of the laboratory’s activities and services, MoDir offers a wide range of scientific-specialist services, ranging from numerical to practical activities. As part of national research projects, such as the “ReLuis” project, the laboratory offers scientific products based on extensive numerical, linear and nonlinear modeling and analysis activities for reinforced concrete and masonry structures and infrastructures, with the ultimate goal of providing research products that can serve as innovations for current technical construction standards. Within several research contracts and projects, the laboratory develops “large-scale” seismic risk and

vulnerability assessment methodologies and applications, preparing ad hoc survey sheets, which are followed by on-site inspections with related metric-photographic surveys and interviews with local technical experts. The modeling work required can vary depending on the degree of accuracy required, involving computational burdens that are not always simply manageable.

This is the case, for example, with modeling of urban building aggregates, which involves extremely detailed numerical modeling and analysis at an onerous computational cost. Alongside modeling and analysis activities, the MoDir laboratory is at the forefront of technical and scientific activities such as monitoring of existing structures and infrastructure subject to different environmental conditions. In particular, comprehensive support is provided to structural monitoring activities, starting from the analysis of case studies to the definition of the most suitable monitoring system, to support in the installation of the necessary instrumentation (accelerometers, acquisition unit), all the way to the analysis and processing of outputs.

Remaining in the field of monitoring existing infrastructure, an additional technical and scientific activity proposed by the MoDir laboratory is that characterizing the study of risk related to strategic infrastructure and especially to existing bridges and viaducts, as well as an extremely relevant issue.

In the last few months, the researchers and faculty staff are involved in the inspection of existing bridges and viaducts in Italy and in the application of the multi-level procedures for the prioritization, safety assessment and management of the new National Guidelines.

## Laboratory for Modeling, Diagnostics and structural inteRventions (MoDiR)

Finally, mention should be made of the laboratory's activities in technical and scientific support in all stages of structural and seismic vulnerability analyses of real cases of existing buildings, from the preliminary activities aimed at the knowledge of structural aspects and interfering risks (geological-geotechnical and hydraulic), to the definition of investigation and site testing plans, to the elaboration of modeling, vulnerability analysis and design of intervention strategies.

The laboratory includes mobile-type equipment for nondestructive structural diagnostics in the field, with particular reference to the estimation of in-situ mechanical properties of structural materials and the monitoring of cracking patterns, hardware equipment and specialist software for advanced structural analysis and modeling: n. 3 workstations for numerical processing and data storage; FEM and numerical computing software: SAP2000 nonlinear, Matlab, 3Muri, Por2000, Edisys, 3DEC, QGis, CDS; HP plotter; Sonic system for masonry investigations; Modular rigid endoscope; LPA data acquisition control unit for monitoring crack paintings complete with sensors and cables; Mechanical deformometer; Rebound Hammer; Ultrasonic detection unit "Sirio"; Pacometer for surveying reinforcing bars; CANIN corrosion potential mapping device; Laser distance meters.

### Collaborations with companies and institutions:

- CNR – STIIMA Institute of Intelligent Industrial Systems and Technologies for Advanced Manufacturing (Cnr, Istituto di Sistemi e Tecnologie Industriali Intelligenti per il Manifatturiero Avanzato)
- Fuzhou University-College of Civil Engineering, Fuzhou-China
- Loughborough University- School of Architecture, Building and Civil Engineering, Loughborough, UK
- National Technical University of Athens, School of Civil Engineering, Athens, Greece
- Politecnico di Milano - Department of Architecture, Built Environment and Construction Engineering, Milan, Italy
- Politecnico di Torino - Department of Structural, Geotechnical and Building Engineering (DISEG)
- RWTH Aachen University - Chair of Structural Analysis and Dynamics, Aachen, Germany
- Sapienza Università di Rome-Department of Structural Engineering and Geotechnics
- UCL Institute for Risk and Disaster Reduction, London, UK
- UCL Civil, Environmental and Geomatic Engineering, London, UK
- Universidade do Porto - FEUP - Faculdade de Engenharia, Porto, Portugal
- Università degli Studi di Modena e Reggio Emilia - DIEF, Department of Engineering "Enzo Ferrari" Modena, Italy
- Universitat Politècnica de València - ICITECH, Valencia, Spain
- University of Bath - Department of Architecture & Civil Engineering, Bath, United Kingdom
- Università di Calabria - Department of Computer Engineering, Modeling, Electronics and Systems; Department of Civil Engineering, Rende, Italy
- University of Cantabria - Civil Engineering School, Structural Engineering & Mechanics Dept.,

## Laboratory for Modeling, Diagnostics and structural inteRventions (MoDiR)

- Santander, Spain
- Università di Camerino - SAAD Department, Ascoli Piceno, Italy
- Università di Chieti-Pescara G. d'Annunzio - Department of Engineering and Geology, Pescara, Italy
- University of Dundee - School of Science and Engineering, Dundee, Scotland,
- Università di L'Aquila - Department of Civil, Construction-Architectural and Environmental Engineering, L'Aquila, Italy
- University of Minho, ISE, ARISE, Department of Civil Engineering, Guimarães, Portugal
- University of Novi Sad - Faculty of Technical Sciences, Novi Sad, Serbia
- Università di Roma Tre, Department of Architecture, Rome, Italy
- Università del Salento - Department of Engineering for Innovation
- Università di Salerno - Department of Civil Engineering
- University of Surrey - Department of Civil and Engineering, Guildford, United Kingdom
- University School for Advanced Studies IUSS Pavia, Pavia, Italy
- Aleandri SRL, General Construction Company, Italy
- Anas SRL, Italy
- Astm Group, Italy
- Autorità di Bacino della Regione Puglia (Autorità di bacino distrettuale dell'Appennino Meridionale)
- Fabre Consortium (Research consortium for the evaluation and monitoring of bridges, viaducts, and other structures)
- Reluis Consortium (Consortium of the Network of University Laboratories of Earthquake and Structural Engineering)
- Ministero della Cultura – Segretariato regionale per la Puglia
- Municipality of Brindisi (Puglia, Italy)
- Municipality of Panni (BR, Puglia, Italy)
- Municipality of Bisceglie (BAT, Puglia, Italy)
- PLANETEK ITALIA s.r.l., Bari, Italy
- Port Network Authority of the Southern Adriatic Coast Italy
- Regione Puglia (Assessorato per il Diritto allo Studio)
- Mercatorum University
- Barcelona Official Chamber of Commerce, Industry, Services and Navigation (Catalunia)
- Association of the Mediterranean Chambers of Commerce and Industry (Catalunia)
- Jordan Inbound Tour Operators Association (Jordan)
- Rene Moawad Foundation (Lebanon)
- The Royal Society for the Conservation of Nature (Jordan)
- WWF Mediterranean North Africa (Tunisia)
- Regione Autonoma della Sardegna
- University of Reading (UK)
- MODUL University (Vienna)

- University of Banat-Timisoara (Romania)
- UNWE Sofia (Bulgaria).
- Università di Bari Aldo Moro
- Università della Basilicata

### Active Research Programs

**PRIN 2022 PNRR** "Artificial Intelligence for ENVIRONMENTAL impact minimization of SEISMIC Retrofitting of Structures (AI-ENVISERS)"

**Research Contract with Municipality of Brindisi:** "Scientific support to the path of knowledge, investigation and definition of modeling strategies, analysis, verification and design of interventions for the building "Ex-Ministry of Finance" located in the City of Brindisi"

**Research Project Reluis-DPC 2022-2024.** UR Politecnico di Bari-Dicotech. WP2: Inventory of existing structural and building types – CARTIS; WP11: Regulatory Contributions Related to Existing Reinforced Concrete Buildings

**Research Contract with FABRE Consortium:** "Technical and scientific support for the evaluation of the inspection methodology currently used by Anas; development of the methodology for carrying out the census, initial inspections and identification of Attention Classes; development of a methodology for the prioritization of level 4 assessment and intervention operations for works characterized by High Attention Class; verification of the quality and homogeneity of the results for L0-L1-L2 level assessments, analysis and systematization of the collected data, definition of the criteria for the knowledge of the works and for the assessment of L4 safety."

**Research Contract with FABRE Consortium:** "Technical and scientific support for the development of the methodology for the inventory, inspections and identification of Warning Classes of a sample of bridges and viaducts managed by Anas Spa; prioritization of level 4 assessment operations; verification of the quality and homogeneity of results"

**Research Contract with FABRE Consortium:** "Technical and scientific support for the application of the guidelines of the Superior Council of Public Works for risk classification and management, safety assessment and monitoring of existing bridges operated by the concessionary subsidiaries of the ASTM S.p.A. Group."

**Agreement with FABRE Consortium:** "Risk assessment, safety verification, control, surveillance and monitoring of bridges, viaducts and existing works of road and rail infrastructure, with reference to both operational actions and natural phenomena."

**Research Contract with Municipality of Panni (FG):** "Scientific support to the knowledge of typological, structural and constructive characters of residential construction in the municipality of Panni and mapping and analysis of structural and seismic vulnerability".

**Research Contract with Port Network Authority of the Southern Adriatic Coast Italy:** "Dynamic characterization and structural monitoring activities aimed at controlling the effects of ordinary and extraordinary environmental vibrations in the Marisabella area on the building Former Passenger Maritime Station - FF.SS."

**People:**

**Giuseppina Uva,**  
PO, Icar/09-Tecnica delle Costruzioni

**Rita Greco,**  
PA, Icar/09-Tecnica delle Costruzioni

**Mariella Diaferio,**  
PA, Icar/09-Tecnica delle Costruzioni

**Saverio Spadea,**  
PA, Icar/09-Tecnica delle Costruzioni

**Sergio Ruggieri,**  
RTDa, Icar/09-Tecnica delle Costruzioni

**Contact persons**

Giuseppina Uva  
giuseppina.uva@poliba.it  
tel 0805963832

Sergio Ruggieri  
sergio.ruggieri@poliba.it



### Competencies and research activities

The LabSoMat is located in the Campus of the Polytechnic Università di Bari. The research activities are based on the group's experience in the field of applied mathematics and solid mechanics with an emphasis on polymeric, bio-polymeric and smart materials (such as shape memory alloys and electro-active polymers). These activities are related to the description and analysis of the thermo-chemo-mechanical behavior of both multi-stable and elasto-fragile materials, typically hierarchical, and applications in the engineering and biomedical fields.

More in detail, the research focuses on the validation of models and characterization of materials that exhibit phenomena such as

- conformational and phase changes induced by multi-stability at the micro-scale (such as in the case of unfolding of macromolecules);
- adhesion/detachment processes and interaction and analysis of the interaction of thin layers with substrates;
- nucleation and propagation of defects with generation of interfaces at the macroscales;
- macroscopic mechanical effects induced by temperature (e.g. in the case of the thermo-mechanical response of biopolymers or modification of crack propagation induced by thermal effects).

These activities allow for the deduction of predictive multiscale models for existing materials and to attain instruments in the field of new materials design (bio-inspired and metamaterials).

The laboratory equipment consists of a biaxial machine for mechanical tests on materials (including

biological and bioinspired) with cells that allow a load with forces from 1 N up to 1000 N. This machine is used to validate models developed for the study and prediction of material properties (e.g., hysteresis, multistability, macroscopic effects of microstructure, residual stretches) and obtain stress-strain diagrams at different rates.

The machine is composed of four motorized linear units, each including controller, actuator and load cell. The machine includes a software for the control of the linear units, the acquisition of test data and pictures through a camera. The tests are in force or displacement control on specimens up to 100x100x10 mm. The maximum stroke is 400 mm per axis, and speed range is from 0.005 mm/s to 5 mm/s. The system is also equipped with Digital Image Correlation software to obtain displacements and deformations.

The instrumentation has been acquired using funds available in several projects related to multidisciplinary topics in the area of modelling and characterization of innovative materials and structures that can combine versatility and performance with the ultimate goal of optimizing the use of resources and improving the sustainability of technological solutions.

The laboratory is also acquiring new instrumentations:

1. a (low forces) biaxial machine with temperature and humidity control and the possibility of tests under controlled physiological conditions;
2. a machine for single-axial testing of biological materials (e.g., natural or artificial spider silks) with control of temperature conditions up to 50°C and humidity up to 95%RH and 0.5N load cells. Such parameters can drastically influence

and change the elasticity, fracture, and hysteresis properties of materials (e.g., modification of Maxwell stress, the maximum force required to achieve detachment from surfaces).

**Contact Person**

Giuseppe Puglisi  
giuseppe.puglisi@poliba.it

**Funded research projects:**

**PRIN 2017** (Mathematics of active materials: From mechanobiology to smart devices)

**PRIN 2017** (Multiscale Innovative Materials and Structures)

**PRIN 2022** (Innovative mathematical models for soft matter and hierarchical materials)

**PRIN 2022** (Mathematical Modelling of Heterogeneous Systems)

**PRIN 2022** PNRR (Innovative multiscale approaches, possibly based on Fractional Calculus, for the effective constitutive modeling of cell mechanics, engineered tissues, and metamaterials in Biomedicine and related fields)

**PRIN 2022** PNRR (Innovative mathematical modelling for cell mechanics: global approach from micro-scale models to experimental validation integrated by reinforcement learning)

**Companies and Institutions**

- Università di Napoli "Federico II" ( M. Fraldi),
- Università di Trento ( N. M. Pugno),
- Università di Perugia ( G. Saccomandi),
- Oxford University ( A. Goriely),
- Massachusetts Institute of Technology ( M. J. Buehler),
- Univ. Lille, CNRS, Centrale Lille ( S. Giordano)

### Competencies and research activities

The Architectural and Urban Modelling Laboratory (MAULab) of DICATECH, promotes and coordinates scientific research in the field of Survey and Representation of Architecture, Monuments, Natural and Urbanised Environment, with digital techniques, offering itself as an institutionally operating subject in the field of scientific research and studies in the specific field of digital 3D Modelling of buildings for Virtual, Augmented and Mixed Reality (VR/AR/MR) even within BIM and HBIM processes.

### Project:

Specialist technical consultancy concerning the preparation of studies and analyses aimed at drafting amendments to the municipal regulations for the occupation of public land. (Municipality of Ruvo di Puglia) Research projects called POLIBIM POLIMAP. (Heritage Office of the Polytechnic of Bari) Innovative techniques for the survey and architectural representation applied to the knowledge process of a historical building: Starita Palace in Bari.

Design and delivery of training courses aimed at the understanding of design, analysis and verification methodologies in BIM environment.

### Facilities

LaserScanner FARO 3D 120; Geomax Zoom 3D; 3D Eye 2.0; DJI Spark drone; Manfrotto 360 VR; VR Oculus Rift; CGraphics Workstation. Municipality of Bari

### ERC classification

- PE8\_3 Civil engineering, architecture, maritime/hydraulic engineering, geotechnics, waste treat-

ment;

- PE8 Products and Processes Engineering

### Companies and Institutions

- Departamento De Arquitectura-Universidad de Zaragoza;
- Asset-Apulia Region;
- Arca Capitanata - Regional Agency for housing and living;
- Municipality of Ruvo di Puglia (BA);
- Municipality of Cisternino (BR);
- Municipality of Trinitapoli (BAT);
- Graitec s.r.l.;
- ICMQ s.p.a. Geomax (3D measuring systems).

### Contact Person

Cesare Verdoscia  
cesare.verdoscia@poliba.it

### Competencies and research activities

The Laboratory of Building Technologies is involved in lab and onsite activities concerning performance assessment of construction components, identification of building pathologies, indoor monitoring and energy diagnosis of buildings. Specifically, it offers advanced solutions for maintenance, conservation and refurbishment of the built heritage, with specific focus on the safeguard and enhancement of cultural

assets. Main expertise in the fields of: VR/AR digital models and environments for building refurbishment and cultural heritage promotion.

Investigation of materials, decay, crack and damp patterns, particularly for the built heritage, by means of advanced digital diagnostic techniques; Assessment of masonry structures and stone elements by integrated systems of diagnostic tests, including sonic and ultrasonic testing, single and double flatjacks, bore-hole drilling, reconstruction of stratigraphy, water-content measurements, video-endoscopy, qualitative active and passive thermography, high frequency radar scanning for 3D tomography; Assessment of vaults and slabs by integrated systems of diagnostic tests, including visual inspection, video-endoscopy, radar scanning, magnetometric testing, ultrasonic testing, qualitative active and passive thermography, bore-hole drilling,

reconstruction of stratigraphy; Investigation and assessment of underground structures, foundations and anthropic caves by radar scanning at different frequencies and digital reconstruction of stratigraphy and/or 3D tomography; Assessment of reinforced concrete structural elements by integrated systems of diagnostic tests, includ-

ing rebound-hammer testing, ultrasonic testing, SonReb correlation technique for estimating the onsite mechanical resistance, assessment of the concrete carbonation, measurements of the corrosion potential in the rebars, magnetometric testing; Assessment of timber elements by integrated systems of diagnostic tests, including resistograph techniques, ultrasonic testing, high frequency radar scanning, visual inspection; Analysis of energy performances of building components, including thermographic radiometric mapping, onsite thermal transmittance measurement, advanced modelling for dynamic simulations; Indoor microclimate monitoring by measurement of relevant environmental parameters, including air temperature, relative humidity, radiant temperature and velocity, as well as heat flux, surface temperature and lightening; Measurement, monitoring and analysis of deformations, cracks and vibrations by multi-sensors reading units, including strain gauges, electric extensometers, LVDT, seismic accelerometers, advanced modelling for dynamic simulations.

### Some funded research projects:

3D-IMP-ACT - Virtual reality and 3D experiences to IMProve territorial Attractiveness, Cultural heritage smart management and Touristic development" (Interreg Italy- Albania-Montenegro 2018);

"VERBuM - Virtual Enhanced Reality for Building Modelling" (Apulia Region INNONETWORK 2018)

"BeS2ECURE- Built Environment Safer in Slow and Emergency Conditions through behavioural assessed/designed Resilient solutions" (PRIN 2017)

"Contactless diagnostic system by augmented reality for buildings with high cultural value and low accessibility" (MIUR "Start Up" 2014);

"Methodological framework for assessment of energy behavior of historic towns in Mediterranean climate" (Fondazione Cassa di Risparmio di Puglia 2013);

"Assessment of the state of conservation of traditional architectures by innovative approaches for 'knowledge' management" (Poliba FRA 2012);

"Innovative solutions for energy efficiency and micro-generation of the existing building stock. The case of Mediterranean historic towns" (PRIN 2009);

"HPWALLS. High Performance Wall System" (Apulia Region FESR 2007-2013);

"Innovative laser techniques for the restoration of the cultural heritage. The case of Apulia Region" (Apulia Region APQ "Ricerca Scientifica").

- Museum Centre of Puglia
- Polishape3D srl
- Politecnico di Milano
- Polytechnic University of Tirana
- Regione Puglia
- University of Montenegro
- Università degli Studi dell'Aquila
- Università degli studi di Bari Aldo Moro
- Università degli Studi della Basilicata
- Università degli Studi di Catania
- Università Federico II di Napoli

### Collaborations with companies and institutions:

- Agenzia Regionale per la Casa e l'Abitare - Regione Puglia
- BOVIAR srl
- B.Re.D. - Building Refurbishment and Diagnostics srl
- Comune di Bari
- Comune di Putignano
- Comune di Toritto
- Ferramati srl
- Fondazione Cassa di Risparmio di Puglia
- GaribaldiFragasso srl
- Institute of Cultural Monuments "Gani Strazimiri" - Albania
- L.A.Ser.Inn. Scarl

### Contact person

Fabio Fatiguso  
fabio.fatiguso@poliba.it

### Competencies and research activities

The Laboratory of Chemistry (LC) consists of 2 large labs for chemical manipulations; a NMR lab equipped with the NMR Bruker Avance 400 spectrometer; 3 labs equipped with the following main instruments: a GC-MS and two GC-FIDs, a high-resolution mass spectrometer (HRMS) with ESI and APCI interfaces, two HPLC; a FT-IR spectrometer with ATR module; a UV-Vis-NIR spectrometer, a fluorescence spectrometer, a CHNS elemental analyzer; a microwave mineralizer, an AAS spectrometer; two thermogravimetric analyzers (TGA); a differential scanning calorimetry analyzer (DSC); a polarized optical microscope (POM).

The research activities in LC cover several fields of basic chemistry and its related sciences and its main research topics can be summarized in the following points: Innovative syntheses in inorganic chemistry New recyclable heterogenous catalysts for fine chemical syntheses Molecular nanotechnologies for controlled drug delivery Advanced organic materials for electronics, opto-electronics and photonics Food traceability by Nuclear Magnetic Resonance (NMR) Decision Support Systems (DSSs) for food quality and food origin assessment.

### Collaborations with companies and institutions:

- University of Zaragoza
  - LCC CNRS, Laboratoire de Chimie de Coordination, Toulouse
  - Institute for Advanced Studies in Basic Sciences (IASBS), Zanjan
  - Universidad de La Rioja
  - Linköping University, Norrköping, Sweden
  - Johannes Kepler University, Linz, Austria
  - Joanneum Research Forschungsgesellschaft mbH, Weiz, Austria
- Università di Bari - Aldo Moro
  - Università di Modena e Reggio Emilia
  - National Research Council (CNR)
  - Istituto Poligrafico e Zecca dello Stato-SpA (IPZS)
  - Mediterranean Agronomic Institute of Bari (IAMB)

### Contact person

Piero Mastrorilli  
p.mastrorilli@poliba.it

### Competencies and research activities

- The Laboratory of Spatial Cognition and Planning is a strong reference framework for activities related to the disciplines of spatial planning, urban planning and land engineering, toward study and academic research, as well as consultancy and “third mission” i.e., outreach and public engagement.
- It is concerned with analysis, forecasting, evaluation, layout modelling, environmental, territorial, urban relations and transformations, as well as with assisted planning, supported both by multiagent models of spatial cognition and analysis and GIS oriented techniques, and by the use of sensors to monitor environmental and social phenomena. They are activities that allow the construction of possible visions and future scenarios, that are fundamental to support decisions in a perspective of sustainable development and protection of environment and of territorialized relationships.
- The skills acquired in recent years, even in the use of techniques and advanced technology, made it possible to support several National and European research projects (such as JPI Urban Europe, “PRINs”, PON, FAMI), as well as numerous agreements with public and private institutions, municipalities, Apulia Region, park authorities, etc.

### Collaborations with companies and institutions:

- Apulia Region
- Municipalities
- Park Authorities
- National Research Council (CNR) - Laboratory for Applied Ontology (ISTC-Trento)
- National Research Council (CNR) - Institute of Atmospheric pollution Research (IIA)
- Mediterranean Agronomic Institute of Bari (IAMB)

- Politecnico di Milano
- Unioversità La Sapienza di Roma
- Università di Trieste
- University IUAV, Venice
- Università di Bari Aldo Moro
- Università di Foggia
- Università di Napolo - Federico II
- University of Westminster – London
- Università di Salento
- Università di Basilicata
- Università di Cagliari
- Università di Pisa
- Università del Sannio - Benevento
- Free University of Bozen-Bolzano
- Università di Catania
- Università di Trento
- Università di Sassari
- Climate Service Center Germany (GERICS), Helmholtz Zentrum Hereon - Hamburg
- Ricerca sul Sistema Energetico, RSE S.p.A.
- Université Libre de Bruxelles
- Vrije Universiteit, Bruxelles
- Resolia, Bruxelles

### Contact person

Angela Barbanente  
angela.barbanente@poliba.it

**Competencies and research activities**

The Lab carries out research in the field of Regional, Economic and Environmental Sciences. It is therefore a resource of the DICATECH Department (PoliBA) and of the Departments of Economics (UNIFG) and Humanistic Studies. Letters, Cultural Heritage, Education Sciences (UNIFG) for the services offered to the territory and the support for research in the disciplines of spatial planning and environmental engineering. It deals with territorial analysis, evaluation of socio-economic and territorial structures and transformations, using theoretical and applied modeling to the study of interactions between socio-economic and environmental ecosystems.

These activities can support policy makers in the construction of effective local public policies and in complying with community policies in the context of sustainable development and protection of the territory.

LEEReS also carries out professional and academic support and training activities (for example organization of workshops, seminars, summer schools, etc.) in the field of socio-economic and regional, environmental, urban and territorial sciences.

The skills acquired over the last few years have allowed LEEReS to apply for and/or support various regional (Puglia Region, Province of Foggia) and European (for example Interreg) research projects as well as agreements with public and private bodies (Municipalities, Puglia Region Park Authorities, etc).

**Collaborations with companies and institutions:**

- Apulia Region
- Municipalities
- Park Authorities

- Mercatorum University
- Barcelona Official Chamber of Commerce, Industry, Services and Navigation (Catalunia)
- Association of the Mediterranean Chambers of Commerce and Industry (Catalunia)
- Jordan Inbound Tour Operators Association (Jordan)
- Rene Moawad Foundation (Lebanon)
- The Royal Society for the Conservation of Nature (Jordan)
- WWF Mediterranean North Africa (Tunisia)
- Regione Autonoma della Sardegna
- University of Reading (UK)
- MODUL University (Vienna)
- University of Banat-Timisoara (Romania)
- UNWE Sofia (Bulgaria).
- Università di Bari Aldo Moro
- Università della Basilicata

**Contact Person**

Domenico Camarda  
domenico.camarda@poliba.it



**Competencies and research activities**

The laboratory is structured into two different sections: a section on Environmental Geoengineering and a section on Groundwater Hydrology. Regarding the Environmental Geoengineering section, the scientific activity concerns the following topics:- Physical modeling of flow, mass and heat transport in porous and fractured media. Prototyping engineering in order to set up new technologies in environment and energy sectors, providing the activities of design, numerical modeling, prototype manufacturing. Validation and measuring the performance of innovative geothermal technologies.

For the Groundwater Hydrology section, the scientific activity concerns the following topics: numerical modelling of surface and groundwater flow, the response of aquifers to precipitation and climatic forcing. The analysis involves using different methodologies for time series analysis to characterize the system and the hydrological response to climate change. Hydrological balance models are also performed using numerical models for complex aquifers, such as coastal karst aquifers.

**Collaborations with companies and institutions:**

**For the Environmental Geoengineering section:**

- Department of Physics & Earth Sciences, Università di Ferrara (Italy).
- New Energies and Environment Company (NEA), Ferrara (Italy).
- Geo Environmental Energy Technologies Company (GEET), Bari (Italy).
- School of Civil Engineering, University of Queensland, Brisbane (Australia). Institut für Geologie, Mineralogie und Geophysik Arbeitsgruppe Hydrogeologie Ruhr-Universität Bochum (Germany).

nia).

- CEIGRAM, Universidad Politécnica de Madrid - Ciudad Universitaria Madrid (Spain).
- dPELNoT, ERCOFTAC, Instituto Pluridisciplinar, Madrid (Spain).
- Dept. Física Aplicada, Univ. Politecnica de Cataluña, Barcelona (Spain).

**For the Groundwater Hydrology section:**

- EWA-Energy and Water Agency (Malta).
- Soil and Water Resources Institute (SWRI) - Hellenic Agricultural Organisation (HAO), Thessaloniki (Greece).
- Universidad de Almeria at Almeria (Spain).
- Cyprus University of Technology (Cyprus).
- University of Tunis El Manar (Tunisia), la Mersin University at Mersin (Turkey).
- Technische Universität Darmstadt, Darmstadt (Germany).
- Technische Hochschule Lübeck, Lübeck (Germany).
- Centre for Research & Technology Hellas (CERTH), Thessaloniki (Greece).
- Commissario Di Governo per l'emergenza Idrogeologica della Regione Puglia, Bari (Italy).
- CNR IRPI, Bari (Italy).
- Università di Parma, Parma (Italy).
- Università del Sannio, Sannio (Italy).
- SOGESID SpA, (Italy).

**Contact person**

**for Environmental Geoengineering section**  
Concetta Immacolata Giasi  
concettaimmacolata.giasi@poliba.it

**for the Groundwater Hydrology section**  
Gabriella Balacco  
gabriella.balacco@poliba.it

### Competencies and research activities

The Sustainable Road Infrastructure and Testing Materials Laboratory is made up of two sections: the first one dedicated to Testing Materials and the second one to the Sustainable Mobility Research Centre. Since the foundation of the ex-Roads and Transportation Department, later merged into DICATECH, the Testing Material Laboratory has been one of the most distinctive elements of the Polytechnic of Bari, in the field of applied research and for the territory beneficial impact. The second section of the laboratory is intended as relying on the "software" section and "small equipment" for applied research in the Roads, Railways and Airports field. The main operational research topics of this Center are related to the following aspects:

- road safety;
- infrastructures for sustainable mobility;
- extracting relationship between infrastructures and self-driving vehicles.

In the new configuration of the laboratory, the section related to Material Testing will host not only the equipment until now temporarily stored in other areas of the Polytechnic, after appropriate revision and calibration, but also further newly developed equipment which will allow the high profile of the research on infrastructure materials, as well as maintaining competitiveness and attractiveness in the territory.

The section related to the Research Center carries out applied research on road safety, sustainable mobility infrastructures (for which it already provides a valuable research contribution at local, national and international level), and on the impacts of self-driving vehicles on road infrastructures (to represent a national reference point on this topic).

The section dedicated to Material Testing is equipped by numerous instruments to test the properties and quality of road infrastructure materials, i.e. bituminous mixtures and soils, in particular:

- CBR equipment;
- Los Angeles equipment;
- giant Proctor equipment;
- ordinary Proctor equipment;
- load test equipment;
- hydraulic press;
- vacuum test;
- vibrator for sieving with relative sets of sieves/sieves;
- core drill;
- skid testers.

Furthermore, the Research Center relies on the following additional equipment:

- Leica GPS total station for celerimetric surveys;
- n. 12 vehicular speed detectors for long-term investigations and surveys
- a Speed Laser Gun for medium-term investigations and surveys
- a latest generation drone equipped with an HD camera for short-term vehicular trajectories and speed surveys.

### Running Project:

Memorandum of understanding between the Metropolitan Municipality of Bari and the DICATECH of the Polytechnic of Bari: "Preparation of the cognitive framework and the ex-ante, in itinere and ex-post evaluation and monitoring plan of the Sustainable Urban Mobility Plan (SUMP)" - time length: 3,5 years; financing amount: 460 k€

### Collaborations with companies and institutions:

- University of Paris - Gustave Eiffel (France)
- University of Lund (Sweden)
- Università di Bologna - Alma Mater Studiorum
- Regione Puglia
- Metropolitan Municipality of Bari
- Municipality of Bari
- MerMec SpA

### Contact person

Vittorio Ranieri  
vittorio.ranieri@poliba.it

### Competencies and research activities

The Research Platform for Sanitary Engineering and Environmental Monitoring (PRISMA) is a new laboratory located in the “Ernesto Quagliariello” Campus of the Polytechnic Università di Bari.

The laboratory is equipped with different analytical instruments thus allowing the development of many research lines oriented to detailed studies on technical solutions for contaminated environmental matrices remediation and monitoring as well as the preservation and control of the environmental quality. In detail, the laboratory equipment is composed by analytical instruments for compounds determination in gaseous and liquid samples as well as liquid phase extractant solutions from solid matrices acid mineralization.

For gaseous samples, analyses are performed through a GC-TCD to characterize and quantify gaseous compounds such as methane, carbon dioxide, and hydrogen. As for liquid samples, the PRISMA is equipped with an ICP-OES for detection of inorganic pollutants (such as heavy metals and rare earth elements), an IC for determination of cations (such as ammonia, Ca<sup>2+</sup>, Na<sup>+</sup>, and K<sup>+</sup>), a HPLC for determination of organic compounds (such as VFAs), a GC-MS for qualitative and quantitative determination of organic pollutants (such as PAHs and PCBs). The wide number of instruments available allows to focus scientific interests in various application fields of the sanitary and environmental engineering with consequent ongoing researches:

Fermentative processes for the degradation of organic wastes; Advanced oxidation processes for the treatment of recalcitrant pollutants; Kinetic studies on the contaminants mobility in environmental matrices;

Remediation strategies of contaminated solid matrices (soils and sediments); Characterization and monitoring of inorganic and organic pollutants as well as microplastics in marine matrices (marine water and sediments).

In the perspective of a research platform, the activities which can be performed in the PRISMA aim at the achievement of two main purposes, i.e. i) an educational and ii) a technical/professional one. Accounting for the first, the PRISMA offers a wide range of opportunities for MSc and PhD students to carry out research studies for their own thesis fulfillment and deepen their knowledge about the significant aspects of the sanitary engineering. As for the second one, the laboratory establishes a useful research hub for the design and development of projects of national and international interest as well as an interface for the scientific support of Public Authorities in the sanitary and environmental field. The student tutoring and research activities are led by the scientific director of the PRISMA, Danilo Spasiano (Scientific-disciplinary sector: ICAR/03 “Sanitary-environmental engineering”), assisted by researcher and post-doc colleagues with experience in processes and strategies for environmental pollution remediation and monitoring.

### Collaborations with companies and institutions:

- Acquedotto Pugliese S.p.A. (AQP);
- Environmental Surveys s.r.l. (ENSU);
- Veronico s.r.l.;
- E.T.C. Engineering s.r.l.;
- Regione Puglia.
- Università di Naples “Federico II”;

## Research Platform for Sanitary Engineering and Environmental Monitoring (PRISMA)

- Università degli Studi di Cassino e del Lazio Meridionale;
- Università della Basilicata;
- National Salinity Research Center (Iran);
- Istanbul Medeniyet University (Turkey).

### Contact person

Danilo Spasiano  
danilo.spasiano@poliba.it

### Competencies and research activities

The Sustainable Mobility lab is a PNRR funded research infrastructures and is one of the 14 spokes of the network of labs of the Italian National Center for Sustainable Mobility.

The lab has been recently renewed with start-of-the-art research tools and software thanks to the funding of the NextEU program the PNRR Italian plan. The main focus is on the Mobility as a Service (MaaS) and innovative mobility services (spoke 8 as Leader) as well as the CCAM & Smart Infrastructures Topic (as partner of the Spoke 7). Advanced methods and models for the solution of traffic, transportation and logistics are developed. These activities are carried out for both pure research and commissioned studies.

Its activity is devoted to the planning of passengers and freight mobility at the light of Digital and Ecological Transitions focusing on the Equity and Sustainability issues of transportation & mobility.

It is located in Bari at the Dicotech and in Taranto at the "Centro interdipartimentale Taranto Politecnico".

The main activities are the analysis, studies and forecasts on travel demand, Network design problem, evaluation new projects or plans on the transportation system and on the territory, decision support systems in transportation planning, public transport network design, pedestrians evacuation planning, studies on efficiency and quality of transport service, parking studies.

Another expertise of the Lab is about the planning, design, and management of shared mobility systems, with specific focus on bike and kick scooter sharing systems. In this field the lab staff has de-

veloped advanced real-time models for the simulation of micromobility sharing systems (i.e. Big Data Analysis, Machine Learning Technique, etc). In the field of urban logistics, the research is devoted to the optimization of goods delivery by drones and sustainable means of transport. All the solutions are assessed considering equity and social inclusion issues.

The lab is able to carry out surveys on users' choice and traffic counts surveys using both video and

microwaves based systems as well as supporting local government in the transport planning process.

The lab has recently set up a Virtual Reality Module facilities for the simulation and analysis of travel behavior (Cat Walk C2 Simulator, 2 Car Driving simulators, Back pack Augmented Reality Simulator), a MaaS Control Room for traffic simulation and territory data collection and analysis, a Micromobility Floating Sensors Module for the monitoring of real time road infrastructure and environment. A number of drones are also available for traffic and land monitoring.

### Collaborations with companies and institutions:

- A2A
- Vaimoo (gruppo Angels)
- Hitachi Rail
- Lutech AS
- UnipolTech (UnipolSai)
- Autostrade per l'Italia
- ENI
- Centro Nazionale per la Mobilità Sostenibile -

## Sustainable Mobility Lab (SML)

### MOST

- Area Metropolitana Comune di Bari – MaaS4Italy
- Regione Puglia – MaaS per i Territori
- Asset-Regione Puglia
- Puglia Promozione – Regione Puglia
- Distretto Tecnologico Aerospaziale Pugliese
- Comune di Brindisi
- Comune di Palagiano (TA)
- Comune di Cerignola
- Provincia di Taranto
- CIFI
- University of Belgrade
- University of Novi Sad (Serbia)
- University of Cantabria (Spain)
- Università di Padova
- Università di Napoli “Federico II”
- Università di Salerno
- Università Bicocca di Milano
- Università di Cagliari

### Contact person

Michele Ottomanelli  
michele.ottomanelli@poliba.it

Mario Binetti  
mario.binetti@poliba.it



### **LIC - Coastal Engineering Laboratory**

The laboratory occupies a covered area of about 12,500 square meters. It is equipped with state-of-the-art equipment for the survey and acquisition of the main physical quantities of coastal modeling.





# DIF

Department of Physics "Michelangelo Merlin"

### Competencies and research activities

R&D, production and testing of ultra-thin silicon detector for particle physics. The laboratory is equipped with a clean-room (class 10000), a Mitutoyo Crysta APEX 9166 coordinate measuring machine, including an optical system ("optical head") to measure three spatial coordinates, aluminium wedge bonder machines, probe stations with micrometric pass, system for automatic assembly of detector modules, laser machine for micro-bonding.

### Collaborations with companies and institutions

- INFN - Istituto Nazionale di Fisica Nucleare (main partner)
- CERN - The European Organization for Nuclear Research
- IN2P3 - CNRS Centre national de la recherche scientifique
- Institute of Particle Physics, Central China Normal University (CCNU)
- STFC Daresbury Laboratory
- Rutherford Appleton Laboratory
- LBNL, Lawrence Berkeley National Laboratory
- Ukrainian Academy of Sciences, KIPT-KFTI
- Institute of Physics, St. Petersburg State University
- KISTI Korea Institute of Science and Technology Information
- Yonsei University (South Korea)
- Department of Physics - Pusan National University (South Korea)

### Contact person

Giuseppe Eugenio Bruno  
giuseppe.bruno@poliba.it

### Competencies and research activities

The lab is involved in the R&D, production and testing of an ultralight drift chamber as the main tracking device designed to provide efficient tracking, high precision momentum measurement and excellent particle identification. The activity is supported by the future collider program at INFN, CERN and IHEP, along the path defined by the European Strategy for Particle Physics.

Drift chambers prototypes are gas detector designed to cope with high transparency, in terms of radiation lengths, obtained by using a novel approach adopted for the wiring and assembly procedures. Particle identification capabilities are reached by using a cluster counting technique, expected to provide a two-times better particle separation with respect to the traditional method based on energy loss per unit length.

The lab is equipped with instrumentation for powering gas detectors, with gas supply unit and monitoring station, with a soldering station and a wiring machine, with a laser alignment setup and with computers for mechanical design and data analysis.

### Collaborations with companies and institutions

- INFN Bari and Lecce - Istituto Nazionale di Fisica Nucleare (main partner)
- CERN - The European Organization for Nuclear Research IN2P3
- CNRS - Centre national de la recherche scientifique
- IHEP China and several other Chinese institutes

### Contact person

Nicola De Filippis  
nicola.defilippis@poliba.it

Francesco Procacci  
f.procacci@phd.poliba.it

### Competencies and research activities

The lab is involved in R&D and production of advanced gaseous detectors using MPDG-GEM and RPC technologies for particle physics experiments at CERN (CMS, LHCb upgrade) and for medical (beam monitoring of proton and ion beams at hadron therapy and fast timing detectors for TOF-PET diagnostics) and homeland security applications (environmental radiation monitoring, fire detection and muon radiography). The Lab is currently involved in a large production of triple GEM detectors for the upgrade of the CMS experiment, in the design and prototyping of RPC systems with large-area gas gaps for the upgrade of the LHCb experiment and in R&D of new environmental friendly gas mixtures for RPC detectors. Furthermore, it is involved in the development of innovative MPDG and RPC detectors for fast time resolution and high rate capability.

### The lab is equipped with:

- Mitutoyo for precise coordinate measurement, Gas box to dry polyimide foils and high-resolution power supply; multiple gas lines (Ar:CO<sub>2</sub> mix, Ar, CO<sub>2</sub>, N<sub>2</sub>...), HV and LV, gas leak stand;
- Amptek Mini-X : X-ray gun in shielding box for testing large size detectors (~1 square meter) with analog readout up to 4000 readout channels;
- Optical table in dark box with UV laser for testing small size prototypes; Cosmic ray telescope for RPC test up to 12 tracking detectors; Preamplifiers and NIM and VME electronics for signal processing;
- Pico- and femto- amperometers for precise current and charge measurements.
- Access to class 10,000 clean room, class 1000 areas for detector assembly.

### Collaborations with companies and institutions

- In partnership with Istituto Nazionale di Fisica Nucleare
- High Energy Physics experiments at CERN: CMS, LHCb
- R&D collaboration "DRD1" at CERN for the development of Micro-Pattern Gaseous Detectors, with guaranteed access to CERN Micro Pattern Technologies (MPT) and PCB workshops
- International collaborations with Florida Institute of Technology (FIT, USA), RWT Aachen (DE), UGent (BE), Roma Tor Vergata (IT), LNF Frascati (IT), CERN (CH), State Key Laboratory of Solid Lubrication at LICP (CN), State Key Laboratory of Particle Detection and Electronics at USTC (CN), Korea Detector Lab (KODEL) of the University of Korea (KR) Collaborations with PCB and Technology-Transfer companies such as ELTOS, SITAEL, TECHTRA, ITEL, MICROLABEN, CAEN.

### Contact person

Anna Colaleo  
anna.colaleo@uniba.it

Alessandra Pastore  
alessandra.pastore@ba.infn.it

Gabriella Pugliese  
gabriella.pugliese@poliba.it

Rosamaria Venditti  
rosamaria.venditti@uniba.it

Piet Verwilligen  
piet.verwilligen@ba.infn.it

## High Energy photosensors and electronics for space-born and ground-based experiments Laboratory

### Competencies and research activities

In partnership with Istituto Nazionale di Fisica Nucleare, High Energy astroparticle experiments involved: FERMI, CTA, MAGIC. This laboratory is addressed to the development and characterization of innovative sensors for high energy physics, ground-based or space born experiments. The laboratory is equipped with lasers (from NUV to FIR), very precise timing, DAQ systems, using Silicon photomultiplier and PMTs. We perform the characterization of different sensors with electronic solutions for frontend and readout.

### Collaborations with companies and institutions

- Istituto Nazionale di Fisica Nucleare
- Fondazione Bruno Kessler (FBK)
- CAEN
- SITAEL

#### Contact person

Elisabetta Bissaldi  
elisabetta.bissaldi@poliba.it

Nicola Giglietto  
nicola.giglietto@poliba.it

Serena Loporchio  
serena.loporchio@poliba.it

## Laboratory for ultra-thin silicon detectors

### Competencies and research activities

R&D, production and testing of ultra-thin silicon detector for particle physics and medical physics. Most recent research lines: micro-vertex detector for ALICE at the LHC, detector for radio-guided surgery, large area monolithic active pixel sensor in bended geometry. The laboratory is equipped with a clean-room (class 10000), a Mitutoyo Crysta APEX 9166 coordinate measuring machine, including an optical system ("optical head") to measure three spatial coordinates, aluminium wedge bonder machines, probe stations with micrometric pass, system for automatic assembly of detector modules, laser machine for micro-bonding.

### Collaborations with companies and institutions

- IINFN - Istituto Nazionale di Fisica Nucleare (main partner)
- CERN - The European Organization for Nuclear Research IN2P3
- CNRS Centre national de la recherche scientifique
- Institute of Particle Physics, Central China Normal University (CCNU) STFC Daresbury Laboratory
- Rutherford Appleton Laboratory
- LBNL, Lawrence Berkeley National Laboratory
- Ukrainian Academy of Sciences, KIPT-KFTI

## Laboratory for ultra-thin silicon detectors

- Institute of Physics, St. Petersburg State University
- KISTI Korea Institute of Science and Technology Information
- Yonsei University (South Korea)

### Contact person

Giuseppe Eugenio Bruno  
giuseppe.bruno@poliba.it

Domenico Colella  
domeni.colella@uniba.it

## DIF

## Mechanical Workshop

### Competencies and research activities

The Mechanical Workshop provides design consultation, precision machining, and fitting and assembly, all on both prototypes and custom-designed parts. We work with a broad range of polymer and metal materials and state-of-the-art machine tools.

This facility supports the teaching and research activities of the Department providing access to a variety of manufacturing equipment to assist in the development of their designs and research projects. Currently, there are 5 technicians on-site with extensive knowledge and experience in manufacture, assembly and commissioning.

The workshop is equipped with some up-to-date tools for high precision milling and turning:

- Hurco CNC 3-axis and 5-axis Machining Centres
- Hurco CNC mill turn lathe
- Conventional milling machines and lathes Surface grinding
- Welding facilities
- Guillotine Shear

- Press brake
- Bandsaws
- Drill Pesses

### Collaborations with companies and institutions

- In partnership with Istituto Nazionale di Fisica Nucleare
- Thorlabs

### Contact person

Cosimo Pastore  
cosimo.pastore@ba.infn.it

Domenico Dell'Olio  
domenico.dellolio@uniba.it

Giuseppe Iaselli  
giuseppe.iaselli@poliba.it

### Competencies and research activities

The micromachining laboratory specializes in the fabrication of devices using ultrashort pulse laser technology. With applications ranging from automotive components to microfluidics, the lab particularly excels in the latter field. In the realm of microfluidics, the laser technique is applied to manufacture lab-on-chip devices, microfluidic systems capable of processing small liquid quantities. The facility is equipped with two ultrashort pulse laser sources, multiple beam manipulation systems, and comprehensive optical and fluidic sample characterization tools.

The laboratory's commitment to cutting-edge technology places it at the forefront of microscale manufacturing, addressing the demands of diverse industries and showcasing its expertise in ultrashort pulse laser-based fabrication techniques.

### Collaborations with companies and institutions

- ALPhANOV, Centre Technologique Optique et Lasers, Bordeaux, France
- CIRA, Centro Italiano Ricerche Aerospaziali, Italy
- STMicroelectronics, Italy
- Universitat Politècnica de Catalunya. Dept. Mechanical Engineering, Spain
- University West, Department of Engineering Sciences, Sweden
- Foliumtec GmbH, Austria
- CNR NANOTEC-Institute of Nanotechnology, Italy
- CNR-IFN-Institute for Photonics and Nanotechnologies, National Research Council, Italy

### Contact person

Annalisa Volpe  
annalisa.volpe@poliba.it



### Competencies and research activities

ReCaS-Bari ([www.recas-bari.it](http://www.recas-bari.it)) is a middle size data center set up in 2015 at the Inter-university Physics Department by the Bari University and the National Institute for Nuclear Physics (INFN) using a budget coming from the PON project ReCaS (MIUR, PON Research and Competitiveness 2007-2013, Notice 254 / Ric).

It provides services for HEP data analysis and simulation; satellite images analysis for Earth Observation; medical images and medical signals analysis; weather forecast; AI (artificial intelligence) applications; studies of genomes sequenced by Next Generation Sequencing (NGS) facilities; phylogenetic analysis; biochemical system simulations; data acquisition from sensors, analysis and storage; support for Docker containers and micro-services architectures; set up of collaborative testbed (for software development) and demonstrator set up in European, national and regional projects.

The list of the services provided, include:

- High Throughput Computing Farm with more than 7000 CPU cores.
- High Performance Computing cluster with graphic accelerators (20 NVIDIA K40 GPUs) and InfiniBand network connections for parallel computing.
- Disk storage with more than 4000 TB of usable storage, of which 190 TB in replica two.
- Tape storage for back-ups and data preservation with a capacity of 3900 TB of data.
- Hosting of IT resources.

Cloud@ReCaS-Bari, a private cloud infrastructure

based on OpenStack with more than 1900 CPU cores, 7.4 TB of RAM and 370 TB of (raw) storage in replica three which provides the following services:

- IaaS-Infrastructure as a service: provision of Virtual machines;
- PaaS-Platform As A Services (using Heat, Terra and Mesos technologies) for instantiation of database, web services, development platforms and deployments for artificial intelligence calculation;
- Galaxy cluster on-demand;
- RStudio Server on-demand;
- Jupyterhub on-demand (notebook-based IDE for developing Python/R/Octave/ Ruby software/applications);
- ShareLaTeX on-demand (web-based LaTeX environment for production scientific typesetting);
- GitLab on-demand (web-based remote software version control server) OwnCloud personal storage (Dropbox-like service);
- Desktop as a Service (web-based access to virtual desktops);
- WordPress on-demand (Content Management System to deploy web sites); Moodle on-demand (eLearning platform)

### Collaborations with companies and institutions

- ARPA Puglia Agenzia Regionale per la Prevenzione e la Protezione dell'Ambiente
- CNR-IBIOM (Institute of biomembrane and bioenergetics)
- CNR-IIA (Institute of Atmospheric pollution Research)

- CNR-IREA (Institute for electromagnetic sensing of the environment) Comune di Bari
- Concept Reply S.p.A.
- Department of Physical sciences, Earth and environment (Università di Siena) EGI (European GRID Infrastructure)
- ELIXIR (ESFRI Infrastructure)
- INGV (National Institute of Geophysics and Volcanology) Lifewatch (ERIC ESFRI infrastructure)
- MIUR (Ministry of Education, University and Research) Planetek Italia Srl
- Servizi Locali S.p.A.
- WLCG (Worldwide LHC Computing Grid)

**Contact person**

Domenico Di Bari  
domenico.dibari@uniba.it

Nicola De Filippis  
nicola.defilippis@poliba.it

### Competencies and research activities

#### The main areas of expertise are:

Geohazard assessment and Infrastructure Instability Monitoring Design and implementation of Multi-Temporal SAR (Synthetic Aperture Radar) and Interferometric techniques for topographic mapping and for ground/infrastructure instabilities detection and monitoring. Calibration of SAR images with Artificial Reflectors and Active Transponders. Assessment of EO-based methodologies to produce landslide early-warning maps. Thematic mapping and change detection techniques applied both to SAR and Optical images for the generation of flood maps, land use maps, deforestation maps, fire maps, coastline extraction and evolution, etc.

Environmental Monitoring Study of the pollution of the sea coastal waters, using Optical and Infrared satellite spectrometers, through the estimation of the concentration of biophysical indicators and pollutants (chlorophyll-a, suspended sediments, yellow substances, turbidity, colored dissolved organic carbon, water leaving reflectance and sea surface temperature). Study of indirect methods for mapping Potential Fishing Zones and exploring fishery resources from satellite VIS/NIR data. Oil spill and oil slick detection using SAR and TIR data.

Meteorological Weather Forecasting. Development and exploitation of prognostic high-resolution Numerical Weather Models (NWM). Analysis and forecasting of weather conditions associated with various types of environmental hazards, particularly in air pollutants diffusion, hydro-geological risk conditions forecasting (flood risk), fire ignition and spread risk forecasting, sea conditions forecasting. Meteorological and climate data processing. Wind reanalysis.

### Collaborations with companies and institutions

- Space Agencies (ASI, ESA, NASA).
- Geophysical Applications Processing s.r.l., Planetek Italia s.r.l., SITAEL
- S.p.A., TECNOGAMMA S.p.A.
- ENEA, CNR, Civil Protection Department.
- European Commission, Apulia Region, ARPA Puglia, Municipalities.
- Space Agencies (ASI, ESA, NASA).
- Geophysical Applications Processing s.r.l., Planetek Italia s.r.l., SITAEL
- S.p.A., TECNOGAMMA S.p.A.
- ENEA, CNR, Civil Protection Department.
- European Commission, Apulia Region, ARPA Puglia, Municipalities.

#### Contact person

Maria Teresa Chiaradia  
 mariateresa.chiaradia@ba.infn.it

**Competencies and research activities**

The LAB has a consolidated experience in the development and manufacture of silicon based detectors for high energy physics applications. It has been actively involved in the construction and commissioning of the tracking detectors of the ALEPH and CMS experiments at CERN and is presently assembling the Outer Tracker PS modules for the future Phase\_2 CMS apparatus. Moreover, it is involved, within the CERN research program DRD3 – Solid State Detectors, in irradiation campaigns and radiation damage studies on silicon detectors, providing electrical and functional characterization of the devices, both before and after irradiation.

The LAB has the capability to build and test microstrip and pixel modules and can provide both mechanical CAD design and production of jigs for assembly and testing purposes.

**Facilities and equipment:**

- Clean room: 90 m<sup>2</sup> class 10000 + 10 m<sup>2</sup> class 1000;
- Manual probe station Karl Suss PA150
- Automatic probe station Karl Suss PA200 (temperature controlled chuck: -40 +150 °C) Modular DC source monitor HP4142B
- LCR meter HP4284A
- 1053 nm Laser + Sr90 Radioactive Source Automatic Wire Bonder Delvotec G5
- Mitutoyo BHN506 - XYZ micrometric measurement x-Ray Inspection Nikon XTV160
- Gantry for automatic module assembly

**Collaborations with companies and institutions:**

- INFN - Istituto Nazionale di Fisica Nucleare (main partner)
- CERN - The European Organization for Nuclear Research
- FBK - Fondazione Bruno Kessler (Trento)
- DESY - Deutsches Elektronen-Synchrotron, Hamburg, Germany
- KIT - Institut für Experimentelle Teilchenphysik, Karlsruhe, Germany
- Paul Scherrer Institut, Villigen, Switzerland
- ETH - Institute for Particle Physics and Astrophysics, Zurich, Switzerland
- Imperial College, London, United Kingdom
- Fermi National Accelerator Laboratory, Batavia, USA
- Brown University, Providence, USA
- University of California, San Diego, La Jolla, USA

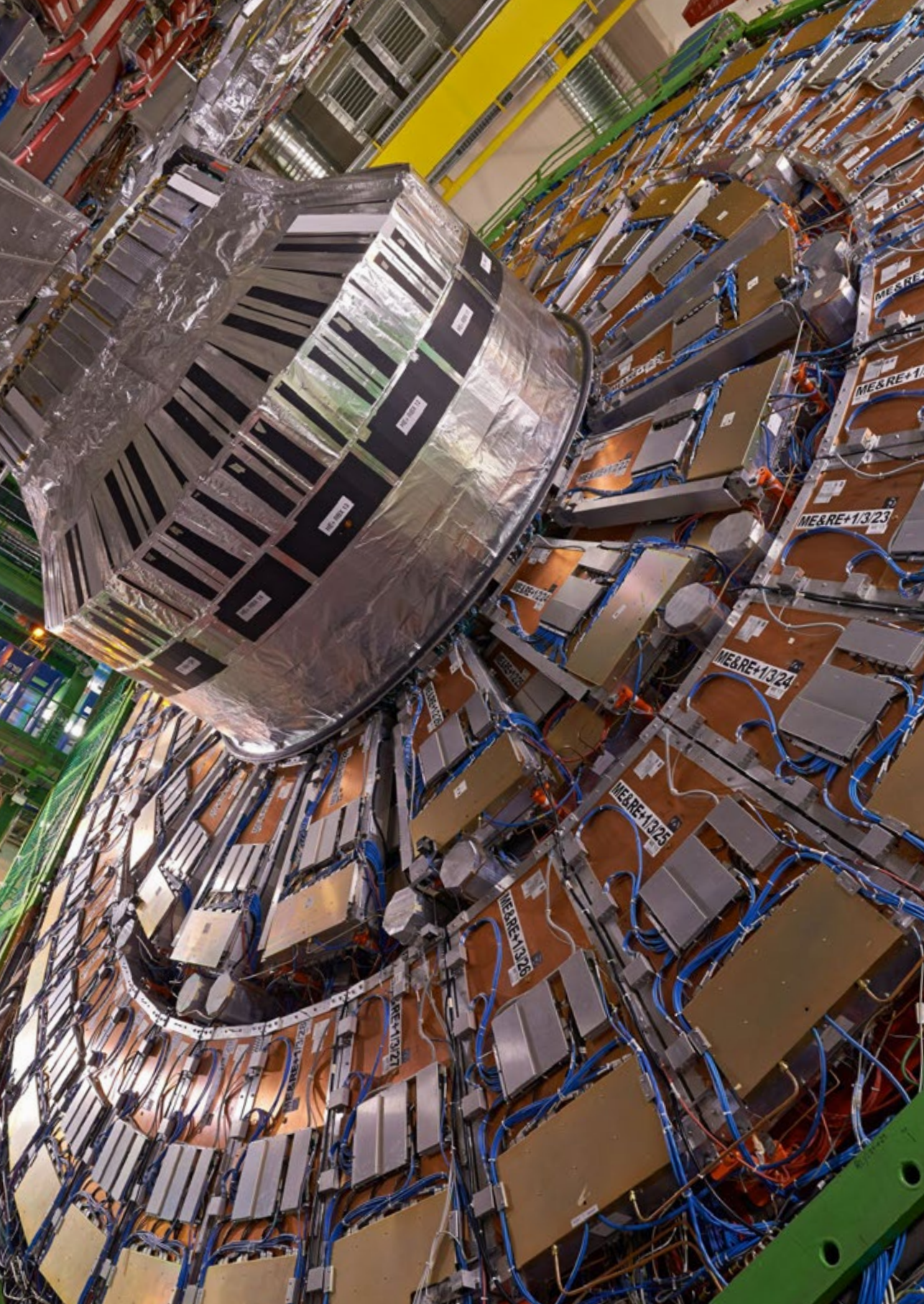
**Contact person:**

Donato Maria Creanza  
donato.creanza@poliba.it

Salvatore My  
salvatore.my@uniba.it







# DMMM

Department of Mechanical Engineering, Management,  
and Mathematics.



### Competencies and research activities

The AF&M-lab is part of the network of laboratories of the research group on Materials and Innovative Technology (“SMATigroup”) whose members operate in the scientific area of Manufacturing Systems and Technologies (ING-IND/16).

The above-mentioned network of laboratories is composed by the laboratory of:

Physical Simulation of Manufacturing processes (PhySiMaP-Lab), Optimization of Manufacturing Processes by Numerical Simulations (ManOnSim), Metallography and Microscopy (OMM) and Thermo-Physical Characterization of Post-Formed Polymers. All the laboratories are located in Viale Japigia 182 – Bari – Italy (DMMM).

The AF&M-lab is equipped with suitable facilities for the investigation of conventional and innovative sheet metal forming processes, like:

- Electro Hydraulic combo press machine (4000 kN) for warm Hydroforming (max pressure: 350bar; max temperature: 300°C) and Superplastic Forming (max pressure: 30bar; max temperature: 1000°C)
- Electro Discharge Machine Agie Charmilles (plunge type) for die manufacturing
- Nabertherm Furnace for thermal treatments using inert gas (max temperature: 1280°C)
- Micrograph facilities for specimen preparation
- Microscopes multi-zoom Nikon AZ100M equipped with an image acquisition and data analysis system (Camera Nikon DS-Fi1 with software NIKON ELEMENTS D)
- Inverted Metallurgical Microscope Nikon MA200

equipped with an image acquisition and data analysis system (Camera Nikon DS-Fi1 with software NIKON ELEMENTS D)

- Micro Harness tester HighWood (Vickers/Knoop)
- Roughness tester Mitutoyo SJ 401
- Multi processors workstations (2 x equipped with an image acquisition and data analysis system (Camera Nikon DS-Fi1 with software NIKON ELEMENTS D)16cores) for FE simulations
- In the AF&M-lab, innovative manufacturing processes characterized by the use (even combined) of laser sources, flexible media (pressurized gas or oil) and warm/hot working conditions can be investigated by using a numerical-experimental approach based on the mechanical and deformative behaviour (using the facilities in PhySiMaP-Lab and OMM-lab) and on the Finite Element simulations (using the facilities in ManOnSim).
- For example:
  - Sheet Hydroforming, in cold (SHF) and warm (WHF) condition;
  - HydroMechanical Deep Drawing (HMDD);
  - SuperPlastic Forming (SPF);
  - Warm Deep Drawing (WDD);
  - Single Point Incremental Forming (SPIF).

The investigated materials are:

deep drawing steels (HMDD), aluminium alloys (SHF, WHF, WDD, SPF), Magnesium alloys (WDD, SPF), Titanium alloys (SPIF, SPF).

Currently, in the AF&M-lab, research activities financed by the Italian Ministry of Education, Universities and Research Government and by private

## Advanced Forming & Manufacturing

companies are conducted aiming at investigating:

- the SPF process for producing highly customized biomedical Titanium prostheses;
- the warm forming process for producing parts for railways applications;
- the adoption of tailor heat treated blanks for stamping complex shaped aluminium components at room temperature.

### Contact person

Gianfranco Palumbo  
gianfranco.palumbo@poliba.it

### Collaborations with companies and institutions

- Fontana Group
- Omer spa
- Master / MasterLab
- Centro Sviluppo Materiali, Roma
- Gigant, Bologna
- Nuovo Pignone - Bari
- Enginsoft, Mesagne (Brindisi)
- Calabrodental / Tecnologica, Crotona
- Ceramed, Loures (Portugal)
- Università della Basilicata
- Politecnico di Milano
- Università di Calabria
- Università di Bologna
- CNR-IFN UOS Bari
- University of Mugla, Turkey
- Institute for Metal Research, Chinese Academy of Science
- University West, Sweden
- University Medical Center, Utrecht (The Netherlands)

**Competencies and research activities**

Interferometric techniques (speckle, moiré and holography) are applied to stress/strain analysis of electronic components, biological specimens and industrial components, reconstruction of 3-D shape of objects, evaluation of thermal distortions and residual stresses, identification of constitutive behavior of materials with high nonlinearities (e.g. biological membranes).

Nanosciences: nanolography, roughness measurement with nonconventional illumination (e.g. evanescent fields), measurement of strains of crystalline arrays (at dislocation level).

Gradient-based (SLP, SQP and modified feasible directions) and metaheuristic optimization algorithms (simulated annealing, harmony search, big bang-big crunch, firefly algorithm, heat transfer search) have been developed for sizing and layout optimization of large-scale skeletal structures, preliminary design of liquid hydrogen tank, and hybrid methodologies for mechanical characterization of materials (composites, biotissues, cells).

**Collaborations with companies and institutions****2001-2009:**

- Department of Mechanical, Materials and Aerospace Engineering, Illinois Institute of Technology (USA) ( Cesar A. Sciammarella)
- 2011-2012: Department of Engineering Science and Mechanics, Pennsylvania State University (University Park, USA) ( Aklesh Lakhtakia)
- 2010-2013: School of Engineering, University of Warwick (Coventry, UK) ( K.K. Liu)
- 2009 to present: Department of Mechanical Engineering, Northern Illinois University (DeKalb,

USA), (Cesar A. Sciammarella and Federico M. Sciammarella

- 2009 to present: Istituto di Fisica, Università Cattolica del Sacro Cuore, Roma (M. De Spirito and M. Papi;
- 2009 to present: Dipartimento di Scienze Ginecologiche Ostetriche e Scienze Urologiche, "Università La Sapienza" ( R. Brunelli)
- 2009 to present: Istituto di Farmacologia Traslazionale, Italian National Research Council, Roma (T. Parasassi)
- 2010 to present: Department of Chemistry and Physics - University of Southeastern Louisiana (Hammond, USA) ( S. Yoshida)
- 2011 to present: Department of Civil Engineering, Dicle University, Diyarbakir (Turkey) ( S.O. Degerterkin)

**2015 to present:**

- Dipartimento di Tecnica e Gestione dei Sistemi Industriali, Università degli Studi di Padova - Department of Engineering Design and Materials, Norwegian University of Science and Technology, Trondheim (Norway) - Department of Mechanical Engineering, Aalto University, Helsinki (Finland) ( F. Berto and P. Gallo)
- Leonardo Finmeccanica (formerly Alenia Aeronautica)
- Centro Ricerche Fiat
- Magneti Marelli

**Contact person**

Luciano Lamberti  
luciano.lamberto@poliba.it

### Competencies and research activities

The Lab carries out research activities mainly on the following topics:

Structural Diagnostic with traditional and new applications and development of new non-destructive techniques (Thermal methods – IRT; Ultrasound – UT; magnetic particles – MT; Penetrant – PT; Strain Gauges – SG; Eddy Current - EC; Xrays – only interpretation)

Main research activities:

- Stimulated thermographic techniques for defects assessment in Additive Manufacturing components
- Ultrasound and stimulated thermographic techniques for defects assessment in composite materials (CFRP and GFRP) components
- Liquid Penetrant and Magnetic Particle testing
- Eddy currents for defects detection in metallic components
- Numerical models for simulating NDTs
- Defect characterization by means of Machine learning algorithms (in collaboration with CNR ISSIA).

The lab is equipped with all needed and up to date instruments for non destructive testing (3 UT systems (Phased array) with possibility of c-scan, MT, PT, 5 Thermocameras in all possible ranges and performances, Phased array Eddy current system with single and differential probes, Strain gauges, etc).

The scientific coordinator has the following certifications:

- Level 3 NDT according to UNI EN 473:2008 ISO 9712 rules in the following methods:

- Thermal Testing
- Liquid Penetrant Testing
- Magnetic Particle Testing
- Visual Testing
- Strain Gauges
- Level 2 NDT according to EN4179/NAS410 in the following methods:
- Magnetic Particle Testing
- Liquid Penetrant Testing

Level 3 NDT according to ASNT (SNT-TC-1A) in Thermal/Infrared Testing Method

### Collaborations with University

- Tomsk Polytechnic University, Department of Physical Methods of Non-Destructive Testing (Russia), Research activities for NDT applications on composite components with thermographic and Ultrasonic techniques.
- CIRA (Italian Aerospace Research Centre), (Italy). Research activities for temperature and emissivity assessment of aerospace components subjected to high temperatures.
- Escuela de Ingeniería de Bilbao, Photothermal Techniques Laboratory (Bilbao, Spain), Research activities for investigating the capability of the vibro-thermography technique.
- BAM: Bundesanstalt für Materialforschung und -prüfung (Berlin–Germany). Research activities regarding NDT thermographic techniques for evaluating volumetric defects in Additive Manufacturing components.

## Advanced Structural Diagnostic Lab.

### Collaborations with companies and institutions

- Diagnostic Engineering Solutions srl
- CETMA (IT)
- ENEA (IT)
- CNR - ISSIA (IT)
- Bosch
- Leonardo
- Ferrari
- Baker Hughes
- Stellantis
- TESMEC

### Contact person

Davide Palumbo  
davide.palumbo@poliba.it

### Competencies and research activities

The Laboratory of Business Planning carries out research activities, training and technology transfer in the area of management and business development, with particular focus on entrepreneurship and strategic management of innovation processes.

In particular, regarding the research activities in the context of entrepreneurship, the laboratory is focused on the topic of start-up creation and financing, with particular attention to the theme of crowdfunding.

Concerning, instead, the strategic management of innovation processes, the laboratory has

62DMMM focused its activities mainly on the themes of open innovation and technology analysis. The main methodological tools used to carry out these activities are statistical and econometric models and analysis of case studies.

The laboratory is also used for the training sessions of the course of business planning, in the second year of the master degree in Management Engineering, and for activities of thesis and internship.

### Main research areas are:

Project financing

- Start-up creation
- Crowdfunding
- Open innovation
- Technology assessment
- The most recent thesis, carried out in the laboratory, are related to the following topics:

- Government policies and eco-innovations.
- Analysis of the technological impact of mature technologies in the aerospace sector.

### Innovation and green economy:

study on the marketing of green technologies in the energy sector.

### Success factors in the creative industries:

the case of industry of Hollywood cinema.

### Study on Innovative Services for knowledge management: business intelligence and analysis.

#### Apulian patents:

- analysis of the current situation and identification of success factors.
- Development of a panel of indicators to evaluate the process of technology entrepreneurship within the technological districts.

### Collaborations with companies and institutions:

Biovegetal, Fincons Group, Farmalabor, Pezzol, Amaro Lucano, Serveco, Banca Popolare di Bari, Nuova Fiera del Levante, Green Blu, Sudsistemi, Open Work, Exprivia, Master, Ariete, Lucente, Auriga

### Contact person:

Claudio Garavelli  
claudio.garavelli@poliba.it

### Competencies and research activities

Demufacturing is a neologism that represents a promising economic activity and is being developed all over the world for the potential of significant reduction in the consumption of non-renewable resources. It focuses on a new concept: the reversibility of manufacturing production processes.

Demufacturing concentrates on those processes that can return (with different degree of reversibility) a product to its ex-ante state, i.e. before the production or assembly phase.

The research activity in the lab is mainly concentrated on the transition from the laboratory to a real settings. Main focus is therefore industrial research projects focused on recycling, reusing, reducing resources, recovering, redesign, remanufacturing.

Competencies are related to technologies, processes, and systems the can perform several demufacturing actions depending on different products to assure a complete and actual circular economy paradigm.

Also several training classes are given for spreading the culture of 6R: recycle, reduce, reuse, recover, remanufacture, redesign.

### Collaborations with companies and institutions:

Main company involved is Globeco S.r.l. On the basis of the knowledge of the research group and of registered international patents) as well as of the available facilities (research laboratories), a pilot plant for demufacturing PV panels is available as a demonstrator. (TRL = 7).

DASSISTI M. (2013) "Cryogenic thermal-mechanical

delamination process controlled for the complete recovery of mono or poly-crystalline or amorphous materials coated with plastic materials (DE-CRYO)" (Patent: R-BR-I-309/13/020 Int. Bureau of WIPO)

<https://iris.poliba.it/handle/11589/24598>

### Contact person:

Michele Dassisti  
michele.dassisti@poliba.it  
Rector's Delegate for Sustainability

### Competencies and research activities

The e-business laboratory research activities include four main streams:

- design of Recommender Systems models,
- Customer Experience analysis,
- models of Customer Analytics,
- Social TV consumer behavior analysis.

Recommender Systems (RS) are information systems that predict customers' preferences based on data pertaining their behavior and transactions, and suggest a list of products with the highest preference score. One of the most important research activities is the measurement of the business performance related to the behavior of customers interacting with these systems. Among several RS models, context-aware models and profit-maximizing models have been experimented. Several scientific papers on prominent international journals and conferences have been published. The activities involve both PhD and undergraduate students.

The activities in the area of Customer Experience have developed multi-item marketing scales for measuring the quality of customers' experience.

The perceptions of customers' samples are gathered through surveys. Surveys are designed after a set of interviews.

The goal of the analyses is to investigate the relationships between perceptions and marketing results through statistical models. Most of the analyses have been conducted in retail banking and grocery. The activities involve both PhD and undergraduate students. The results have been published on international scientific papers.

Customer Analytics include the definition of customer behavior metrics and the application of statistical and other mathematical models with the goal of defining appropriate marketing actions.

The activities carried out in the fashion and grocery industries, mainly involving undergraduate students.

Social TV is the phenomenon involving TV audiences who use a second screen (typically smartphone or tablet) while watching the TV screen.

They use the second screen to interact with broadcaster, brands placed in shows and, above all, other users. This phenomenon occurs mainly in Twitter. It has raised huge interest both on the business and the research side because it lets companies and researchers observe and investigate users' behavior and defining well targeted, effective, real-time marketing actions.

The first research activities were aimed at identifying the drivers of "online engagement", i.e., the reasons and factors that make people interact on the second screen during a show.

The engagement is measured by the number of tweet (of different types). Relationships and correlations among online engagement and a show contents, including commercial breaks and Twitter recalls, have been studied through statistical models.

The research involves mainly PhD students but also undergraduate students.

### Collaborations with companies and institutions

Recommender System:

- New York University (New York, USA)
- The Wharton School - University of Pennsylvania



## E-business

(Philadelphia, USA)

- Unilever
- Panini Spa
- Conquist Srl

Customer Experience:

- ESCE International Business School (Paris, France)
- Banca Popolare di Bari

Customer Analytics:

- Megamark Srl
- Mafrat Spa

Social TV:

- The Wharton School - University of Pennsylvania (Philadelphia, USA)
- Borough of Manhattan Community College - City University of New York, NY (USA)
- Telecom Italia Spa

### Contact person

Michele Gorgoglione  
michele.gorgoglione@poliba.it

### Competencies and research activities

EMILIA is a team of people and a laboratory which are the reference for the aeronautical industries of Regione Puglia (but not only) with advanced expertise and facilities for research, testing and design of aerospace structures.

The Integrated Laboratory of Experimental Mechanics for Aerospace (EMILIA) integrates cutting-edge skills and facilities from the point of view of research, testing and design of innovative materials and structures.

Lab. EMILIA, with its offices at the Polytechnic of Bari and the Univ. of Salento, has the aim of satisfying all the basic and applied research needs coming from the aeronautical, mechanical and more generally manufacturing industries not only at local but also national and international level.

The Katia Casavola, Full Professor of Mechanical and Experimental Mechanical Design of the Polytechnic of Bari, coordinates a team made up of highly trained researchers who can boast numerous collaborations with important companies in the aeronautical and non-aeronautical sector (i.e. Leonardo, Agusta, Avio, Boeing, Magneti Marelli, Bombardier, Airbus, Fiat Research Center).

The lab. was financed by the PO Puglia FESR 2007-13 at the Polytechnic of Bari as a recognition of the excellence of the existing experimental mechanics lab in the field of the mechanical and aeronautical sectors.

### Main research activities are:

#### Characterization of materials and structures

Static, fatigue and impact damage tests of metallic materials (steel, aluminum, titanium, sintered),

composites, metallic and polymer foams, plastic and biodegradable materials and aeronautical components using calibrated systems and releasing reports and certificates.

#### Residual stress

Measurement of residual stresses on different materials, in the laboratory and in situ, according to standard or ad hoc procedures.

#### Numerical analysis of structures

Implementation of numerical models in the elastic field and in the elasto-plastic field through the use of commercial or specially developed calculation software. Analysis of the non-linear behavior of aeronautical structures.

Numerical characterization at nano, micro and macro structural level of innovative materials and aeronautical super alloys. Experimental validation of the developed models.

#### Optical techniques

Development of innovative diagnostic methods for experimental analysis and damage assessment based on optical techniques: digital correlation of images, speckle interferometry and holo-shearing systems. Applications on electronic boards and scaled components for industrial and aeronautical uses.

#### Contact person

Katia Casavola  
katia.casavola@poliba.it

### Competencies and research activities

Experimental stress analysis is based on the principle of strain measurement. Initially, bulky mechanical devices were used for measuring strain that displayed strain using a lever ratio of one thousand or more. These devices were the only available type for performing measurements so essential for stress analysis.

Normally, the strains determined with strain gauges are very small. The change in resistance is also minimal and direct measurement is not possible.

The strain gage must be included in a measurement system where accurate determination of the strain gage's change of resistance is possible.

The components include a strain gauge, which converts mechanical strain into a change in electrical resistance and a measuring circuit that is shown as the Wheatstone bridge having the strain gage as one arm. Both the measuring circuit and the strain gauge are passive components.

When the strain gage's resistance changes, due to a strain, the bridge circuit loses its symmetry and its balance. A bridge output voltage proportional to the bridge's unbalance is obtained.

The measuring system includes an amplifier as the third component which amplifies the bridge output voltage to a suitable level for indicating instruments.

In some cases, amplifiers are designed to give a current proportional output to the bridge output voltage, but some models can provide either voltage or current outputs. The fourth component in the measuring system is the display. Here the output signal of the amplifier is converted into a form

which can be understood by the user.

We provide strain gauge testing of mechanical components and structures.

Strain gauges are devices used to determine material strain due to static and dynamic loads coming from internal and external sources such as mechanical, thermal and pressure.

During a given test, a gauge is attached to the specimen by an adhesive bond. As the specimen is deformed by loading, the foil within the gauge is deformed, thus causing the electrical resistance to change. Measurement of the gauge electrical resistance is performed using a Wheatstone bridge circuit and a computerized data logger.

We can bond strain gauges to the test surface, perform data acquisition and provide test data to assist in identifying the stress, mechanical failure or fatigue to verify design, uncover weak points, and/or validate your FEA. We have the experience to assist in increasing every component reliability.

### Contact person

Bartolomeo Trentadue  
bartolomeo.trentadue@poliba.it

**Competencies and research activities**

Modelling and simulation of flows in complex configurations; simulation of the performance of fluid machines and energy systems.

**The research activity concerns in particular:**

- combustion modelling in laminar and turbulent flow regimes;
- combustion in the presence of electric fields;
- supersonic and hypersonic flows;
- stability of flows and transition to turbulent regime;
- fluid-structure interaction and biomedical applications;
- turbomachinery
- simulation of cell transport;
- microfluidic systems;
- immersed-boundary/iso-geometric
- fluid-structure interaction

**Collaborations with companies and institutions**

- Stanford University
- George Washington University
- IIT
- CIRA
- Ecole Nationale Supérieure d'Arts et Métiers - ParisTech
- Baker Hughes a GE Company
- GE Avio Aero
- Karalit

- Roma Tor Vergata
- CNR Nanotech - PLASMiLAB
- Imperial College
- École Polytechnique fédérale de Lausanne
- von Karman Institute for Fluid Dynamics
- Università di Pavia
- Politecnico di Milano
- Politecnico di Torino
- Norwegian University of Science and Technology

**Contact person**

Giuseppe Pascazio  
giuseppe.pascazio@poliba.it

### Competencies and research activities

The Geomatics Laboratory was established in 2004. Since that year, numerous research and educational activities have been developed, including:

- surveys using topographic instrumentation and GNSS satellite systems for cartographic applications, design, monitoring and engineering testing;
- three-dimensional surveys of the topography of places and photogrammetric surveys of archaeological excavations
- geomatic survey methodologies applied to cultural heritage (buildings of high historical and architectural value, monuments, etc.) by means of close-range photogrammetry and terrestrial laser scanners;
- aerial photogrammetric surveys using UAV platforms;
- integrated surveys and modelling of areas subject to hydrogeological instability;
- surveys of the state of the places and structural monitoring of areas subject to forensic investigations;
- management and maintenance of permanent GNSS stations within the national geodetic network;
- high precision surveys of planimetric and levelling networks;
- survey and 3D modelling of industrial plants;
- georeferencing of images (remote sensing, maps and historical iconographies) and processing of remote sensing images;
- research and development of point cloud processing algorithms.

### Collaborations with companies and institutions:

- Superintendence of archaeology, arts and landscape
- Municipal, Provincial and Regional Administrations,
- Public administrations,
- Private clients
- Research centres

#### Contact person:

##### Scientific Director

Domenica Costantino  
domenica.costantino@poliba.it

##### Technical Director

Pepe Massimiliano Pepe  
massimiliano.pepe@poliba.it

Alessandra Capolupo  
Vincenzo Alfio

### Competencies and research activities

The HIPE Lab aligns with the objectives of the renewed Industry 5.0 program by applying a User-Centered design paradigm. Focused on analyzing human-machine interactions, the lab aims to enhance user performance while prioritizing the sustainability and safety of the production process. The lab develops optimized, innovative human-machine collaboration interfaces, leveraging cutting-edge Mixed Reality technologies. These technologies also drive the creation of training systems for safety procedures in production processes and rehabilitation paths in medical and psychiatric domains.

Sustainability within the process is ensured by employing a User-Centered design approach utilizing objective evaluation tools for Human Factors, Ergonomics, usability, and User Experience. The lab designs, develops, and validates innovative tools for assessing ergonomic loads, employing body tracking systems for posture-related measurements and body sensing systems using innovative sensors to measure physiological signals. These measures objectively evaluate physical and cognitive stress conditions related to the ongoing task.

The synergistic use of these technologies, combined with the study of reverse body mechanics modeling, aims to create a Human Digital Twin capable of defining the Human Performance Envelope within specific production processes. The twin monitors and dynamically corrects working conditions in real-time.

These analyses, coupled with real-time performance evaluations, enable:

- Implementation of innovative systems for objective assessment of ergonomic posture-related risks and work-related stress.
- Adjustment of workloads to individual workers' operational capacities, ensuring compliance with regulations and facilitating active aging among workers.
- Early testing of systems and processes using innovative virtual simulators during the design phase, minimizing development costs and time while ensuring compliance with regulations.
- Development and validation of innovative Mixed Reality-based training systems.
- Design and development of systems supporting medical rehabilitation paths.

The HIPE Lab boasts various software and hardware resources:

- Active and passive body tracking equipment;
- Systems for acquiring and analyzing physiological signals, including ECG, EEG, EMG, and SGR;
- High-spec hardware machines for developing and utilizing Mixed Reality applications (AR and VR).
- Systems for immersive Mixed Reality experiences including Microsoft HoloLens 2, HTC Vive Pro Eye, and Meta Quest 3. The lab also possesses high-resolution 360 cameras for creating virtual environments in cinematic VR.

### Collaborations with companies and institutions

- Istituto Nazionale per l'Assicurazione contro gli infortuni sul Lavoro (INAIL) Regione Puglia.
- Istituto Nazionale per l'Assicurazione contro gli infortuni sul Lavoro (INAIL) Dipartimento innovazioni tecnologiche e sicurezza degli impianti, prodotti e insediamenti antropici (Roma).

## Human Machine Interaction & Performance Enhancement Lab: HIPE Lab

- Technical University of Applied Sciences Würzburg-Schweinfurt

### Contact person

Vito M. Manghisi  
vitomodesto.manghisi@poliba.it

### Main projects:

- Secure Roads 360 (SR360) - Development of a Cinematic Virtual Reality-based innovative system for disseminating road safety principles;
- Secure Personalized Immersive Virtual Reality innovative Trainer (SPIRiT) – Development and validation of an Immersive Virtual Reality (IVR)-based platform for training operators working in confined environments;
- Metaverse Justice (METAJUST) - Study, design, implementation, and validation of a virtual courtroom prototype in the Metaverse to serve the training paths of “legal clinics” and public administration

### Competencies and research activities

The hybrid welding laboratory of Politecnico di Bari is a hightech laboratory devoted to the joining and powderless additive processes of metals and metal alloys.

The laboratory is equipped with 3 different welding techniques which are High Power Ytterbium Laser (HPYL), Friction Stri Welding FSR), and Arc Welding (AW).

Those technologies are combined for hybrid welding by coupling two techniques at any time. Single plus coupled techniques account for six different options for solving welding problems.

The team of HWL supplies on demand studies and consulting on enhancing productivity, lower cost, speed up throughput.

The solution can reduce distortion, post-weld rework, and enhance weld quality. Stronger, lighter, better end-products and new products can be designed using the power for fusion and solid-state welding and fabrication technique.

The fabrication of dissimilar metals welded structure is one of the major success of the laboratory.

The services includes also metallurgical, mechanical characterisations and numerical simulation.

### Collaborations with companies and institutions

- Free University of Bozan, Bozan (Italy)
- Malayer University, Malayer (Iran)
- General Motors Collaborative Research Laboratory in Advanced Vehicle
- Manufacturing, University of Michigan, Ann Arbor (USA)
- Getrag, plant of Bari Italy
- Bosch, plant of Bari italy
- Cefival, Persan (France)

#### Contact person

Giuseppe Casalino  
giuseppe.casalino@poliba.it



### Competencies and research activities

The Innovation Management & Technology Entrepreneurship (IM&TE) Laboratory recognizes that billions of dollars are spent annually in the research and development of new technologies that rarely become innovations, hence requiring a better management of innovation and entrepreneurial processes. In this vein, the IM&TE Laboratory aims to serve as an experimental center dedicated to expanding the understanding of the theory and practice of innovation management and technology entrepreneurship.

In detail, the laboratory aims to offer novel insights and actionable tools to: (i) evaluate technology readiness and market fit for competitive advantage in an uncertain future, (ii) manage the fuzzy front-end of the innovation process, also through creative thinking, (iii) overcome the challenges of established companies and family firms about breakthrough innovation and corporate entrepreneurship, (iv) promote technology transfer and Intellectual Property management, (v) build and strategize about a culture and leadership that support innovation and technology entrepreneurship, (vi) scale micro and small businesses up through innovation, (vii) implement ISO/ 56001 standard on Innovation management system, (viii) leverage digital and green technologies as enablers and components of innovation and entrepreneurial processes, (ix) innovate existing business models and creating new ones.

To this aim, the laboratory is equipped to perform technology scouting and advanced statistical analysis via commercial databases, software and business intelligence tools.

Moreover, the laboratory develops a comprehensive view of innovation and technology entrepre-

neurship from a wide range of sectors (e.g., aerospace, energy, healthcare, textile, tourism, public administration) and perspectives complementary to management and entrepreneurship (e.g., strategy, psychology, design).

Finally, it establishes a synergic connection between education, research, consultancy and the third mission, in turn functioning as a connecting link between private companies, institutions, educational organizations and individuals concerned with questions pertaining to innovation management and technology entrepreneurship.

### Collaborations with companies and institutions

- Almagora
- Bosch
- Clementoni
- Engineering
- ESA
- Exprivia
- EY
- Fincons
- IBM
- Magna PTA
- Panini
- Siram Veolia
- Sitael
- Teleperformance
- Unilever

**Main collaborations with universities and research centers**

- Bayes Business School
- Beijing Normal University
- Case Western Reserve University
- ESADE Business School
- IESE Business School
- INTI International University
- Johannes Gutenberg University Mainz
- King's College London
- Paris School of Business
- Skema Business School
- SPRU – University of Sussex
- University of York
- Wharton School
- WHU – Otto Beisheim School of Management

**Contact person**

Antonio Messeni Petruzzelli  
antonio.messenipetruzzelli@poliba.it

**Research activities:**

- 3D printing of sensors
- 3D Printing of soft robots
- 3D Printing of actuators for biomimetics
- 3D printing of silicone
- Numerical and analytical models to optimize extrusion-based 3D printing
- Vrije University, Bruxelles
- Masmec Biomed
- Leonardo Aerostrutture
- Roboze

**Contact person:**

Gianluca Percoco  
gianluca.percoco@poliba.it

**Collaborations with companies and institutions:**

- University of Texas at Dallas, USA
- Baylor University, USA
- University of Texas at El Paso, USA
- Scuola Superiore Sant'Anna Pisa
- Università Magna Graecia Catanzaro

**Competencies and research activities**

The Knowledge Management Laboratory (KMLab) operates in the field of knowledge management with specific focus on innovation and technology management. Its main goal is to favor local and regional development by combining advanced perspectives developed through scientific research and practical industry experience. Accordingly, KMLab conducts cutting-edge research to develop new approaches and methodologies for managing business, organizational, and technological knowledge. In turn, this

research is used to provide firms and public organizations with the necessary support to successfully improve their operational and innovation capacity.

In detail, the research activities of KMLab mainly cover the following topics:

- Environmental sustainability.  
It delves into the definition of strategies for developing and commercializing green technologies, products, and processes and the imple-

mentation of the most suitable practices (e.g., life-cycle assessment, industrial symbiosis, and energy system analysis) for supporting the greening of business at the corporate, local, and national level. Methodologies and techniques to involve the stakeholders' view in the definition of the above-mentioned strategies are also investigated.

- **Open innovation.**  
This research stream evaluates the weakness, strengths, and opportunities of web-based markets and crowdsourcing strategies for buying and selling technologies and ideas between organizations (i.e., market for ideas) and how this external knowledge can be integrated within the organizations' processes.
- **Technology scouting and forecasting.**  
The third topic attempts to provide tools and techniques to keep pace with the most recent technological knowledge and forecast future technological paradigms, so making companies in a better position to react to compete in a turbulent market environment.
- **Supply chain management.**  
This theme aims at developing a better comprehension of the most effective practices for coordinating manufacturing processes and logistic flows both within and between organizations, by adopting the support of IT tools, simulation modelling of productive and organizational systems, and process management.
- **Network analysis.**  
Given the increasing relevance of collaborations to improve performance and overall economic and social growth, the last topic analyses and proposes best practices, solutions, and models that may help policymakers and firms to gain ad-

vantage from networking strategies, as the case of industrial clusters, M&A, and alliances.

These research activities allow the KMLab to provide relevant services, as consulting, education, intelligence, and networking.

- First, consulting offers support to companies and public organizations that wish to improve their performance and achieve sustainable competitive advantage. As a consequence, they are helped to identify and implement opportunities for business process reengineering or innovative ideas.
- Second, KMLab also provides companies and public organizations with dedicated education and training programs enabling them to develop new skills and problem solving and operational techniques, and to build new strategic and organizational orientations.
- Third, intelligence refers to activities devoted to perform customized studies specifically designed for the needs of the diverse organizations aiming at comprehending the best practices in given industries, scanning for the evolution of technologies and markets, and benchmarking with competitors.
- Finally, KMLab can act as broker between multiple organizations, hence allowing them to meet each other and access experts in business, markets, technologies, and policies.

KMLab also hosts the activities of the Competence Center on Business Process Management. Born from a strategical partnership between Politecnico di Bari and Openwork s.r.l, an independent software vendor specialized in the development

## Knowledge Management Laboratory (KMLab)

of enterprise solutions based on business process management, such Center carries out research, technological transfer and third mission activities on Business Process Management (BPM).

The Center is particularly interested in innovating and supporting the digital transformation of healthcare, public administration and production processes, with a focus on the industries more relevant to the regional economy, e.g. textile, wood furniture, auto component and mechanical industries. All the research activities are performed by leveraging on Industry 4.0 enabling technologies and green/sustainable business process management methods and techniques. KMLab also operates a branch located at Centro Interdipartimentale Magna Grecia in Taranto.

### Collaborations with companies and institutions

Research activities of KMLab are currently estimated at about 1 million of Euros, counting on about 20 professors, researchers, and PhD students. KMLab established (since its launch) many collaborations with external academic organizations and R&D departments of both local, national, and international companies.

Among the international academic partners, there are:

- University College London
- Cass Business School
- WHU-Otto Beisheim School of Management
- Hasselt University
- ESADE Business School
- Skema Business School
- Lancaster University
- Birmingham Business School
- Paris School of Business
- Beijing Normal University
- MIT Sloan School of Management
- University of California (Anderson School of Management)
- Among the industrial partners there are:
  - Cézanne Software
  - IBM
  - Getronics
  - Allaxia
  - Natuzzi
  - Alenia Marconi Systems
  - Sudsistemi
  - Openwork
  - Fincons Group
  - Exprivia
  - Banca Popolare di Bari
  - ICAM
  - Cantele
- New York University (Stern Business School)
- University of Navarra (IESE Business School)
- Israel Institute of Technology (Technion)
- McMaster University (De Groote Business School)
- University of Sussex (Science and Policy Research Unit)

## Knowledge Management Laboratory (KMLab)

- TIM
- Geopharma
- SAP
- Fater Group
- Green Blue
- Tersan
- Master Italy
- Lucente SpA
- Coop. Ariete
- Clementoni
- Unilever
- Eni Group
- Farmalabor
- IRCSS Casa Sollievo della Sofferenza
- IRCSS Giovanni Paolo II

### Contact person

Vito Albino  
vito.albino@poliba.it

### Competencies and research activities

The lab is constituted by a closed-loop rig for experimental tests and studies on hydraulic pumps, turbines and PAT (Pumps As Turbines). Due to the possibility to test pumps both in direct and reverse mode, two hydraulic circuits can be set by acting ON/OFF valves.

The turbo machinery under investigation is installed in the test section where it is directly coupled with a DC motor controlled by a four-quadrant converter. The electric machine works as motor during "pump test" and generator during "turbine test".

The test section is provided by a special platform with a rail system, allowing the investigation of turbomachinery of different size.

During "turbine tests", a booster pump, driven by another DC motor, supplies the hydraulic energy through pipelines to the turbine. In this case, the motor that drives the booster pump is partially powered by the turbine. The operating range of the test rig is defined by H-Q characteristics of the booster pump and the constant power line corresponding to the maximum capacity of the loading generator.

### Turbine tests:

- Max test head equal to 280 mH<sub>2</sub>O.
- Max discharge equal to 650 m<sup>3</sup>/h.
- Max rotational speed of the testing machine: 2400 RPM
- Max power equal to 480 kW
- Pump tests:
  - Max test head equal to 270 mH<sub>2</sub>O.
  - Max discharge equal to 350 m<sup>3</sup>/h.
  - Max rotational speed of the testing machine: 2400 RPM
  - Max power equal to 480 kW
  - The test rig is equipped with a surge tank with a capacity of 8 m<sup>3</sup> and an air pressure control system that can increase the absolute pressure up to 11 bar(abs). In the case of cavitation tests, a vacuum pump can reduce the absolute tank pressure to 0.2 bar(abs).
  - During machine characterization, a closed loop cooling system controls the water temperature in the test rig (25 ± 0,1 °C); The test rig is equipped by a control and the data logging system, installed in a control room.
  - Another open-loop hydraulic circuit is used to study and test turbines for low head hydropower applications.

### Collaborations with companies and institutions

- Nuovo Pignone Bari

### Contact person

Marco Torresi  
marco.torresi@poliba.it

### Competencies and research activities

In the area named Ex-Officine Scianatico, thanks to funding from the PrInCE project, Politecnico di Bari transferred the soundproof chamber inside of which two test benches housing internal combustion engines are already available.

Moreover, a methane pipe has been added, which allows to carry out studies of small CHP units based on internal combustion engines of automotive derivation.

The first test bench is equipped with a single 500 cm<sup>3</sup> cylinder research engine, 4-stroke, spark ignition (with both bore and stroke equal to 86 mm), model 5401 produced by AVL. The engine compression ratio is 10.5:1.

The engine has 4 valves, and a Bosch injector that injects, at closed valves, in the intake duct.

The dynamometer consists of an eddy current brake with oscillating cradle and load cell, model System One Alpha 160, rather sophisticated. This implements: oil and water cooling systems (heat exchangers with SIEMENS automated valves); Electric starter (3.2 kW); throttle actuator (stepping motor); Cabinet for cabling of additional acquisition data (Automation Unit); basic data acquisition system (pressure sensors and PT100 thermocouples; pressure transducers and flow switches); internal system for cooling the water of the brake refrigeration system; open access Engine Control Unit (ECU) with maps for early injection and spark ignition and injection, which can be changed in real-time; acquisition system of the indicated cycle; gravimetric balance.

The second test bench is as follows: an eddy AVL Alpha 240 (maximum output current: 240kW, max-

imum speed:  $n = 10000\text{rpm}$ ); HBM U2A load cell for detecting the torque; feeder LSE AVL 435 for the excitation of the dynamometer; loop detection; detecting the composition of exhaust gas; fuel system. The engine currently under investigation is an Alfa Romeo 2.4 JTD 10V, 5-cylinder, one head camshaft (motor code AR32501; 2387cm<sup>3</sup>; 90.4mm stroke; 82mm bore; compression ratio 18.5:1; maximum power 100kW @ 4200rpm, maximum torque 304Nm @ 2000rpm; Bosch's direct fuel injection system with an electronic "Common Rail" controller, EDC-15C.

### Collaborations with companies and institutions

- Bosch
- ETAS

#### Contact person

Sergio Mario Camporeale  
sergio.camporeale@poliba.it



**Competencies and research activities**

The rapid prototyping and reverse engineering (RE) was founded in 1999 and it has been constantly updated with the newest technologies of the field. The laboratory located in Viale Japigia 182 - Bari -Italy (DMMM) presents a wide range of RE instruments and Rapid Prototyping machines. It is composed by a multidisciplinary team, with competencies in additive manufacturing processes, polymeric materials as well as, in reverse engineering, both for contact and non-contact instruments. The scientific area is Manufacturing Systems and Technologies ING-IND/16.

The laboratory is equipped with several instruments for additive manufacturing and RE:

- Stratasys FDM 3000 using ABS material with layer height equal to 0.1 mm. Maximum working volume 254x254x406 mm<sup>3</sup>.
- WASP DELTA 4070, 3D printer for Poly(lactic acid) polymeric material. The maximum printing volume is 400x400x700 mm<sup>3</sup>.
- Zortax M-200, 3D printer optimized for ABS material and printing volume equal to 200x200x150 mm<sup>3</sup>.
- M-One MAKEX, additive manufacturing machine based on liquid resins photopolymerization and characterized by a xy resolution ranging from 60 to 75µm.
- Konica Minolta Vivid 910i, 3D automatic Laser Scanner: working volume ranging from 111\*83\*40 mm<sup>3</sup> to 1196\*897\*750 mm<sup>3</sup>, accuracy X: ±0.22mm, Y: ±0.16mm, Z: ±0.10mm, scanning time comprised between 0.3 and 2.5 sec.
- Roland PIX 250, desktop 3D rotary laser scanner.
- CMM – Coordinate Measuring machine DeMeet 400, equipped with both contact and optical sensors. Measuring volume 400x250x200 mm<sup>3</sup>, resolution of 0.5 µm.
- Measuring arm GARDA, with Renishaw probe, spherical working volume of 2.5 m of diameter, accuracy of 0.05 mm.
- Line Laser Scanner Kreon, 16000 points per second of scanning speed, accuracy of 0.05 mm.
- Micro Z-Scan, Photogrammetric 3D scanning instrument.
- Optimet QC Scanner type 1 ROHS, holographic 3D scanner.
- Optimet ConoScan 3000, compact and non-contact conoscopic holography 3D measuring instrument, for 120x120 mm<sup>2</sup> sized parts.
- ConoProbe HD (High Definition) – Mark 3.0, sensor for high precision 3D measurements (micrometric resolution) based on conoscopic holography principle.
- Optimet NanoConoprobe, conoscopic holography sensor for transparent and reflective surfaces and thickness evaluation comprised between 1-10 µm.
- Microplan, 5 axis conoscopic holography scanning system for axial-symmetrical 2D and 3D profiles.
- The research activities are oriented to the analysis and the study of new methodologies for AM and RE implementation. In AM field, new chemical treatments for surface finishing have been developed. Moreover, process parameters have been optimized in order to improve mechanical

properties, reduce production time and surface roughness.

In RE, new 3D scanning methodologies have been developed based on photogrammetry, for different applications, from mechatronic to biomedical and forensic field. Calibration procedures have been improved for several optical configurations even at micro-scale level.

The laboratory was firstly funded by Piano Triennale MURST (D.M. 21/6/99). Thanks to some industrial research projects of "Distretto Tecnologico delle Meccatronica Pugliese, Regione Puglia, CIPE 20/04, cod. DM01" and POR it has been constantly updated.

### Recent funded research projects:

- European project ADRIATInn - An Adriatic Network for Advancing Research Development and Innovation towards the Creation of new Policies for Sustainable Competiveness and Technological Capacity of SMEs, Consortium with di 20 European partners (2013-2016).
- 2018-2020 Project Leader of the INTERREG IPA CBC ITALY-ALBANIA-MONTENEGRO PROGRAMME 3D-IMP-ACT (Virtual reality and 3D experiences to IMProve territorial Attractiveness, Cultural heritage, smart management and Touristic development), that involves 5 partners from Italia, Albania and Montenegro.
- Apulia Development Center for Additive Repair" laboratory done by the GE Avio and the Politecnico di Bari, research activity on "Reverse Engineering of aeronautical components aimed at their repair by means laser deposition (DL) and cold spray (CS) processes" (2016- now).
- PON MIUR ARS01\_00806 "Innovative solutions for quality and sustainability of ADDitive manufacturing processes (SIADD)" that involves 14 partners among Industries, Research Centers and Universities (2019-2022).
- Collaborations with companies and institutions:
- Università Cattolica del Sacro Cuore Roma, Università di Napoli Federico II, Università di Bologna Policlinico S. Orsola-Malpighi, Università di Bari - Medicina legale, Università di Bari- Dipartimento Interateneo di Fisica "Michelangelo Merlin", Università del Salento – Lecce, Politecnico di Milano – Milano, Università Kore di Enna – Enna;
- Technical University of Denmark, Copenhagen, Università di Kragujevac – Faculty of Engineering (Serbia), Università Politecnica di Tirana (Albania), Università di Poddorica (Montenegro)
- CNR Istituto di Fotonica e Nanotecnologie, CNR ITIA (Istituto di Tecnologie Industriali e Automazione) – Bari, Milano, ENEA – Brindisi
- GE AVIO Srl, GE Oil and Gas, Enginsoft SpA, HB Technology Srl –Taranto (TA), ELFIM srl – Gravina in Puglia (BA), Novotech srl – Avetrana (TA), Umbra Group Cuscinetti S.p.A, Ingenia Srl, Leone Spa, Bosch TDI, ICAM srl, Roboze srl, Simitecno srl, Adler Ortho srl. COFRA, Pezzol, Base Protection, Saint-Gobain, UTG Lavorazioni, Polishape 3D srl, BreD srl.

### Contact person

Luigi Maria Galantucci  
luigimaria.galantucci@poliba.it

### Competencies and research activities

The MILD (Moderate or Intense Low-oxygen Dilution) combustion laboratory is one of the laboratories of the Department of Mechanics, Mathematics and Management (DMMM).

The test rig can be conducted either under conventional combustion conditions, with air as oxidizing gas, or using an air-flue gas mixture with varying levels of exhaust gas and different temperature levels, in such a way as to obtain a MILD combustion. The rig is equipped with automatic control systems capable of varying the mass flow rates, the dilution factors, as well as the thermal power.

### The system consists of:

- A balanced draft test rig for the execution of experimental campaigns aimed to the observation of both conventional and MILD combustion processes;
- Two burners: an experimental burner with an 80 kWt load capacity and a 200 kWt auxiliary fueled by natural gas. The experimental burner can be fuelled by liquid diesel oil or gaseous natural gas and is able to operate under both conventional or MILD combustion regimes;
- Two fans (a blower and discharge fan), both regulated by a Variable-Frequency Drive (VFD), capable of controlling the air mass flow rate and the flue gas recirculation together with the pressure inside the combustion chamber;
- The exhaust gas cooling system based on a shell and tube heat exchanger.
- A facility of the MILD combustion lab is represented by the transesterification plant for the production of bio-diesel from vegetable oils to be used as fuel in the experimental burner.

### Collaborations with companies and institutions

- CCA
- Ansaldo Boilers
- Itea
- ICMEA

### Contact person

Marco Torresi  
marco.torresi@poliba.it

**Competencies and research activities**

The main topics of basic and applied research are related to the technological characterization of polymeric materials, numerical simulation of injection molding processes and the experimental study of tensions induced crystallization. The available instruments in the laboratory are a Differential Scanning Calorimetry (Netzsch Pegasus 404 F3), Dilatometer (Netzsch DIL 402C), Rotational Rheometer (HAAKE MARS III) and two workstations for heavy duty computation.

**Collaborations with companies and institutions:**

The research carried out in the laboratory is very large, with several national and international collaborations with companies and research institutes.

There is close cooperation with the IKV Institute of RWTH Aachen University, highlighted by spontaneous exchanges had in recent years, through the DAAD programs, Erasmus and DFG.

The added values of cooperation are to be able to propose projects promoting innovation and technology transfer, thanks to the skills which were scanned, to local (Italian and German) and international companies.

The Laboratory allows to make joint research with several companies through projects funded by Italian Minister of Research and University (MIUR) and Apulia Region such as:

- BOSCH CVIT,
- GE Oil & Gas,
- Soffigen srl.

**Contact person**

Roberto Spina  
roberto.spina@poliba.it

**Competencies and research activities**

This laboratory is devoted to the performance analysis of Wells turbines to be included in systems OWC systems (Oscillating Water Column) for wave energy harvesting.

For these studies a test bench (specifically designed), is used, which reproduces the conditions of the air flow generated by the wave motion.

The entire system is remotely controlled via software, determining the operating conditions.

The test rig consists of: a suction centrifugal fan controlled by a Variable-Frequency Drive (VFD); a straight pipe where a diaphragm is housed for flow measurement; a plenum chamber; a second straight duct in which is located the AC Brushless

Servo Systems connected to the torque transducer (for torque measurement) and to the Wells turbine.

Collaborations with companies and institutions

Università Mediterranea di Reggio Calabria

**Contact person**

Sergio Mario Camporeale  
[sergio.camporeale@poliba.it](mailto:sergio.camporeale@poliba.it)

### Competencies and research activities

The Microtronic laboratory, operating in the scientific area of Manufacturing systems and technologies (ING-IND/16), is part of the Microtronic network of laboratories. It is aimed to mechatronic sectors which are characterized by an ever higher request for micro-components realized in a large variety of materials.

The team is composed by people with multidisciplinary competences ranging from manufacturing to measuring processes in order to continuously improve the capability of the manufacturing process, such as micro-milling, micro drilling and 3D surface realization, at micro level.

The laboratory located at Polytechnic of Bari in Viale Japigia 182- Bari- Italy (DMMM), is equipped with a wide range of measuring instruments suitable for small and micro-range, as well as, machines for precision subtractive and additive manufacturing processes.

### A complete list of the equipment is reported:

- KUGLER Microgantry micro, 5 axis micro-milling machine, 1kW power spindle and 60000 RPM of maximum velocity, positioning accuracy comprised between 0,5 e 1,0 micrometers for Cartesian axis and  $\pm 1$  arcsec for rotary axis.
- Hirox RH-2000 microscope, able to ensure several magnification levels (up to 10000x) with rotary head and tilting table.
- Taylor Hobson CCI-MP HS, optical profilometer based on interferometric principle equipped for a minimum x-y resolution equal to 1 $\mu$ m.
- WASP DELTA 4070, 3D printer for Poly(lactic acid) polymeric material. The maximum printing

volume is 400x400x700 mm<sup>3</sup>.

- Zortax M-200, 3D printer optimized for ABS material and printing volume equal to 200x200x150 mm<sup>3</sup>.
- M-One MAKEX, additive manufacturing machine based on liquid resins photo polymerization and characterized by a xy resolution ranging from 60 to 75 $\mu$ m.
- The research activities are focused on the combination of micro-milling and additive manufacturing technologies for the realization of 3D complex parts at micro-scale level. Microscope and profilometer for surface analysis are used for performance verification of the micro-machining processes.
- The machines and measuring instruments present in the laboratory are well suited for feasibility studies and services aimed at local companies comprised in the mechatronic district and operating in the fields of precision mechanic, tool design and automotive and machine components.
- The laboratory was funded by Regione Puglia and it is composed by three operating units: Dipartimento Interateneo di Fisica dell'Università degli Studi di Bari, Politecnico di Bari - Dipartimento di Meccanica Matematica e Management (DMMM), CNR Istituto di Fotonica e Nanotecnologia.

### Recent funded research projects:

- Apulia Development Center for Additive Repair" laboratory done by the GE Avio and the Politecnico di Bari, research activity on "Reverse Engineering of aeronautical components aimed at their repair by means laser deposition (DL) and cold spray (CS) processes" (2016- now).
- PON MIUR ARS01\_00806 "Innovative solutions

## Laboratory MICROTRONIC - micro-machining and 3D micro-measures for mechanical components

for quality and sustainability of ADDitive manufacturing processes (SIADD)" that involves 14 partners among Industries, Research Centers and Universities (2019-2022).

### Collaborations with companies and institutions:

- University Cattolica del Sacro Cuore Roma, Università di Napoli Federico II, Università di Bologna – Policlinico S. Orsola-Malpighi, Università di Bari - Medicina legale, Università di Bari - Dipartimento Interateneo di Fisica "Michelangelo Merlin", Università del Salento – Lecce, Politecnico di Milano – Milano, University Kore of Enna - Enna;
- Technical University of Denmark, Copenhagen, Università di Kragujevac – Faculty of Engineering (Serbia), University Politecnica of Tirana (Albania), University of Poddorica (Montenegro)
- CNR Istituto di Fotonica e Nanotecnologie, CNR –

ITIA (Istituto di Tecnologie Industriali e Automazione) – Bari, Milano, ENEA – Brindisi

- GE AVIO Srl, GE Oil and Gas, Enginsoft SpA, HB Technology Srl –Taranto (TA), ELFIM srl – Gravina in Puglia (BA), Novotech srl – Avetrana (TA), Umbra Group Cuscinetti S.p.A, Ingenia Srl, Leone Spa, Bosch TDI, ICAM srl, Roboze srl, Simitecno srl, Adler Ortho srl. COFRA, Pezzol, Base Protection, Saint-Gobain, UTG Lavorazioni, Polishape 3D srl, BreD srl.

### Contact person

Luigi Maria Galantucci  
luigimaria.galantucci@poliba.it

### Competencies and research activities

The Computer numerical control machines laboratory was founded in 1999. It is part of the scientific area of Manufacturing Systems and Technologies ING-IND/16. The laboratory is located in Viale Japigia 182 – Bari – Italy (DMMM) and it presents several CNC machines as well as an hydraulic press for moulding of thermoplastic materials.

In particular there are:

- Alfa Engineering MM 430, CNC Machine Centre, for vertical milling and reaming, 4 controlled axis, Numerical Control SIEMENS 802D sl, ISO Spindle 40 pot. 7 kW, max velocity 10000 g/min, automatic tool change, working volume 900x460x390 mm<sup>3</sup>.
- PENTAMAC srl QUICKLYT 1000, CNC Lathe. Distance between centres 1000 mm, max turning diameter 460 mm. Max spindle velocity 2000 RPM. Electrical turret with 6 positions.
- FCN 500, CNC 4 axis milling machine, ISO spindle 30 pot. 1 kW, vel. 100-3000 g/min, with Ethernet Motion Controller 7761M, working volume 500x140x215 mm<sup>3</sup>.
- DEMAG-ERGOTECH, Hydraulic press (maximum load: 80 ton) equipped for moulding of thermoplastic materials.

The laboratory equipment has been adopted for research activities supporting the more innovative technologies, through the realization of prototypes and tools. Specimens for calibration procedure of measuring instruments, samples for material characterization and specifically designed tooling systems have been realized on CNC Machines. Moreover, different polymeric materials have been tested through the hydraulic press with different moulds.

The laboratory was funded by Piano Triennale MURST (D.M. 21/06/99) and, then, further potentiated through the explorative project POR.

### Collaborations with companies and Institutions

- University Cattolica del Sacro Cuore Roma,
- Università di Napoli Federico II,
- Università di Bologna
- Policlinico S. Orsola-Malpighi, Università di Bari
- Medicina legale, Università di Bari
- Dipartimento Interateneo di Fisica “Michelangelo Merlin”, Università del Salento – Lecce,
- Politecnico di Milano – Milano,
- University Kore of Enna – Enna;
- Technical University of Denmark, Copenhagen,
- University of Kragujevac – Faculty of Engineering (Serbia), Università Politecnica di Tirana (Albania), Università di Poddorica (Montenegro)
- CNR Istituto di Fotonica e Nanotecnologie,
- CNR – ITIA (Istituto di Tecnologie Industriali e Automazione) – Bari, Milano, ENEA – Brindisi
- GE AVIO Srl, GE Oil and Gas, Enginsoft SpA, HB Technology Srl –Taranto (TA), ELFIM srl – Gravina in Puglia (BA),
- Novotech srl – Avetrana (TA), Umbra Group Cuscinetti S.p.A, Ingenia Srl, Leone Spa, Bosch TDI, ICAM srl, Roboze srl, Simitecno srl, Adler Ortho srl. COFRA, Pezzol, Base Protection, Saint-Gobain, UTG Lavorazioni, Polishape 3D srl, BreD srl.

### Contact person

Luigi Maria Galantucci  
luigimaria.galantucci@poliba.it

Roberto Spina  
roberto.spina@poliba.it

Fulvio Lavecchia  
fulvio.lavecchia@poliba.it



**Competencies and research activities**

The research group working in the Experimental Stress Analysis laboratory, in the field of Experimental Mechanics, has developed wide experience for both in lab and in situ inspections, related to the stress/strain analysis on materials, components, structures in aeronautical and aerospace field, naval, biomedical, automotive, mechatronics.

Many techniques and applications have been developed to study Experimental data acquired from real components or stereolithographic model during working conditions:

STRAIN GAGE, BRAGG'S FIBER, WIFI sensors

PHOTOELASTICITY:

- Transmission photoelasticity (2D)
- Photoelasticity coating technique: stress analysis of real components
- with birefringent coatings;
- Integrate photoelasticity: stress analysis of axisymmetric components

Frozen stress photoelasticity: stress analysis of 3D models (rapid prototipe models, etc.)

OPTICAL METHODS (allow displacements and strain measurements on real components; accuracy: tens of nm; data analysis can be done in real time):

- Moiré
- Speckle
- Holographic interferometry
- Integrated Holo-Shearing system

**Collaborations with companies and institutions**

Many collaborations have been established with industry (i.e. Alenia Aeronautica (Leonardo) – Agusta - Sital Aerospace - Bosch - Mer Mec - Centro Ricerche Fiat, Enginsoft – MBL Solutions – Inglass, etc.), university and research centre (i.e. Univ. of Nottingham; Univ. of Manchester; University of Washington, Seattle; University of California, San Diego; Illinois Institute of Technology, Chicago; Institute of Micromechanics and Photonics, Warsaw University of Technology; Dep. de Ingeniería Mecánica, Univ. de Zaragoza; Dublin City University; Trinity College; McGill University, Canada; ENEA, CALEF, CETMA, Centro Laser, etc.).

**Contact person**

Katia Casavola  
katia.casavola@poliba.it

### Competencies and research activities

Actually, the staff of Laboratory of Industrial System Engineering (LISE) is composed of: 1 full professor, 2 associate professors, 3 researchers, 1 PhD Candidate. The LISE is organized in two sections:

- Systems and Operations Management (SOM);
- Health, Safety & Environment (HSE).

Research areas investigated in the SOM section are:

- production systems design and optimization,
  - operations and service management,
  - supply chain and logistics management.
- Research areas investigated in the HSE section are:
- industrial and work safety,
  - ergonomics and human factors,
  - industrial and logistics sustainability,
  - environmental management.
- In these areas, scientific consultancies and research activities financially supported by "EU", "Italian Ministry of Education, University and Research", "Apulia Region", national, international companies, and public institutions are offered.

- Isringhausen S.p.A.
- Public utilities
- AQP S.p.A.
- AMIU Puglia S.p.A.
- AMGAS S.p.A.
- Public Services
- Ferrotramviaria S.p.A.
- Healthcare
- Merck Serono S.p.A.
- Sanofi Aventis S.p.A.
- ITEM Oxygen S.r.l.
- IRCCS "Casa Sollievo della Sofferenza"
- Ospedale Consorziale Policlinico di Bari
- Food
- Heineken Italia S.p.A.
- Peroni SAB Miller S.p.A.

### Contact person

Salvatore Digiesi  
salvatore.digiesi@poliba.it

### Examples from the past activity of the laboratory are:

System design and optimization.

### Collaborations with companies and institutions

- Automotive
- Bosch S.p.A.
- CNH Fiat Industrial S.p.A.
- Bridgestone S.p.A.

### Competencies and research activities

Simulation models and mathematical programming techniques can deal with manufacturing systems which call for complex decisions concerning daily issues as well as middle and long horizon strategies (e.g. the introduction of new machines, new products, etc.).

Among the most recent computing algorithms, artificial and swarm intelligences have demonstrated their capability of solving scheduling, programming, and maintenance problems in manufacturing complex systems.

The team of Laboratory of “Intelligent Computation for Manufacturing and Manufacturing Systems” has matured a considerable experience in resolving optimization problems for advanced technologies like welding and additive fabrication ones, and modelling the overall manufacturing system.

The same approach can be potentially applied to a variety of processes that involve low resources availability and necessity of a high degree of efficiency, like processes in the health care systems.

The team can design a screening experiment and explore the process to be simulated by enquire its actors. The information is structured as an input to the process and several solutions are found by means of commercial software and customer programming. Then, the team will discuss until the better solution, if not the best, is selected.

The capability of the team embraces also the use of Statistical Process Control (SPC) with the aid of Design of Experiment technique (DoE).

### Collaborations with companies and institutions

- Dublin City University, Dublin (EIRE)
- Istituto Italiano delle Saldature, Genova (Italy)
- University of West of Scotland, Paisley, (Scotland, UK)
- Università di Napoli, Federico II, Napoli, (Italy)
- ISI Italia, Grugliasco (To), (Italy)

#### Contact person

Giuseppe Casalino  
giuseppe.casalino@poliba.it

**Competencies and research activities**

Since 2007, the Laboratory of Manufacturing processes by Laser Technologies (LLT) of Politecnico di Bari has been working on Laser Additive Manufacturing processes of metals and on laser micro-machining.

The laboratory currently houses a Selective Laser Melting (SLM) and a Laser Metal Deposition machine, able to process metal powders. Both techniques are solid freeform fabrication processes where 3D parts can be fabricated layer by layer by fusing metal powders with a high energy laser beam.

SLM machine is equipped with a nanosecond Nd:YAG laser source with a maximum power of 100 W and a scanning head with deflecting mirrors to direct the laser beam over the powder platform. The laser can operate in both continuous and pulse mode. In continuous mode, it allows the selective laser sintering and selective laser melting of metal powders; in pulsed mode, it is able to fabricate micro-components by laser ablation, with a pulse width in the nanosecond range and a repetition rate between 0 and 65kHz. Materials that can be processed by selective laser melting are mainly steels. On the other hand, it is possible to treat different materials (steels, titanium alloys, aluminum alloys, ceramics, glass, etc) by means of laser micro-machining.

LMD machine is characterized by a 5-axis movement system and by an inert chamber that allows processing several materials including reactive metals such as titanium and aluminum alloys. LMD is used for solid freeform fabrication and for laser cladding.

The main research topics carried out in the laboratory are:

- Study and characterization of materials obtained by Selective Laser Melting and Selective Laser Sintering
- Manufacturing of hybrid structures and porous structures with controlled density by Selective Laser Melting
- Thermal treatments of sintered materials
- Laser surface processing of metals and glass
- Repair of aeronautic components by Laser Metal Deposition
- Freeform fabrication of complex geometries by Selective Laser Melting and Laser Metal Deposition
- Laser Metal Deposition of WC by Functionally Graded Materials technique
- Development of numerical and analytical models for process optimization

**Collaborations with companies and institutions**

- Ge Avio
- Elfim srl
- Università di Salerno

**Contact person**

Sabina Luisa Campanelli  
sabinaluisa.campanelli@poliba.it

**Competencies and research activities**

The laboratory carries out research activities mainly on the following topics:

- Contact mechanics
- Fracture mechanics
- Fatigue
- Adhesion and friction
- Tribology
- Soft materials
- Finite element simulations
- Mechanics of solids

The goal is to employ highly innovative, design-oriented, methodologies in the field of mechanical and structural engineering for predicting life cycle and behaviour of mechanical components. The laboratory is equipped with:

- Non-Contacting Video Extensometer
- Electrodynamical testing machine based on linear motors
- SPECTROCHECK – Mass Spectrometer
- Multi-core Workstation
- Resonant fatigue testing machine
- Optical microscope

**Collaborations with University and Research Institutes**

- École supérieure de physique et de chimie industrielles de la Ville de Paris - Laboratoire de Sciences et Ingénierie de la Matière Molle (Paris, France), Research topics: soft matter, fracture mechanics, adhesion and friction.
- Imperial College London - Department of Mechanical Engineering, (London, UK). Research topics: tribology, contact mechanic, finite element methodology.
- Saarland University - Faculty of Natural Sciences and Technology (Saarland, Germany), Research topics: contact mechanics.

**Collaborations with companies and institutions**

- Polimech srl
- Magna PT SpA
- CMC srl – Aerial platforms
- A2F Ingegneria srl
- OMC Axles&Trailers srl
- Tecnomech Engineering srl
- ICAM srl

**Contact person**

Luciano Afferrante  
luciano.afferrante@poliba.it

**Competencies and research activities**

The research group working in this laboratory, in the field of Experimental Mechanics, has developed wide experience for the stress-strain measurement on innovative materials and real components, also for in situ inspection.

Mechanical Characterization of Materials is a very important topic in the analysis of materials.

Data coming from experimental tests are necessary to a proper design and to an accurate formulation of numerical simulations. To fully characterize the material response to external loads, many types of tests can be performed, requiring specific equipment and tools for the analysis of the results.

Some tests are ruled by technical standard, while ad hoc experiments have to be planned in order to characterize innovative materials.

**In this lab. we can perform:**

- Classical Mechanical Characterization (standard test – ad hoc test)
- Hybrid Mechanical Characterization (numerical+experimental)

The main activities of the laboratory concern with the application and the improvement of the most widespread experimental techniques for the measurement of displacements, strains and stresses (i.e. strain gage methods coupled with static and dynamic acquisition systems, acoustic emissions, thermography, digital image correlation-DIC, photoelasticity on models and reflection photoelasticity on real structures, moiré interferometry, digital holography, speckle interferometry, structured light projection system. All techniques are fully automated by means of computers and software for

data elaboration and analysis.

The Lab. is fully equipped for the mechanical characterization of materials and structures (static, fatigue, impact tests) in different environmental conditions (temperature and humidity controlled), utilizing experimental techniques for the real time monitoring of stress conditions.

In the laboratory are present 7 loading machines for static, dynamic and low velocity impact tests (load capacity from 500 N to 500 kN; load frequency up to 150 Hz).

Moreover, a vertical load frame (5 m x 5 m) for 1:1 mechanical test on real component with two MTS hydraulics actuators (250 kN) is available.

Furnace and climatic chambers are also available for tests at low/high temperature (in the range -165 °C to 1400 °C).

Equipment for metallographic analysis and fracture inspections have been recently updated (i.e. durometers, several microscopes including a Scanning Electron Microscope, Zeiss Coordinate Machine Measurement). A corrosion chamber is also available to produce accelerated aging of materials and components in order to study how mechanical performances are modified.

Lab. is equipped with modern instrumentations for displacement/strain/stress measurements (strain gage, Bragg's fibres, wi-fi sensors), optical set up (moiré and speckle interferometry, holo-shearography, DIC), acoustic emission, thermography, 3D reconstructions by means of structured light projection system.

Finally, a computer cluster is present for the nu-

## Laboratory of testing on innovative materials and structures

merical analysis of stresses and structural optimization.

### Collaborations with companies and institutions

Many collaborations have been established in the recent years with industry (i.e. Alenia Aeronautica (Leonardo) – Boeing – Agusta - Avio – Airbus - Sital Aerospace - Magneti Marelli – Bosch - Mer Mec - Centro Ricerche Fiat - SRB Costruzioni - Ansaldo, etc.) and university/research centre (i.e. Univ. of Nottingham; Univ. of Liverpool; Univ. of Manchester; Laboratoire de Fiabilité Mécanique, Université de Metz; Univ. of Lille 1; Univ. Of Chalon en Champagne; University of Washington, Seattle; University of California, San Diego; Illinois Institute of Technology, Chicago; Institut Fraunhofer LBF, Darmstadt; Institute of Micromechanics and Pho-

tonics, Warsaw University of Technology; Dep. de Ingeniería Mecánica, Univ. de Zaragoza; Dublin City University; Trinity College; McGill University, Canada; ENEA, CALEF, CETMA, etc.).

### Contact person

Katia Casavola  
katia.casavola@poliba.it

## DMMM

## Levantine Lab for Sustainable technologies (SESTANTE)

### Competencies and research activities

The strong commitment of Politecnico di Bari towards manufacturing sustainability deploys into the proactive promotion of social involvement of its students into the sustainability topics. The long experience on-the-field led to build up a multidisciplinary laboratory for the promotion and development of manufacturing sustainability both in research and teaching.

The services offered are directed toward students and/or teachers as well as outside Politecnico (research and third mission) toward manufacturing companies.

The main services are: analysis for optimisation of manufacturing processes and sustainability improvement in manufacturing and production systems.

Labs are oriented to let the student gain critical skills on recognising, measuring and applying sustainable solutions to different manufacturing processes.

Strong competences are available on the analysis of complex real production systems, on the use of advanced methodologies and non-conventional tools for designing and implementing continuous process actions.

## Levantine Lab for Sustainable technologies (SESTANTE)

### Collaborations with companies and institutions

- ILVA s.p.a. (Taranto)
- Bosch T.D.It (Bari)
- Masmec (Bari)
- Mermec (Monopoli)
- Getrag (Bari)
- Fantini (Lucera e Terlizzi)
- Buzzi Unicem (Barletta)
- IVECO (Foggia)
- ALENIA (Foggia)
- Natuzzi (Santeramo)
- Cofra (Barletta)
- FIAT Iveco (Foggia)
- Om-Pimespo (Bari)
- Magneti Marelli (Bari)
- Procter&Gamble (Campobasso)
- GEDI Costruzioni S.r.l. (Altamura)
- Intini Legnami (Noci)
- Tubinsud (Bari)
- SIEMENS (Pisa)
- Tecnomec Enginnerign s.r.l (Altamura)
- Mobilturi (Bari)
- Bawer (Santeramo)
- Master Italy (Conversano)
- TERA (conversano)
- VANPLAST (trani)
- COFRA (Barletta)
- Globeco (Molfetta)
- Apulia Strech (Martina)
- Brovedani (Modugno)
- Gruppo Turi (Modugno)

### Contact person

Michele Dassisti  
michele.dassisti@poliba.it



### Competencies and research activities

Math-Lab is a laboratory dedicated to didactics, students' guidance, research and experimentation. In particular, activities in the field of didactics and experimentation are developed in collaboration with the world of secondary school by promoting students' orientation, teachers' formation and experimentation of non-traditional forms of teaching.

In the spirit of "alternanza scuola lavoro" (work-linked training) which is one of the most relevant innovations of the Italian educational system (law 107/2015 the Good School "La buona scuola"), and in line with the open school principles, students of secondary school can attend didactical modules in the Math-Lab laboratory.

Students, thanks to an interactive board, will be allowed to use manipulative software such as GeoGebra in a more attractive way, they will be supported on Opedia platform (on-line learning) and by Teachnet didactical LAN, and will be led to reinforce their 3D visualization by digitalizing, manipulating and printing 3D objects.

Summer courses are being organized in order to promote Science, Technology, Engineering and Mathematics (STEM learning) with respect also to the parity of genders.

The laboratory is used in the validation processes, i.e. in the proof of convergence of numerical schemes, of the various models developed in the research activities.

The main applied research is the development of robust numerical methods, which are able to simulate traffic on road networks, salt fingering phenomena, and the dynamical (discontinuous)

behaviour of thin elastic 1D and 2D bodies with an adhesive interaction with the environment.

### The scientific director has been:

Classroom Trainer and online tutor for the following ministerial projects of renovation of the teaching staff of SSMMSS developed by the National Agency for the Development and Autonomy Scholastic (ANSAS former INDIRE) or the National Assessment of Educational System Education and Training (INValSI) in the following courses:

- National teachers training project area Informatics ex D.L.vo n. 59/2004
- National training teachers project FORTIC C1 (second edition) s.y. 2005/06, national project Digiscuola s.y. 2006/07 and 2007/08
- National training teachers project PON "technologies for teaching (course 2)" Annuity 2008-Code project- E-2-FSE-2008-172
- National training teachers project PON "technologies for teaching (course 2)" Annuity 2009-Code project- E-2-FSE-2009-140
- National project "PON M@t.abel+" for training teachers for mathematics annuity 2009/2010 Code project--E-2-FSE-2009-161
- National project "PON M@t.abel+" for training teachers for mathematics annuity 2010/2011 Code project--E-2-FSE-2010-88
- Expert plan National Dissemination digital white-board annuities 2010.
- National plan for dissemination digital white-board annuities 2011.
- National Plan of "Training and Information on the survey PISA" Structural Funds Programming

## MATH-LAB

2007/2013-PON "Skills Development" AXIS I - Human Capital Action B.3 "Interventions of training on evaluation in the learning process."

### Collaborations with companies and institutions

- The laboratory, completed toward the end of 2016, now constantly interfaces with the Promotion Orientations Placement project especially in the LAB action "Stage in the laboratories of search" offered by Politecnico di Bari to secondary schools.
- The following secondary schools are collaborating:

- Liceo Scientifico "E. Fermi" in Bari for "alternanza scuola lavoro" stages.
- Liceo Scientifico "Federico II di Svevia" in Altamura for "summer STEM courses".

### Contact person

Giuseppe Devillanova  
giuseppe.devillanova@poliba.it

## DMMM

## Mechanical and Thermal Measurements Laboratory

### Competencies and research activities

The laboratory of Mechanical and Thermal Measurements is arranged to perform mainly experimental activity typical of the field of research: basic metrology, calibration of sensors, design and manufacture of instrumentation for environmental applications, analysis of the signals, the temperature and pressure measurements, vibration measurements, acoustic measurements, fluid dynamic measurements, monitoring and control of machinery and plants.

### Major Facilities and Instrumentation

- Wind-Tunnels

- LDA 2D Dantec
- LDA 3D Dantec
- LDV 100 Polytec
- PIV 2D Dantec
- Wire Anemometer CTA
- Piezo accelerometers
- Electro-Magnetic flowmeters
- Digital Electronic Instruments

Part of the equipment available also allows its use for educational activities, mainly addressed to laboratory internships, where students can simulate and / or manage the operation tools through Lab-

## Mechanical and Thermal Measurements Laboratory

View or Matlab/Simulink platforms on opportune test benches.

### Collaborations with companies and institutions:

- Centro Ricerche ANSALDO Caldaie - Gioia del Colle
- Centro IRCCS Medea – Brindisi
- Centro LAT SITEC – Molfetta
- Loccioni S.p.A - Ancona
- AQP S.P.A. – Bari
- BOSH – Modugno (BA)
- C.M.C. S.r.l. - Carovigno (BR)
- Consorzio CETMA - Brindisi
- TU/e (University of Technology) – Eindhoven, Germany
- Vrije University - Belgium

- VKI Insitute - Belgium
- Università Politecnica delle Marche
- Politecnico di Milano
- Università del Salento
- Università di Reggio Calabria
- Università di Perugia

### Contact person

Laura Fabbiano  
laura.fabbiano@poliba.it

## DMMM

## Metallography and Microscopy (M&M-Lab)

### Competencies and research activities

The M&M-Lab is part of the network of laboratories of the research group on Materials and Innovative Technology (SMATI group), which work in the scientific Area of Manufacturing Systems and Technologies. The network includes the laboratories of Advanced Forming & Manufacturing, Physical Simulation of Manufacturing processes, Optimization of Manufacturing Processes by Numerical Simulations, and Thermo-Physical Characteriza-

tion of Post-Formats Polymers. The laboratories of the network are located in the DMMM, Viale Japigia 182 – Bari - Italy.

Aim: The M&M-Lab performs teaching, research and service activities on the analysis of metals and alloys microstructure in relation to the physical and technological process involved in the production of an industrial part. Using Metallography for the specimens preparation (sectioning, mounting,

## Metallography and Microscopy (M&M-Lab)

course grinding, fine grinding, mechanical and electrochemical polishing, chemical and electrochemical etching) and Optical Microscopy for the microstructure evaluation, the procedures implemented in the lab allow to determine whether an alloy was correctly manufactured, observing the amount and morphology of microstructures or defects such as voids, cracks or impurities.

**Skills:** Supporting the SMATI group research activities, in the M&M-Lab skills on the metallographic analysis of steels and light alloys (titanium, magnesium and titanium) have been developed, when processed with different manufacturing processes, such as heat treatments, laser beam welding, laser beam hardening, laser-MIG welding, MIG and Cold Metal Transfer welding, explosion welding of dissimilar aluminium-steel, superplastic forming, sheet metal forming (in cold, warm and hot condition).

**Current research activity:** Currently, the M&M-Lab is involved in research activities financed by the Ministry of Education and by private industry, aimed to the (i) experimental validation of the process analysis of new assembly technologies for the lightening of vehicle structures (Single-Side Resistance Spot welding, Friction Stir Spot Welding, Friction Element Welding, fiber laser welding), (ii) hot stamping of advanced high strength steel.

### **Collaborations with companies and institutions:**

- Centro Ricerche Fiat - TO
- Fontana Group - LC
- Omer -PA
- Getrag S.p.A. - Bari
- Borsh - Centro Studi Componenti per Veicoli

S.p.A. - Bari

- Nuovo Pignone - Bari
- Master - Conversano (BA)
- MasterLab - Conversano (BA)

### **Contact person**

Luigi Tricarico  
luigi.tricarico@poliba.it

### Competencies and research activities

Mixed reality (MR), the next-generation everyday experience, surpasses the paradigm of fully mechanical or fully digital goods, with a potentially disruptive impact on almost every field of human activities. However, evolutionary design is not applicable, and the challenge is to explore the benefits and limitations of the combination of tangible assets and the upcoming technologies like metaverse, spatial/contextual/multimodal interfaces, sensor, and data-rich environments, AI, and IoT.

MELAB fosters products and services revolution with a multidisciplinary laboratory, integrating engineering competencies with creative design and human sciences. The goal is to employ a highly creative, design-oriented, holistic approach to MR for multisensory, engaging, intuitive, and comfortable experiences. Instead of pursuing mere performance and efficiency, MELAB follows a sustainable and inclusive driver, building applications with a positive impact on society, human life, and the environment.

Main research activities focus on the application of MR products and services to a wide range of enterprises, whatever the dimension, digitalization, and specialization level, including creative craftsmanship. A special interest is towards “made in Italy” industry and the incoming challenges toward sustainability and digitization.

The expected outcomes are novel “out of the box” creative and multisensorial experiences, improving the state of the art in various sectors like the fashion industry, healthcare, wayfinding, logistic, yacht design, sport, leisure, etc.

### Collaborations with companies and institutions:

- Hevolus– Molfetta (BA)
- Emme Evolution – Martina Franca(TA)
- Genesys Software (BA)
- Marea - Centro di Cultura del Mare Gallipoli (LE)
- Neo yachts and Composities (BA)
- Tecbus - Modugno (BA)

### Contact person

Michele Fiorentino  
michele.fiorentino@poliba.it

**Competencies and research activities**

The Sim-Bios-Lab is a strongly multidisciplinary research laboratory involving the collaboration of various professionals such as physicians, biologists, engineers and materials scientists aimed at the design and optimisation of biomedical devices.

The activity of the Sim-Bios-Lab is to develop in silico and in vitro models to identify the optimal parameters that biomedical devices must possess to minimise healing time and maximise their performance. The Sim-Bios-Lab also supports the physician in choosing and defining the optimal device to implant in the specific patient in order to maximise the success rate of the implant procedure.

The laboratory's activity fits in well with the innovative approach known as Precision Medicine where therapy is seen not as a treatment aimed at the 'average patient' but as a tailor-made treatment based on the patient's specific individual characteristics.

The laboratory's research activity is articulated on several scales: (i) macroscale: optimisation of the geometry of prosthetic devices; (ii) mesoscale: optimisation of the shape and the pore size of porous structures for regenerative medicine; (iii) microscale: optimisation of the shape of substrates aimed at maximising the adhesion process of cells.

The Sim-Bios-Lab consists of facilities such as:

- software for simulation of biological processes and CAD parameterisation;
- ad hoc designed experimental devices, aimed at the corroboration and validation of the models developed.

**Collaborations with companies and institutions:**

- CNRS UMR 5628 (LMGP), Grenoble 38016, France
- Trinity College Dublin, Trinity Centre for Biomedical Engineering, Ireland
- Max Planck Institute for Medical Research, D-69120 Heidelberg, Germany
- Heidelberg University, D-69120 Heidelberg, Germany
- LaBs Laboratory of Biological Structures, Milano, Italy
- Tecnologica S.r.l., Crotone, Italy
- Università di Salerno, Fisciano, Italy
- Biomechanics Research Group, Universidad Nacional de Colombia, Colombia
- Istituto di Fisica, Università Cattolica del Sacro Cuore, Rome 00168, Italy
- UMR 85, Physiologie de la Reproduction et des Comportements, INRA-CNRS-Université de Tours, IFCE, 37380 Nouzilly, France
- Università di Bari, Bari, Italy
- Università di Foggia, Foggia, Italy
- Università di Ferrara, Ferrara, Italy

**Main Projects**

- Program PON/MISE (D.D. n. 279 of November 29 2018); Decree of Concession n. 1859, April 22th 2020 (Project "FABRICARE", FABRication of Customized bioActive pRosthetic devicEs) financed by The Italian Ministry of Economic Development.
- Programme PON R&I 2014–2020 and FSC (Pro-

ject "CONTACT", Custom-made anti-bacterial/bioActive/bioCoated prostheses ARS01\_01205) financed by the Italian Ministry of Education, University and Research.

- Research project PNRR of the National Competence Centre for Simulation, Computation and High Performance Data Analysis, Spoke 8, In Silico Medicine & Omics Data.

### Contact person

Antonio Boccaccio  
antonio.boccaccio@poliba.it

## DMMM

## Noise and Vibration Laboratory (NVLab)

### Competencies and research activities

Mission of the NVLab at DMMM, PoliBA is the theoretical and experimental analysis of Noise and mechanical Vibrations having the aim of their control. Main sectors of application are macro- and micro-devices, machines, plants and facilities, manufacturing processes, transportations, environment. Main activities are in the fields of theoretical (Multibody/FEM/BEM) and experimental analysis (classical and innovative modal testing, acoustics mapping, environmental testing, and NVH analysis for road/rail vehicles) of the dynamical behaviour of mechanical systems and devices. Experimental activities can be carried out either in lab or in loco.

### Specifically, tests that the lab is able to perform are:

- structural identification by Experimental Modal Analysis (Input-Output Modal Analysis of linear and nonlinear systems), Operational Modal Anal-

ysis (Output-only Modal Analysis), Vibro-Acoustic Modal Analysis tests, Transmissibility-based Operational Modal Analysis, Operational Modal Analysis of vehicle systems;

- vibration measurements by accelerometers, Laser Doppler Vibrometer, and u ( $\mu$ -flown) probes;
- acoustics measurements, i.e. sound power measurements by p-p and p-u ( $\mu$ -flown) sound intensity probes, acoustic impedance measurements by p-u ( $\mu$ -flown) probes, acoustic fields' mapping and source localization by acoustic holography, Transfer Path Analysis (TPA, OPA);
- vibration (environmental) testing of mechanical, mechatronic systems and devices on electro-dynamic shakers of large size (up to 20 kN), under close loop controlled base excitation (linear, log swept sine deterministic, white, pink stochastic).

### The facilities for technical computing are:

## Noise and Vibration Laboratory (NVLab)

Server comprising 2 cluster nodes, each equipped with 2 XEON processors E5-2680 v3, for a total of 96 cores, 448 GB RAM, and 16 TB of disk space.

### The facilities for experimental testing are:

- Mobile PC based multichannel analyzer platform for noise and vibration analysis equipped with the needed software applications, having real-time capability, able to perform signal processing (FFT, 1/n-octave (CPB) and overall analyses simultaneously on the same or different channels/signals), signal generation, modal parameter estimation.
- Electrodynamic shakers (2 N, 200 N, 450 N, 2000 N, 20000 N) equipped with the needed power amplifiers.
- Impact hammer.
- Piezoelectric and piezoresistive accelerometers of different classes with the needed calibrators and cables.
- Impedance heads.
- Laser Doppler Vibrometer and all the needed measure chain components.
- Sound Intensity probe kit equipped with the needed calibrator.
- Sound level meters.
- Microphones of different classes equipped with the needed calibrators and cables.
- Micro-flown transducers.

### Collaborations with companies and institutions:

- The NVLab at DMMM, PoliBA is and has been involved in several national and international cooperation activities with research groups be-

longing to other universities:

- New York University - USA,
- University of Liege - Belgium,
- Aalborg University - Denmark,
- Kiel University - Germany,
- RWTH Aachen University - Germany,
- Università Politecnica delle Marche - Italy)
  
- SISW – Belgium,
- MERMEC – Italy, MASMEC – Italy,
- ISOTTA FRASCHINI MOTORI - Italy.

### Contact person

Leonardo Soria  
leonardo.soria@poliba.it



**Competencies and research activities**

The lab ManOnSim is part of the network of laboratories of the research group on Materials and Innovative Technology ("SMATgroup") whose members operate in the scientific area of Manufacturing Systems and Technologies (ING-IND/16).

The above mentioned network of laboratories is composed by the laboratory of: Advanced Forming & Manufacturing (AF&M-lab), Physical Simulation of Manufacturing processes (PhySiMaP-Lab), Metallography and Microscopy (OMM) and Thermo-Physical Characterization of Post-Formed Polymers.

All the laboratories are located in Viale Japigia 182 – Bari – Italy (DMMM).

The lab ManOnSim is equipped with suitable facilities for the numerical simulation of industrial processes, like:

- Sheet Metal Forming in warm and hot conditions;
- Casting (sand and high pressure);
- Surface treatment (laser hardening, laser remelting);
- Heat treatment on steels and aluminum alloys;
- Multiphysics processes (induction heating, electro magnetic forming, electric heating);
- Residual stresses.

A numerical-experimental approach, based on the mechanical and deformative behavior (using the facilities in PhySiMaP-Lab and OMM-lab) and on the following experimental validation (using the facilities in the AF&M-lab), is adopted.

Both the model tuning and the optimal process conditions are obtained using multi objective optimization techniques based on genetic algorithms and the Response Surface Methodology.

Currently in the lab ManOnSim research activities financed by the Italian Ministry of Education, Universities and Research Government and by private companies are conducted aimed at simulating: (i) the SPF process for producing highly customized biomedical Titanium prostheses; (ii) the warm forming process for producing parts for railways applications; (iii) both the local heat treatment and the stamping process of aluminum heat treated blanks.

**Collaborations with companies and institutions:**

- Fontana Group (Accordo Quadro dal 2015);
- Omer spa (Accordo Quadro dal 2016 ed una convenzione di dottorato);
- Master / MasterLab (Accordo Quadro dal 2016);
- Enginsoft, Mesagne (Brindisi);
- Centro Ricerche Fiat;
- Università degli studi della Basilicata;
- Politecnico di Milano;
- Università della Calabria;
- CNR-IFN UOS Bari;
- Institute for Metal Research, Chinese Academy of Science;
- University of Mugla, Turkey.

**Contact person**

Gianfranco Palumbo  
gianfranco.palumbo@poliba.it

**Competencies and research activities**

The PhySiMaP-Lab is part of the network of laboratories of the research group on Materials and Innovative Technology (SMATIgroup), which works in the scientific Area of Manufacturing Systems and Technologies. The network includes the laboratories of Advanced Forming & Manufacturing, Metallography and Microscopy, Optimization of Manufacturing Processes by Numerical Simulations, and Thermo-Physical Characterization of Post-Formed Polymers. The laboratories of the network are located at the DMMM, Viale Japigia 182 – Bari - Italy.

**Aim:**

The PhySiMaP-Lab performs teaching, research and service activities based on the reproduction in a laboratory scale of a real-world manufacturing process or of the end use of a material. Thermal and mechanical cycles are imposed on small samples of the investigated material, using a commercial physical simulator (3185 Gleeble System) or in home designed equipment. The latter are designed integrating and controlling a Universal testing Machine (200kN - INSTRON 4485), a Digital Image Correlation software (Aramis), a gas pressure system and heating devices based on induction heating or electrical resistance heating. Knowledge acquired through this approach has been used in applications concerning process simulation, testing and basic material studies on steels and light alloys (titanium, aluminium and magnesium).

**Skills:**

Supporting the SMATI group research activities, in the M&M-Lab skills on some process simulation applications, like heat treatments, hot deformation, gas forming, post weld heat treatment have

been developed. Testing applications concern the determination of stress vs. Strain curves in cold, warm and hot condition, Creep/Stress Rupture evaluation, superplastic characterization, weld heat affected zone simulation for weldability assessment, determination of drawability, bendability, stretch-bendability and formability (by Marciniak and Nakazima test) in cold and warm condition (until 300°C). Application in basic materials studies concern work hardening, precipitation hardening and annealing.

**Current research activities:**

Currently, the PhySiMaP-Lab is involved in research activities financed by the Italian Ministry of Education, Universities and Research Government and by private industry, aimed to the (i) experimental validation and the process analysis of new assembly technologies for the lightening of vehicle structures (Single-Side Resistance Spot welding, Friction Stir Spot Welding, Friction Element Welding, fiber laser welding). (ii) hot stamping of advanced high strength steel.

**Collaborations with companies and institutions**

- Centro Ricerche Fiat -TO
- Fontana Group - LC
- Omer -PA
- Masinara Spa - Monteveglio (BO)
- AZ Perazsole Srl - Carinario (CE)
- Getrag S.p.A. - Bari
- Borsh - Centro Studi Componenti per Veicoli S.p.A. - Bari
- Nuovo Pignone - Bari

## Physical Simulation of Manufacturing processes (PhySiMaP-Lab)

- Master - Conversano (BA)
- MasterLab - Conversano (BA)

### Contact person

Luigi Tricarico  
luigi.tricarico@poliba.it

## DMMM

## Polimare Lab

### Competencies and research activities

The Polimare Project is a multidisciplinary laboratory of educational activities and research for the development of systems related to the sea, boating and sailing boats.

The main objective is to investigate and develop new systems and devices for boating, in particular developing the following areas:

- Advanced sustainable manufacturing technologies
- Augmented Reality for easy sailing
- Automatic and manual mechanical devices for driving the vehicle
- Biomaterials for boating
- Green design and production for boating
- Fluid dynamics for innovative boat and propulsion
- Sport ergonomic and efficiency
- Yacht design and interior nautical design
- The Polimare is equipped with virtual calculation and design systems, mechanical equipment for the first prototyping and works in a public-private agreement with a nautical production companies

with hi-tech composite construction devices.

### Collaboration with companies and institutions:

- Secondary Education Institute "Archimede" (Taranto)
- Neo Yacht & Composite, Bitonto (BA)
- Centro Universitario Sportivo Bari

### Contact person

Mario Massimo Foglia  
mariomassimo.foglia@poliba.it

Michele Dassisti  
michele.dassisti@poliba.it

Michele Fiorentino  
michele.fiorentino@poliba.it

Rossana Carullo  
rossana.carullo@poliba.it

Giuseppe Pascazio  
giuseppe.pascazio@poliba.it

### Competencies and research activities

The research group working in the RS lab. has developed wide experience for the measurement of RS by means of different experimental techniques (i.e. HDM with strain gage rosette, HDM with optical methods, X-ray diffractometer, Barkhausen noise). Moreover, the analysis of RS generation and evolution under dynamic load has been implemented also by numerical methods.

The RS lab. is accounted as Italian reference residual stress laboratory for measurement on on-flight component in the aviation industry.

In the past years the Residual Stress laboratory (RS Lab.) reach great experience on the use of the Hole Drilling Method (HDM) for the measure of residual stress on innovative materials (e.g. titanium, sintered materials, composites).

Welded components made by steel, aluminium or titanium alloys were investigated to relate the welding parameter to the mechanical response of the joints, in particular to the fatigue strength.

To estimate sign and magnitude of residual stresses to account properly for their effect in a numerical model is indeed a very difficult task.

RS related to different welding techniques can be studied (laser welding, FSW, LAFSW, electron beam, etc.).

Selective laser melting (SLM) is used in rapid prototyping processes because of the possibility of building complex three-dimensional metal parts. However, the SLM process introduces some modifications in the material due to the thermal cycle produced layer by layer on the component by the laser beam, including alterations of microstructure

and residual stresses. The emphasis on the study of these residual stresses is justified by the strong influence that macro stresses have on the mechanical behavior of the analyzed components.

HDM technique allow a good evaluation of the stress-strain condition in a small area of a structure, but it is a semi-destructive test and does not allow a full-field measurement of the stress condition. So, in order to overcome some limitation related with the HDM, alternative techniques has been developed: in particular, X-ray diffractometer (steel, aluminum, titanium alloys) with chemical etching for in-depth measurements, HDM with optical method (for full field and non-contact measurements), Barkhausen noise and a new methods developed at Politecnico di Bari.

### Collaboration with companies and institutions:

Many collaborations have been established in the recent years with industry (i.e. Avio GE - Alenia Aeronautica (Leonardo) – Airbus – Boeing – Sitaer Aerospace - Magneti Marelli – Bosch, etc.) and university/research centre (i.e. Univ. of Nottingham; Univ. of Sheffield; Laboratoire de Fiabilité Mécanique, Université de Metz; Univ. Of Lille 1; Univ. Of Chalon en Champagne; University of Washington, Seattle; University of California, San Diego; Institut Fraunhofer LBF, Darmstadt; Institute of Micromechanics and Photonics, Warsaw University of Technology; McGill University, Canada; etc.).

### Contact person

Katia Casavola  
katia.casavola@poliba.it

### Competencies and research activities

Over the last 20 years, the Robotic Mobility laboratory of the Polytechnic Università di Bari's DMMM, has developed expertise in the field of design and manufacturing of mobile robots with application to unstructured environments (other than indoor and industrial contexts), e.g. precision agriculture and planetary exploration, which pose many challenges. First, the need to guarantee high mobility on difficult surfaces with varying irregularity and deformability. The research activity also involves the study and development of ultra-light pedal-assisted electric vehicles for urban micro mobility and multi-articulated and underactuated robotic hands for prosthetic and rehabilitation purposes.

The activity is conducted using modern computer aided design tools (e.g., AutoCAD, Solid Works, PTC Creo) and with the aid of multibody simulation software (e.g., MSC Adams). The construction and assembly of the robots is carried out partly by using internal machining at the Polytechnic Università di Bari and partly by innovative mechanical workshops/start-ups in the Apulia area with which the RML has been collaborating for several years.

### Collaboration with companies and institutions:

- University of Michigan (USA), Tohoku University (Japan), Australian Center for Field Robotics (Sydney, Australia), Istituto di Studi sui Sistemi Intelligenti per l'Automazione (STIIMA-CNR, Italy), Autonomous Systems Laboratory of École Polytechnique Federale de Lausanne (EPFL), Universidad di Almería (Spain), Fraunhofer IAIS (Germany), National Research Institute of Science and Technology for Environment and Agriculture (IRSTEA, France), Universidad Técnica Federico Santa María (Chile), Danish Technological Institute

(DTI), Chalmers University of Technology (Sweden), Concordia University (Canada). The main projects in which the RML has been involved or which are currently active are listed below:

- STAR - giving Smell sense To Agricultural Robotics, ERANET ICT-AGRI-FOOD 2022, Partners: Fraunhofer IAIS (DE), Technion - Israel Institute of Technology, Todos Technologies (ISR)
- ANTONIO - Multimodal sensing for individual pLANT phenotyping in agriculture robotics, ICT-AGRI-FOOD 2019, Partners: Main partners: Aristotle University of Thessaloniki (GR), Fraunhofer IAIS (DE), AgriCircle (CH), ISSIA-CNR (IT).
- ATLAS - Agricultural Interoperability and Analysis System, H2020-DT-2018-2: Agricultural digital integration platforms (H2020). Partners: Fraunhofer (DE), AgriCircle (CH), Center for Research and Technology Hellas (CERTH) (GR), CNR (IT), Robot Makers GmbH (DE).
- ADE - Autonomous DEcision making in very long traverses, SPACE-12-TEC-2018: Space Robotic Cluster (H2020), Partners: GMV Aerospace and Defence (SP), Thales Alenia Space (IT), Deutsches Forschungszentrum für Künstliche Intelligenz (DE), Airbus Defence and Space LTD (UK), University of Oxford (UK), King's College London (UK), Université Grenoble Alpes (FR), Universidad de Malaga (SP).

### Contact person

Giulio Reina  
giulio.reina@poliba.it

**Competencies and research activities**

The Lab is a laboratory of educational activities and research for the development of robotic solutions and mechanisms for automatic systems. The researchers of the lab collaborate with other teams in all mechatronics field to integrate mechanical capability with electronic and electrical innovative devices.

The main objective is to investigate and develop new systems and devices for automatic machine, dealing with the following areas:

- Agriculture automation
- Optimized mechanisms for automation
- Robotic and automatic vehicles
- Prosthesis mechanism and exoskeleton
- Machinery to improve sport efficiency
- The robot mechanics lab is equipped with mechanical calculation and design software, measurement equipment, mechanical equipment for the first prototyping.

**Collaboration with institutions and companies:**

- New York University (USA)
- Delft University of Technology (NL)
- ANTY S.R.L., Modugno (BA)
- Osa Demolition Equipment, Molfetta (BA)

**Contact person**

Mario Massimo Foglia  
mariomassimo.foglia@poliba.it

**Competencies and research activities**

The Lab carries out research activities mainly on the following topics:

- Rapid characterization of fatigue behaviour of materials/components with InfraRed techniques
- Stress analysis with Thermoelastic Stress Analysis (TSA)
- Damage monitoring (Acoustic Emission; Thermography, TSA, DIC, etc)
- Fracture Mechanics and fatigue crack growth assessment
- Structural Health Monitoring of material and structures
- Thermophysical characterization of materials for structural behaviour assessment

The lab is equipped with all needed and up to date instruments for damage monitoring (IR cameras in all possible ranges and performances, Strain gauges, hole drilling rosette for residual stresses, etc).

In particular the possibility to use 100kN MTS Hydraulic loading machine with thermal cameras allows the fast analysis of fatigue behavior of various materials (tested for aluminum alloys, titanium alloys, traditional and innovative steels, composites) and fatigue limit evaluation in about 3 days instead of 6-8 weeks needed for standard testing. Research carried out in the lab showed the possibility to obtain the entire fatigue curve. Research also focuses on the study of Fracture Mechanics behavior of materials in order to localize the crack tip position and to assess the Stress Intensity Factor and then, the crack propagation law.

The strong point of the adopted approach is the

applicability on operating real and complex shaped components (i.e. FSW welded joints).

**The research group was awarded of:**

- AEA Technology award during 1998 International Conference of Experimental Mechanics
- Innovation Award of ALENIA AERMACCHI 2014 for development of thermographic innovative technique for resin pocket characterization
- Innovation Award of FINMECCANICA 2014 for development of a system for quantitative measurements of resin pockets.
- AIAS award 2015 for best paper presented in 2014 conference of Italian Association for Stress Analysis
- Best Student Paper at 2017 SPIE Conference "Thermosense"

The vision of the lab is that all engineering lab activities have to be properly used in the territory. The effort is always to consider, in the development of new application or new technologies, the possibility for a proper implementation of the results of the research in the production line or the product development. The lab cooperates strictly with the spinoff company DES - Diagnostic Engineering Solutions.

All activities carried out in the lab are and can be industrialized and customized in proper in line control.

The scientific coordinator registered 4 patents: 2 European related to new instruments for Non Destructive Testing based on thermography and 2 national patents (one for thermography application

## Structural Diagnostic and Thermal Methods for Experimental Mechanics

and one for monitoring blood pressure with a wearable device).

The lab is involved actively in a number of industrial and research projects such as PON, regional, and private collaborations.

### Collaborations with companies and institutions

In recent years the Lab was involved in many funded projects and international collaboration. The following list is not comprehensive of all activities but is a good example of collaborations and technological transfer.

- CIRA (Italian Aerospace Research Centre)
- BAM: Bundesanstalt für Materialforschung und -prüfung (Berlin–Germany).
- Università di Jaen,
- Baker Hughes
- Diagnostic Engineering Solutions srl
- Istituto Tecnologico Aeronautico (ITA), (Brasil).
- CETMA (IT)
- ENEA (IT)
- CNR - ISSIA (IT)
- Bosch
- Leonardo
- Ferrari
- Stellantis
- FIAT Research Centre
- CNR - ITIA (IT)
- Università di Palermo (IT)

- Università del Salento (IT)
- Mermec
- ITRIB (ES)
- GE AVIO
- Tesmec

### Contact person

Umberto Galietti  
umberto.galietti@poliba.it



**Competencies and research activities**

The Lab carries out research activities mainly on the following topics:

- Rapid characterization of fatigue behaviour of materials/components with InfraRed techniques
- Stress analysis with Thermoelastic Stress Analysis (TSA)
- Damage monitoring (Acoustic Emission; Thermography, TSA, DIC, etc)
- Fracture Mechanics and fatigue crack growth assessment
- Structural Health Monitoring of material and structures
- Thermophysical characterization of materials for structural behaviour assessment

The lab is equipped with all needed and up to date instruments for damage monitoring (IR cameras in all possible ranges and performances, Strain gauges, hole drilling rosette for residual stresses, etc).

In particular the possibility to use 100kN MTS Hydraulic loading machine with thermal cameras allows the fast analysis of fatigue behavior of various materials (tested for aluminum alloys, titanium alloys, traditional and innovative steels, composites) and fatigue limit evaluation in about 3 days instead of 6-8 weeks needed for standard testing. Research carried out in the lab showed the possibility to obtain the entire fatigue curve. Research also focuses on the study of Fracture Mechanics behavior of materials in order to localize the crack tip position and to assess the Stress Intensity Factor and then, the crack propagation law.

The strong point of the adopted approach is the applicability on operating real and complex shaped

components (i.e. FSW welded joints).

The research group was awarded of:

- AEA Technology award during 1998 International Conference of Experimental Mechanics
- Innovation Award of ALENIA AERMACCHI 2014 for development of thermographic innovative technique for resin pocket characterization
- Innovation Award of FINMECCANICA 2014 for development of a system for quantitative measurements of resin pockets.
- AIAS award 2015 for best paper presented in 2014 conference of Italian Association for Stress Analysis
- Best Student Paper at 2017 SPIE Conference "Thermosense"

The vision of the lab is that all engineering lab activities have to be properly used in the territory. The effort is always to consider, in the development of new application or new technologies, the possibility for a proper implementation of the results of the research in the production line or the product development. The lab cooperates strictly with the spinoff company DES - Diagnostic Engineering Solutions.

All activities carried out in the lab are and can be industrialized and customized in proper in line control.

The scientific coordinator registered 4 patents: 2 European related to new instruments for Non Destructive Testing based on thermography and 2 national patents (one for thermography application and one for monitoring blood pressure with a wearable device).

The lab is involved actively in a number of industrial and research projects such as PON, regional, and private collaborations.

- ITRIB (ES)
- GE AVIO
- Tesmec

### Collaborations with companies and institutions

In recent years the Lab was involved in many funded projects and international collaboration. The following list is not comprehensive of all activities but is a good example of collaborations and technological transfer.

- CIRA (Italian Aerospace Research Centre)
- BAM: Bundesanstalt für Materialforschung und -prüfung (Berlin–Germany).
- Università di Jaen,
- Baker Hughes
- Diagnostic Engineering Solutions srl
- Istituto Tecnologico Aeronautico (ITA), (Brasil).
- CETMA (IT)
- ENEA (IT)
- CNR - ISSIA (IT)
- Bosch
- Leonardo
- Ferrari
- Stellantis
- FIAT Research Centre
- CNR - ITIA (IT)
- Università di Palermo (IT)
- Università del Salento (IT)
- Mermec

### Contact person

Umberto Galietti  
umberto.galietti@poliba.it

### Competencies and research activities

The Tribodynamics Lab aims at studying the adhesive properties of soft micro-structured interfaces subjected to variable loadings. Understanding the adhesive interactions between mechanical components is of fundamental importance in the development of miniaturized-interfaces, in the picking and manipulation of objects by robotics arms, in the field of human-robot interaction. Commonly, the design of bio-inspired adhesive surfaces has followed a quasi-static approach, ignoring the effects due to dynamic excitations (vibrations). However, recent experimental evidences have shown that micrometric vibrations with frequencies below 1 kHz are able to interact with macroscopic adhesive properties of soft contacts.

The Tribodynamics Lab was founded in 2022 thanks to the funds received by the ERC Starting Grant project "SURFACE". At the Tribodynamics Lab we conduct both numerical and experimental research. Numerical techniques are used to simulate the contact of soft interfaces where viscoelasticity and adhesion have to be taken into account. To this end both commercial Finite Elements and ad-hoc Boundary Elements codes have been developed.

The experimental part is supported by brand-new equipment for topography measurements, rapid prototyping, polymeric substrate micro-fabrication, 3D printing, plasma activation, adhesion test benches, shakers and a data acquisition system for dynamic loading.

The major equipment is the microfabrication system "Photonic Professional GT2" by Nanoscribe, which, exploiting two-photon-polymerization, allows for micro-fabrication polymeric interfaces with extremely low resolution, down to 200 nanometres. Hence, the Tribodynamics Lab is capable to print interfaces with optimized topographies

with minimal surface roughness. The Laboratory is equipped with the latest digital microscope by Keyence (VHX-7000) which allows sample visualization up to a 2500x magnification, automatic stitching and 2D and 3D reconstruction of the interface. Furthermore, 2D and 3D biocompatible and/or biodegradable scaffolds can be fabricated for bioengineering application. In December 2023 the Tribodynamics Lab has started working on the PRIN project "REPAIR", together with the Department of Biotechnology of the Università di Bari, which aims at the development of bio-compatible cell scaffolds for neurosensory retina-retinal pigment epithelial interface re-attachment.

### Collaborations with companies and institutions

The Tribodynamics Lab collaborates with several international research institutes and universities, in particular with: the Department of Mechanical and Aerospace Engineering at La Sapienza (Rome, IT), the Laboratoire de Tribologie et Dynamique des Systèmes (LTDS – Lyon, FR), The Hamburg University of Technology (Hamburg, DE), the Berlin University of Technology (Berlin, DE), the Budapest University of Technology (Budapest, HU), the Department of Biotechnology of the Università di Bari (Bari, IT).CIRA (Italian Aerospace Research Centre)

### It follows a list of the major equipment available:

- 3D microfabrication system based on two-photon-polymerization, resolution down to 200 nm, Photonic Professional GT2 (Nanoscribe)
- Digital microscopy 4K, up to 2500x magnification, Keyence VHX-7000N
- Data Acquisition System, Krypton Dewesoft
- High precision linear stage, PI
- High precision force sensor, Futek
- High precision accelerometer, Micro-Measure-

ments

- Dynamic shaker up to 250 N max force, Dynalabs
- Total exhaust fume hood for polymer/solvent manipulation
- Plasma activation system, Colibri, Gambetti
- UV and thermal polymer curing, Formlab
- Rapid prototyping, Prusa i3MK3S+
- Optical table and optomechanical components
- Workstations for numerical simulations

**Contact person**

Antonio Papangelo  
antonio.papangelo@poliba.it

### Competencies and research activities

The TriboLAB belongs to the net of research labs TRASFORMA, recently established at Politecnico di Bari thanks to the financial support of the Government of Apulia Region. The mission of the TriboLAB is to investigate phenomena taking place at the interface of contacting bodies, such as rough contact mechanics, friction, hydrorepellence, lubrication, crack propagation.

### Collaborations with companies and institutions

The Tribolab has been funded by several Industries, Academic Departments and local Governments.

The research collaborations are:

- “LASER4FUN” (European Project “Marie Skłodowska-Curie”). Scientific Coordinators Antonio Ancona and Giuseppe Carbone. The funding assigned to the Bari research unit of CNR-Politecnico di Bari–Università, is 252k€.
- “INNOVHEAD “ PON Ricerca e Competitività 2007–2013. Research Unit Scientific Coordinator G. Carbone. The funding assigned at the research unit: 193k€
- “Elettronica di controllo, sistema d’iniezione, strategie di combustione, sensoristica avanzata e tecnologie di processo innovativi per motori diesel a basse emissioni inquinanti”- PON Ricerca e Competitività 2007–2013. Research Unit Scientific Coordinator G. Carbone. The funding assigned at the research unit: 93k€
- “Modelli Innovativi per Sistemi Meccatronici”, APQ Ricerca III Atto Integrativo della Regione Puglia. Research Unit Scientific Coordinator G. Carbone. The research unit has been funded with 130k €. “Tecniche di Ricerca Avanzate per lo Studio e l’implementazione della FORMAtura con mezzi flessibili di Leghe Leggere tramite l’utilizzo di superfici ad attrito controllato e lamiere saldate di differente spessore (TRASFORMA)”. Research Unit Scientific Coordinator G. Carbone. The project has been funded by Apulia Region (Bollettino Ufficiale della Regione Puglia -12/02/2008). The research unit has been granted with a budget of 500k €.
- “An Integrated Framework for Engineering Bio-Mimetic Adhesive Interfaces (EBioAdI)”. Scientific Coordinators G. Carbone and P. Decuzzi. The project was funded for the period 2008–2011 by the European Science Foundation. “Metal chain CVT efficiency and traction performances” . Scientific Coordinator G. Carbone. The project was funded by the dutch company Gear Chain Industrial B.V. Neunen The Netherlands for a total amount of 66k€. The project involved also JTEKT – Corporation Japan.
- “Innovative models for Mechatronic systems”. Scientific Coordinator of the research unit on Tribology of surfaces: G. Carbone. The total funding under the responsibility of Carbone was of 130 k€
- “Friction and Wear of Ceramic and Composite Materials Scientific Coordinator G. Carbone The project was funded by General Electric – Nuovo Pignone – Italy for a total amount of 37k€ + VAT
- “International Center for Ocular Physiopathology-Fondazione Banca degli Occhi del Veneto Onlus (FBOV)” Scientific Coordinator of the research unit on Tribology of surfaces: G. Carbone. The aim is to determine the mechanical properties of human cornea membranes by means of Atomic Force Microscopy. The project was funded by FBOV.

## Tribology Laboratory (TriboLab)

- “Sviluppo di Materiali Avanzati e Tecnologie Innovative per turbomacchine per impiego in condizioni estreme-SMATI”. Scientific Coordinator of the research unit on Tribology of surfaces: G. Carbone. The aim is to design and develop wear and corrosion resistant coatings.
- “ARGOTRACTORS” Scientific Coordinator: G. Carbone The total funding was 80k€ + VAT “BOSCH” Scientific Coordinator: G. Carbone The total funding was 40k€ +VAT
- “ESI” Scientific Coordinator Tribology of surfaces: G. Carbone The total funding was 20k€ +VAT

### Contact person

Giuseppe Carbone  
giuseppe.carbone@poliba.it

**Competencies and research activities**

The VR3Lab is a multidisciplinary research facility for the development and testing of innovative tools and methods in engineering and medicine. Its goal is to explore and apply cutting edge technologies in the following areas:

- Virtual and Augmented Reality simulation & marketing
- Augmented Reality solutions for Industry 4.0
- Augmented Reality maintenance
- Virtual training
- Virtual tours and experiences for cultural heritage
- Natural User Interfaces
- Industrial advanced interfaces
- CAD and PLM consulting
- Composite materials modelling
- CAD advanced surfacing and style
- Reverse engineering and CAD reconstruction
- Industrial ergonomics and human-centered design
- Bioengineering simulations
- Bioengineering devices design and prototyping

The lab is provided with the latest VR & AR technologies in order to test and apply the optimal solution to the specific problem: head mounted displays, led and laser projectors, a virtual theater, software tools and libraries.

Moreover, 3D scanners and 360-pano cameras are available for object and ambient reconstruction, while a 3D printer and a mechatronic-lab allow for prototyping novel devices.

**Collaborations with companies and institutions**

- Idea75 – Bari (BA)
- Hevolus – Molfetta (BA)
- SER&P – Bari (BA)
- InResLab – Monopoli (BA)
- ICAM - Putignano (BA)
- Master Italy - Conversano (BA)
- Simulo - Bari (BA)
- HGV - San Severo (FG)
- 3D Research - Rende (CS)
- Tecbus - Modugno (BA)
- LORAN - Modugno (BA)

**Contact person**

Antonio Uva  
antonio.uva@poliba.it

### Competencies and research activities

The subsonic closed loop wind tunnel of the GAVE Lab has a 1 meter squared test section.

The wind tunnel is of rectangular shape, is 30 m long, and has a sufficient length to ensure the uniformity of the flow across the test section.

The wind tunnel can be divided into four different zones.

The first zone (downstream the test section) includes a diverging portion of increasing rectangular section, whose task is to recover part of the kinetic energy; two (90deg) curves follow, guiding the flow toward the inlet of the fan. Upstream the fan, orifices are provided in order to prevent the wind tunnel pressurization due to the air heating during steady state operation.

The second zone is constituted by the axial fan, which is driven by a three-phase AC motor (55kW) mounted on a special cradle inside the cylindrical duct which encloses the impeller.

The possibility to adjust the engine rotation speed by means of a Variable-Frequency Drive (VFD), allows one to obtain variable speed in the test section, and then to recreate different operating conditions.

The third zone, located downstream the fan, includes other two curves (this time with guide vanes), that allow the curvature of the flow without introducing flow distortions or significant secondary flows.

Finally, a convergent duct (with a contraction ratio equal to 4:1) accelerates the flow up to the rated speed on the input section of the test area (this is

subsonic wind tunnel, then air can be considered incompressible). Upstream the convergent there is an "honeycomb", in order to make the flow uniform (elimination of any macro-turbulence).

The last zone is constituted by the test section composed with side walls made of transparent polycarbonate. This material allows one the use of non-intrusive laser measurements.

Moreover, its structure consists of a Rexroth aluminum frame. In the test section, a three-axis Cartesian robot controls the position of a hot-wire probe for measuring the wind speed. The upper closure panel of the test volume is formed, therefore, by two polycarbonate half-panels, between which is inserted the wind speed probe; the two panels are movable, in order to allow the horizontal displacement of this probe.

The three-axis Cartesian robot is basically composed of the following elements: stepper motors; control and driving boards; profiles and guides (traversing).

### Contact person

Sergio Camporeale  
sergio.camporeale@poliba.it





**Drone** flying in front of the seal of the Polytechnic Università di Bari.





### **AEEI - ARCHITECTURAL & ENGINEERING SURVEY OF ENVIRONMENT AND INFRASTRUCTURES S.R.L.**

#### **Competencies**

Integrated survey, Environmental and Structural monitoring, Intelligent points cloud viewer, Remote sensing, GIS and Database.

[www.aesei.it](http://www.aesei.it)

#### **Contact person**

Domenica Costantino  
Mobile: + 393338697933  
Tel & Fax: +390994733215  
[info@aesei.it](mailto:info@aesei.it)

### **AP-IS - APULIA-INTELLIGENT SYSTEM S.R.L.**

#### **Competencies**

Intelligent Systems, Industry 4.0, Computer Vision, Diagnostics, Security.

[www.spinoffapis.com](http://www.spinoffapis.com)

#### **Contact person**

Francescomaria Marino  
Mobile: +393204316384  
Tel & Fax: +390805963586  
[info@spinoffAPIS.com](mailto:info@spinoffAPIS.com)

### **APULIAN BIOENGINEERING S.R.L.**

#### **Competencies**

Decision Support System (DSS) for clinical and industrial applications, Electronic and Information Bioengineering, Human-Machine Interaction, Intelligent Systems, ICT Solutions for Industry 4.0, Machine Vision for Industry 4.0, Intelligent Biomedical Computer-Aided Decision Systems

[www.apulianbioengineering.com](http://www.apulianbioengineering.com)

#### **Contact person**

Vitoantonio Bevilacqua  
Mobile: +393476428361  
Tel & Fax: +390805963326/3397  
[info@apulianbioengineering.com](mailto:info@apulianbioengineering.com)  
[vitoantonio.bevilacqua@poliba.it](mailto:vitoantonio.bevilacqua@poliba.it)

### **AUTOLOGS - AUTOMATION IN LOGISTICS AND SERVICE SYSTEMS S.R.L.**

#### **Competencies**

Industry 4.0, Decision Support System (DSS), Logistic, Optimization, Automation.

[www.autologs.eu](http://www.autologs.eu)

#### **Contact person**

Maria Pia FantiW  
Mobile: +393476146434  
Tel. : +390805963312 (Bari office)  
Tel. : +39040558784 (Trieste office)  
Fax: +390805963410  
[info@autologs.eu](mailto:info@autologs.eu)

## SPIN-OFF companies

### BEST - BARI ELECTRONIC SYSTEMS FOR TELE-COMMUNICATIONS S.R.L.

#### Competencies

Custom integration of TLC systems, HW and SW integrated platforms for biomedical/welfare support, Microwave and mm-wave systems for industrial automation, Wireless multi-sensor networks for environmental monitoring, Custom design and development of electronic systems.

[www.bestengineering.it](http://www.bestengineering.it)

#### Contact person

Giuseppe Coviello  
Mobile: + 393479755323  
[info@bestengineering.it](mailto:info@bestengineering.it)

### BLOKKO S.R.L.

#### Competencies

Customizable modular blocks, Innovative solutions for the world of construction and design, System of movable and multifunctional walls, Walls integrated with sustainable technology.

#### Contact person

Calogero Montalbano  
Tel: +39 080 596 3568  
[calogero.montalbano@poliba.it](mailto:calogero.montalbano@poliba.it)

### B.R.E.D. - BUILDING - REFURBISHMENT AND DIAGNOSTICS S.R.L.

#### Competencies

Building Diagnostics, Innovation in Building, Building Refurbishment, Cultural Heritage, UAV Surveys.

[www.bred-srl-com](http://www.bred-srl-com)

#### Contact person

Fabio Fatiguso  
Tel: +390805963678

Rocco Rubino  
Tel: +390805963442  
[info@bred-srl-com](mailto:info@bred-srl-com)

### DES - DIAGNOSTIC ENGINEERING SOLUTIONS S.R.L.

#### Competencies

Performance, Quality, Safety, Integration, Innovation.

[www.desinnovation.com](http://www.desinnovation.com)

#### Contact person

Annalisa Ferrara  
Mobile: +393286274660  
Tel: +390808806497  
[a.ferrara@desinnovation.com](mailto:a.ferrara@desinnovation.com)

## SPIN-OFF companies

### DONKEY POWER S.R.L.S.

#### Competencies

Development of innovative solutions and products for pervasive scenarios in the Semantic Web of Things (SWoT) and Artificial Intelligence fields.

<https://www.donkeypower.it/>

#### Contact person

Michele Ruta  
michele.ruta@poliba.it  
info@donkeypower.it

### GAP - GEOPHYSICAL APPLICATIONS PROCESSING S.R.L.

#### Competencies

Radar Satellite Remote Sensing, VIS/NIR Satellite Remote Sensing, UAV Technologies, Meteorological Services, Biomedical Applications.

[www.gapsrl.eu](http://www.gapsrl.eu)

#### Contact person

Filomena Ciola  
Tel & Fax: +390805442180  
mimma.ciola@gapsrl.eu

### GEET - GEO ENVIRONMENTAL ENERGY TECHNOLOGIES S.R.L.

#### Competencies

Energy efficiency, geothermal low enthalpy, biomass valorization, bio-methane, optimization of the anaerobic digestion.

#### Contact person

Concetta I. Giasi  
Mobile: +393293173220  
geet.startup@gmail.com

### IDEA (INNOVATION, DECISION, ENVIRONMENT, AWARENESS) RESEARCH TRANSFER S.R.L.

#### Competencies

Environmental Data Modelling, Water Distribution System Management, Asset Management, Innovation in Civil Engineering, Courses for Innovation in Water Industry.

[www.idea-rt.com](http://www.idea-rt.com)

#### Contact person

Vincenzo Simeone  
Mobile: +393293173094  
info@idea-rt.com

## SPIN-OFF companies

### INGENIUM S.R.L.

#### Competencies

Technology Scouting, Crowdfunding & Crowdsourcing, Recommender systems & Customer experience, Business process management, Logistics & Performance management.

[www.ingenium.poliba.it](http://www.ingenium.poliba.it)

#### Contact person

Claudio Garavelli

Mobile: +393296206276

Tel & Fax: +390805962719

[ingenium@poliba.it](mailto:ingenium@poliba.it)

### INNOLAB S.R.L.

#### Competencies

Process optimization, Logistics, Decision support systems, Automation, Energy systems.

[www.innolabsrl.it](http://www.innolabsrl.it)

#### Contact person

Nicola Epicoco

Mobile: +393288224827

Tel: +390805963843

[nicola.epicoco@poliba.it](mailto:nicola.epicoco@poliba.it)

### INNOVATIVE SOLUTIONS S.R.L.

#### Competencies

Agri-food, Traceability, Shelf-life, Precision Support Systems, Magnetic Resonance..

[www.innovative-solutions.it](http://www.innovative-solutions.it)

#### Contact person

Vito Gallo

Mobile: +393280021049

Tel: +390805963607

[info@innovative-solutions.it](mailto:info@innovative-solutions.it)

### MICROLABEN S.R.L.

#### Competencies

Design, prototyping and production engineering of custom electronic systems, Wireless sensor networks and IoT applications, Electronic systems for environmental monitoring, Electronic systems for smart metering, Embedded systems.

[www.microlaben.com](http://www.microlaben.com)

#### Contact person

Cristoforo Marzocca

Pierfrancesco Losito

Tel: +390805963536

[info@microlaben.com](mailto:info@microlaben.com)



## SPIN-OFF companies

### OMNIGRASP S.R.L.

#### Competencies

Design and development of low energy consumption robotic grippers that exploit electroadhesion, Soft robotics, Electrical soft robotic gripper for crops harvesting, food industry, textiles, biomaterials, assembling of high-end, delicate goods.

<https://omnigrasp.com/>

#### Contact person

Vito Cacucciolo  
vito.cacucciolo@poliba.it

### POLIMECH S.R.L.

#### Competencies

Mechanical design and Structural Optimization, Continuously Variable Transmission (CVT), Thermoelastic and Dynamic Instability in Clutch and Brakes, Composites, Contact Mechanics, Superhydrophobic surfaces, Seals.

#### Contact person

Giuseppe Pompeo Demelio  
Mobile: +393479665773  
Tel: +395962701  
Fax: +395962777  
polimechsr@gmail.com

### POLYSENSE INNOVATIONS S.R.L.

#### Competencies

Development of optical-based sensors for detection and monitoring of physical quantities in critical fields, Solutions to strategic problems related to the "new green deal", ecological transition and national plan on recovery and resilience, Consultancy on applications related to gas sensing.

<https://polysense.it/>

#### Contact person

Vincenzo Spagnolo  
Tel: +39 0805442373  
vincenzoluigi.spagnolo@poliba.it  
polysense@poliba.it

### QUAVLIVE S.r.l.

#### Competencies

Video encoding as a Service, Video streaming as a Service, Immersive Video, Mobile video surveillance, Video conference as a Service.

[www.quavlive.com](http://www.quavlive.com)

#### Contact person

Saverio Mascolo  
Tel: +390805963851  
info@quavlive.com

## SPIN-OFF companies

### WEA TECNO S.R.L.

#### Competencies

Design and development of wearable sensors for eHealth.

#### Contact person

Francesco Dell'Olio  
Tel: +390805962065  
francesco.dellolio@poliba.it

### WIDEVERSE S.R.L.S.

#### Competencies

Virtual reality, mixed reality, augmented reality, recommender systems, personalized information access, recommendation, personal assistant, artificial intelligence, machine intelligence, cognitive computing.

[www.wideverse.com](http://www.wideverse.com)

#### Contact person

Tommaso Di Noia  
Tel: +393282226200  
info@wideverse.com





## HORIZONTAL TRAP FOR MARINE SEDIMENTS

MISE-UIBM

Patent number IT 102019000000931

### Abstract

The invention aims to solve the typical problems that affect the entrapment of marine sediments in deep waters. Typically, sediment traps must remain vertical in the water to work properly. On the contrary, the proposed trap has been developed to remain horizontal with side entrance and exit, and a central sedimentation tank.

### Keywords

Horizontal sediment trap, Sea sediments, Marine pollution, Climate change, Ocean currents.

### Inventors

Michele Mossa, Marco Orsi, Moluldi Ben Meftah, Francesca De Serio, Sergio Tucci, Antonio Siccardi, Antonio Felice Petrillo

### Contact person

Michele Mossa  
michele.mossa@poliba.it  
Tel: +390805963289

## LIGHTWEIGHT CEMENT BASED MORTAR WITH HIGH THERMAL PERFORMANCES FOR STRUCTURAL APPLICATIONS

MISE-UIBM

Patent Number 0001429017

### Abstract

Cement-based conglomerate, light-weighted by recycled EPS, which makes the compound lighter and highly insulating. The mixture is featured by the partial replacement of sand parts/fractions with corresponding recycled EPS parts. The mixture can be used also for construction of structural components, featured by lightness, sustainability and improvement of thermal properties.

### Keywords

Cement conglomerate, sustainability, recycling, waste reduction, improvement of properties.

### Inventors

Luigi Amati, Giambattista De Tommasi, Fabio Fatiguso, Alessandra Pierucci, Albina Sciotti

### Contact person

Fabio Fatiguso  
fabio.fatiguso@poliba.it  
Tel: +390805963789

## PATENTS

### LOW-COST NON-INTRUSIVE SYSTEM FOR DETERMINING THE PRESSURE IN A CYLINDER OF A DRIVING OR OPERATING MACHINE BY MONITORING THE STRESSES ON THE CONNECTING ROD

MISE-UIBM

Patent number IT 102019000020114

#### Abstract

The proposed invention concerns a low-cost non-intrusive system for evaluating the pressure in the cylinder by monitoring the mechanical stresses which are determined on the connecting rod of reciprocating fluid machines with push crank mechanism. It presents a cost-effective and non-intrusive system for determining the in-cylinder pressure in alternative fluid machinery, such as internal combustion engines and reciprocating compressors. Strain gauge measurements are used to monitor stress and deformation of the connecting rod, from which it is possible to provide a reliable, high-fidelity reconstruction of the in-cylinder pressure signal in real-time. The system also exploits a wireless (or wired) transmission device to capture and digitize the voltage signal from the strain gauge measurements, along with an acquisition and processing system that correlates the signal to the in-cylinder pressure. The processed data can be used for closed-loop control systems in engine control units, allowing for real-time adjustments in operational parameters.

#### Keywords

Connecting rod, cylinder, fluid machines, pressure, strain gauges.

#### Inventors

Riccardo Amirante, Pietro De Palma, Elia Di Staso, Nicola Leonetti.

#### Contact person

Riccardo Amirante  
riccardo.amirante@poliba.it  
Tel. +390805963470

### METHOD AND APPARATUS FOR PROCESSING SIGNALS FOR DETECTING AND SIGNALLING AN IMMINENT LOSS OF BALANCE OF A SUBJECT AND ASSOCIATED SYSTEM FOR PREVENTIVE DETECTION OF A FALL

EPO, USA

Patent Number EP4135576A1, US2023157621A1, WO2021209880A1

#### Abstract

The proposed invention concerns a method for processing physiological signals acquired from a subject that allows the detection of an imminent loss of balance of the subject and the generation of a signal indicating the imminent loss of balance. The method comprises: the reception of electromyographic signals representative of a detected muscle activity of selected muscles of the subject, and brain signals acquired by means of an electroencephalogram and representative of a cortical activity of the subject during said muscle activity; the analysis and processing of the electromyographic signals in order to extract a muscle activity pattern, MAP, and generate an indicator of normality/abnormality of the detected muscle activity pattern; the analysis and processing of the brain signals in order to generate one or more cortical response indicators of the subject upon occurrence of said detected muscle activity; a classification step, wherein at least one indicator of normality/abnormality of the MAP and one or more of said cortical response indicators are correlated to generate a signal indicating an imminent loss of balance.

#### Keywords

Evaluating sense of balance, Fall detection, Electroencephalography [EEG], Electromyography [EMG], Analysis of electromyograms, Monitoring progression or stage of a disease.



**Inventors**

Daniela De Venuto, Giovanni Mezzina,  
Eugenio Di Sciascio, Michele Ruta

**Contact person**

Daniela De Venuto  
daniela.devenuto@poliba.it  
Tel: +390805963582

**METHOD FOR DETERMINING THE MODAL PARAMETERS OF ROAD OR RAIL VEHICLES AND FOR THE IN-DIRECT CHARACTERIZATION OF ROAD OR RAIL PROFILES**

EPO, JAPAN, CHINA  
Patent number EP 3362773 A1, JP 6736669 B2, CN 108139299 B / ZL 015800839090

**Abstract**

Method for the identification of modal parameters (resonance frequencies, damping factors, and modal vectors) of a road or rail vehicle in steady operation, by a smart processing of the outputs of the system (displacements, velocities, or accelerations), measured in defined sensor locations. The invention allows moreover, for the indirect characterization of the statistic properties of road surfaces or railway tracks, which the vehicle is in contact with whilst moving.

**Keywords**

NVH analysis, OMA, Road rail profiles,  
Vehicles modal parameters

**Inventors**

Giovanni De Filippis, Luigi Mangialardi's heirs,  
Davide Palmieri, Leonardo Soria

**Contact person**

Leonardo Soria  
leonardo.soria@poliba.it  
Tel: +390805963484

## PATENTS

### METHOD FOR STABILIZATION OF MARINE CLAYS

MISE-UIBM, PCT  
Patent Number IT 102021000025103,  
WO2023053056A1

#### Abstract

The present invention relates to a novel method for stabilizing marine clays such as sediment, marine sediment or dredging sludge with mussel shell meal and cement, their use and product thereof. Properly treated ground mussel shell flour is mixed with a cement in order to obtain a solid powder composition, which is then mixed with marine clay to give a product that can be used in construction.

#### Keywords

Dredged sediment, mussels,  
circular economy, ecocement.

#### Inventors

Claudia Vitone, Rossella Petti, Alexander Puzrin, Michael Plötze, Maurizio Iler Marchi

#### Contact person

Claudia Vitone  
claudia.vitone@poliba.it  
Tel: +390805963708

### MODULAR STRUCTURAL ELEMENT HAVING SELF-SUPPORTING AND SUSTAINABLE CHARACTERISTICS

EPO (Italy, Germany), CANADA  
Patent number EP2992146B1, EP2992146B1,  
CA2911100C

#### Abstract

The invention consists of a modular, self-supporting structural element for house building construction, which is provided with mechanical constraining means for the dry mutual connection with at least one second modular structural element. The modular structural element has a variable density along at least one reference direction. A building structure comprising a plurality of structural elements which are constrained to each other by said constraining means and a process for the construction of the building structure are also described.

#### Keywords

Self-clinching blocks, earthquake-proof, self-construction, high technical performance building, housing types flexibility

#### Inventors

Calogero Montalbano, Attilio Petruccioli,  
Carla Antonia Chiarantoni, Michele Dassisti

#### Contact person

Calogero Montalbano  
calogero.montalbano@poliba.it  
Tel: +390805963568



## PATENTS

### MULTIPLE RADIAL JOINT

MISE-UIBM

Patent number IT 102018000020032 A1

#### Abstract

The invention consists of a “multiple radial joint with fine angular control” which allows constraining in a reconfigurable way a plurality of elements converging towards a node of a structure, creating rigid systems that can be dismantled and easily modified in shape. Used for bicycle frames, it allows each user to configure the bike with simple tools and with minimal handcrafting.

#### Keywords

Customizable bicycles, Customizable bicycle joints, Customizable bicycle frames, Bike Hacks, Bicycle

#### Inventors

Rossana Carullo, Antonio Labalestra, Antonio De Feo, Rocco Di Liso, Francesco Piccolo, Michele Fiorentino.

#### Contact person

Rossana Carullo  
rossana.carullo@poliba.it  
Tel: +390805963560

### OPTICAL ROTATION SENSOR AS WELL AS METHOD OF MANUFACTURING AN OPTICAL ROTATION SENSOR

WIPO

International Publication Number WO/2014/161565

EPO

International Publication Number EP 2917691A0

US Patent Number 9863771

EPO (Holland, Austria, Greece, Italy, France, Germany, UK, Ireland, Switzerland, Belgium), USA

Patent number EP 2917691 B1, US 9863771 B2

#### Abstract

An optical rotation sensor is provided, comprising an optical ring resonator (RR) formed by a one-dimensional photonic crystal (1D PhC) waveguide, and a bus waveguide. A light input section of the bus waveguide is connectable to a light source, and a light output section of the bus waveguide is connectable to a light detector.

The bus waveguide is optically coupled to the ring resonator within a coupling area which is located between the light input section and the light output section of the bus waveguide. The optical rotation sensor is configured to measure a shift of frequency of a resonance area (or a plurality of resonance areas) close to a band edge of a photonic band gap of the ring resonator, wherein the shift of frequency is caused by a rotation of the optical rotation sensor.

#### Inventors

Ciminelli Caterina, Campanella Edoardo C.,  
Armenise Mario N.

#### Contact person

Caterina Ciminelli  
caterina.ciminelli@poliba.it  
Tel: +390805963404

## PATENTS

### PRECAST COMPONENT WITH HIGH MECHANICAL, THERMAL AND ACOUSTIC PERFORMANCES FOR LOAD-BEARING AND NOT LOAD-BEARING WALLS

MISE-UIBM

Patent Number 0001429016

#### Abstract

Partially precast system for opaque vertical components, both structural and not, featured by high thermal insulation and reinforced by metallic framework. The system is composed of a disposable formwork made of two conglomerate-based panels, both combined with an additional EPS panel showing high thermal insulation. The panels are connected by horizontal transversal connections, in order to shape a reinforced cavity, where concrete (or equivalent with innovative materials) can be onsite poured. The above-described panels become an integral part of the vertical system: the final onsite grouting also connects adjacent wall modules in both longitudinal and transverse direction, in order to create a single integrated structure. The system is designed to withstand suitably the vertical and horizontal stresses of seismic type and to be equipped by plant engineering systems.

#### Keywords

Precast concrete walls, high thermal performance, sustainability, construction methods and techniques, Technical and technological performances of pre-cast systems.

#### Inventors

Luigi Amati, Giambattista De Tommasi, Fabio Fatiguso, Alessandra Fiore, Albina Sciotti.

#### Contact person

Fabio Fatiguso  
fabio.fatiguso@poliba.it  
Tel: +390805963789

### THERMO-MECHANICAL CONTROLLED CRYOGENIC DELAMINATION PROCESS FOR THE RECOVERY OF RIGID MATERIALS COATED WITH PLASTIC MATERIALS

MISE-UIBM, EPO (Germany, Turkey), CHINA

Patent Number IT 0001416552,

EP 2973744 A1, CN 105246604A

#### Abstract

The purpose of the invention is to provide a process for the recovery of raw materials from multilayer artifact. The process involves cryogenic conditioning of the materials to be recovered and exploits the different thermal and elastic behaviour of different layers of different material.

The cryogenic process is based on a methodology which involves the exploitation of the different thermal expansion characteristics of the plastic materials adjacent to the rigid components (in the case of photovoltaic panels in the mono, poly-state crystalline or amorphous) and of the different ductile/brittle transition curves of the same to induce, possibly also simultaneously with mechanical vibration stresses, a controlled thermo-mechanical delamination.

#### Keywords

De-manufacturing, delamination, cryogenic processes, WEEE, recycle

#### Inventors

Michele Dassisti

#### Contact person

Michele Dassisti  
michele.dassisti@poliba.it  
Tel: +393296506022

## DESIGNS PATENTS

### 3D VIOLIN

MISE-UIBM

Number IT 2023000001626

#### Inventor

Giuseppe Fallacara

#### Contact person

Giuseppe Fallacara

giuseppe.fallacara@poliba.it

Tel: +390805963874

## SUPPORT FOR MUSICAL INSTRUMENTS

MISE-UIBM

Number IT 2023000001638

#### Inventor

Giuseppe Fallacara

#### Contact person

Giuseppe Fallacara

giuseppe.fallacara@poliba.it

Tel: +390805963874



Politecnico di Bari is very active in developing partnerships with the industry, especially in the fields of industrial and technological research. Joint research laboratories have been set up between Politecnico and several private companies to respond to a specific research and development issue compatible with the university mission and scope.

Research activities are carried out in different facilities around the university campus.

Currently, there are ten active laboratories specialized in different thematic areas:

- EFB - Energy Factory Bari with AVIO AERO
- I4M - Innovation for Mills Lab with Molino Casillo and Idea75
- MET- More Electric Transportation Lab with Centro Studi Componenti per Veicoli S.p.A (Bosch Group)
- PolySense Lab with Thorlabs, Inc.
- RDC - Repair Development Center Lab with AVIO AERO
- CPS - Cyber Physical Systems with AROL SpA
- HYPER - Laboratory with Transpod Italy Srl
- ETF - Energy Transition to the Future with Centro Combustione Ambiente (CCA), Sofinter Group
- BPM CC: Business Process Management Competence Center with Openwork s.r.l
- IPZS-POLIBA with Istituto Poligrafico e Zecca dello Stato-SpA (IPZS)
- Innovation Hub with TERNA SpA
- IOT 4.0 with Electric80 S.p.A. and SM.I.LE80 S.r.l.
- ESA\_Lab@Poliba with European Space Agency (ESA)
- Baker Hughes Pump Lab with Baker Hughes
- Cognitive diagnostics with Comau SpA

### EFB - Energy Factory Bari

AVIO AERO and Politecnico di Bari, in 2010, realized an integrated multidisciplinary laboratory called "Energy Factory Bari" (EFB), to develop research and development activities in areas of common interest in the fields of aerospace and energy.

The laboratory is located inside the university campus in Bari and it is connected with other laboratories operating in the fields of electrical, information, and mechanical engineering at Politecnico di Bari to develop experimental investigations.

The aim of the laboratory is to coordinate joint research activities, to identify issues for the growth of the Apulian Aerospace Technology District, to monitor the international scientific scene in order to identify the innovative ideas, and to create an area of integrated expertise and human resources in order to rationalize the efforts, according to the interest to both partners.

The research areas involved in the activities of the laboratory also cover:

- high-speed electrical machines;
- high frequency power converters;
- control systems;
- fluid mechanics and energy systems;
- machine design;
- control systems for gas turbine;
- aeronautical sensors and motor accessories;
- data analysis and software.

Currently, the laboratory enrolls about 40 researchers. Among the main laboratory facilities there is equipment to design test and characterize electrical machines and power electronic devices in the power range up to 200 kW.

### I4M - Innovation for Mills

Molino Casillo (world leader in the processing and marketing of wheat) Idea75 (startup company in the engineering sector), and Politecnico di Bari have launched a joint public/private laboratory to develop research projects, product and process innovation within the Industry 4.0 mainframe in the following areas.

- Energy efficiency and predictive maintenance of complex industrial processes: advanced techniques for the efficient design of electric drives for flour milling industry, innovative algorithms for predictive diagnosis of incipient faults of electric motors and drives.
  - Automation and Information systems for flour milling industry: advanced algorithms, data analytics, and optimization to improve energy efficiency, soft computing techniques for optimal production planning.
  - Technologies for zero-defect manufacturing: advanced systems for predictive maintenance and process optimization, innovative methods to improve the performance of the automation systems for the processing of wheat, production and packaging of flour.
- big data analysis;
  - computer networks, wireless sensor networks;
  - urban mobility;
  - optimal control of nonlinear dynamic systems.
  - Technologies and electrical systems for transportation:
    - electrical machine design
    - control of electric drives
    - components and sensors, device integration;
    - automated test and measurement systems, diagnostics, SCADA systems.
  - Powertrain technologies
    - optimization of powertrain for hybrid applications;
    - exhaust post-treatment technology in hybrid applications;
    - innovative fuel supply systems.
  - Mechanical technologies for automotive applications
    - additive and unconventional manufacturing processes;
    - laser surface texturing;
    - plastics and new materials.

### MET - More Electric Transportation

Centro Studi Componenti per Veicoli S.p.A (a Bosch Group company) and Politecnico di Bari in 2016 started an integrated multidisciplinary laboratory called "More Electric Transportation" (MET) to develop a strategic partnership in research projects, technological development and innovation in the following areas:

- Automation and Information systems for mobility:

## PUBLIC-PRIVATE JOINT LAB

### Polysense

Thorlabs, Inc. is a privately held optical equipment company headquartered in Newton, New Jersey. Thorlabs has about 1,500 employees and its production and research offices are located in different American States, Brazil, Canada, China, France, Germany, Japan, Sweden, and the United Kingdom. It sells approximately 20,000 different products with a turnover of 480 M\$.

Thorlabs and Politecnico di Bari have established partnership for joint research activities, technological developments and innovations in the area of "Optical Gas sensing" and have launched an integrated multidisciplinary laboratory called "Polysense Lab" located in Physics Department of Politecnico di Bari.

The activities of the joint research lab will be focus on the research and development of innovative optical gas sensing systems.

Main research activities of Polysense Lab are:

- Development and implementation of novel techniques for gas sensing;
- Highly sensitive trace gas sensors, portable, compact, robust for in situ & real time detection for the following potential applications:
  - Breath analysis;
  - Environmental monitoring;
  - Leaks detection;
  - Hydrocarbon gases monitoring;
  - Monitoring of hotspot areas (explosive precursors, narcotics).
- To support the newly formed strategic partner-

ship, Thorlabs provide the necessary instrumentation as well as technical staff and funding for both the research and personnel, while the university provide the laboratory and office space as well as conduct the research.

### RDC - Repair Development Center

GE Avio is a leader company in the design, production and maintenance of components and systems for civil and military aviation, with recognized excellence within General Electric in the field of mechanical transmissions, low-pressure turbines, combustors, control systems, additive manufacturing and repair technologies.

In the framework of a long-term agreement between GE AVIO and Politecnico di Bari, the Repair Development Centre (RDC) has been introduced to develop innovative technologies to repair aeronautical components, and transfer the results of the research to actual components in the GE AVIO plants.

The main focuses are research and development of advanced repair systems based on additive manufacturing techniques able to guarantee the high-quality standards required for aeronautical applications.

The attention is focused on repair techniques based on laser deposition and cold-spray using dedicated experimental equipment available in the RDC laboratory.

Research and experiments are based on components with complex geometry made by materials difficult to repair with traditional techniques such as nickel- or cobalt-based super alloys, light alloys, intermetallic materials.

### CPS - Cyber Physical Systems - Arol Bari

AROL SpA is globally recognized as a top of mind brand specialized in safety of closing solutions, capable of managing all the capping process from the analysis of the caps/containers till the product integrity after the capping.

AROL and Politecnico di Bari have launched a joint public/private laboratory ("Cyber Physical Systems – AROL Bari) to develop technologies in the field of industrial automation, electric drives, electric motors, control systems, SW development for HMI systems.

The main topics the R&D activities of the CPS Lab are:

- Advanced techniques to size and design efficient drives and electric motors for industrial manufacturing applications;
- Robotic systems for high speed applications
- Innovative algorithms for predictive diagnostics;
- High-speed vision systems;
- Development of innovative sensors and laser spectrometry;
- New collaborative man machine interface models.

### Hyper Laboratory

Hyper is a public-private laboratory aimed to develop new technologies for very high-speed transport, including transport within pipes, the TransPod vehicle and hyperloop systems.

The researches include systems and components for railway, automotive, aeronautical and space markets.

The laboratory will develop new generation propulsion and communication technologies that will represent a leap forward compared to the current development of hyperloop, with particular attention to sustainability, energy saving and ensuring a higher safety level for passengers and products.

### Energy Transition to the Future - ETF

In 2018, the Centre for Combustion and Environment (CCA), a company of the Sofinter group (together with Ansaldo Boilers, Macchi, Itea, EuroPower), and Politecnico di Bari realized an integrated multidisciplinary laboratory called "Energy Transition to the Future" (ETF) in order to work together on research and development activities the aim to face the important challenges to make energy needs compatible with the environmental protection.

Energy is one of the 12 areas of specialization identified by the 2015-2020 PNR in line with the National Smart Specialization Strategy. In particular, this Area refers to "... innovative components, technologies and systems for the production, storage and distribution, under a logic of efficient management, of sustainable energy with a low CO2 content...".

In order to actively participate in the transition phase of the energy sector towards greater environmental sustainability, the ETF laboratory is an observatory that monitors the international scientific landscape for the identification of ideas for technological innovation as well as promote joint research and experimentation actions with particular attention to the following topics:

- Numerical and experimental study of advanced combustion systems;



## PUBLIC-PRIVATE JOINT LAB

- Study of thermo-acoustic instability;
- Study of systems for the use of alternative and / or renewable fuels;
- Processes of energy transformation and storage (gasification; power to gas; etc.);
- SCADA systems for integrated process management;
- Development of advanced instrumentation and diagnostics;
- Power digitalization;
- CHP - Combined Heat and Power generation;
- Advanced materials for components with high thermal and chemical resistance;
- Thermal vectors and PCM, Phase Changing Material.

Currently, the laboratory enrolls about 10 researchers. The laboratory is located inside the university campus in Bari and it is connected with the CCA's experimental facilities in Gioia del Colle (BA) where prototypes (designed and numerically validated at the Politecnico di Bari) can be tested.

### **BPM-CC: Business Process Management Competence Center**

Established in 2016 based on a strategical partnership between Politecnico di Bari and Openwork s.r.l, an independent software vendor specialized in the development of enterprise solutions based on business process management, the Business Process Management Competence Center carries out research, technological transfer and third mission activities on Business Process Management (BPM).

The Center is particularly interested in innovat-

ing and supporting the digital transformation of healthcare, public administration and production processes, with a focus on the industries more relevant to the regional economy, e.g. textile, wood furniture, auto component and mechanical industries.

The Center also carries out research on how to innovate methods and technologies so as to improve the BPM reachness (i.e. ability to support processes that cross several organizations) and richness/ambidexterity (i.e. ability to address process criticalities while also transforming opportunities and visions into new processes). All the research activities are performed by leveraging on Industry 4.0 enabling technologies and green/sustainable business process management methods and techniques.

As to technological transfer and third mission activities, the Center supports companies interested in improving and digitally transform their own business processes. The Center also organizes lifelong learning courses, seminars and workshops on process organizations, business process management and, in general, business administration.

### **IPZS – POLIBA**

In April 2023 Politecnico di Bari and Istituto Poligrafico e Zecca dello Stato (IPZS) signed an agreement in order to create an integrated laboratory for the development of innovative materials and production processes in the security and anti-counterfeiting sectors, paying great attention to the issue of environmental sustainability.

The first initiatives covered by the agreement will concern the industrial development of new coat-

## PUBLIC-PRIVATE JOINT LAB

ings for vehicle license plates, obtained through the use of more economical and eco-sustainable processes; the synthesis of new low-toxicity materials that can be used in the production processes of security products such as holograms; the development of innovative anti-counterfeiting elements to be integrated into banknotes, passports and stamps created by Poligrafico.

The activities will be carried out at the laboratories of the Politecnico di Bari and the industrial center of Foggia del Poligrafico and will involve various groups of researchers and technical experts from the two institutions.

### INNOVATION HUB

In April 2020 Politecnico di Bari and Terna SpA, Italian group responsible of grid planning, development and maintenance activities, signed an agreement for research, technological development and innovation of the national electricity infrastructure.

The agreement provides for the opening of an Innovation Hub, i.e. an integrated multidisciplinary laboratory within the Politecnico, Campus area, in which a mixed team of university researchers and company experts will work together on scientific projects of common interest.

The projects, based on economic, social and productive needs of the territory, will be aimed at technological innovation for the management and security of the national electricity system. In particular, they will cover the topics of real-time data collection and analysis; advanced services for electricity infrastructures; IT security; digital technologies; 3D printing and additive manufacturing.

### IOT 4.0

In January 2020 Politecnico di Bari, Isires, private research organization, and Electric 80 SpA and SM.I.LE80 srl, leading companies in the transport automation and logistics sector, signed an agreement in order to create new public-private laboratory called "IOT 4.0". The aim is to develop innovative projects in the logistics sector, through the optimization of the automated management of picking pallets, automatic transport planning and, more generally, of some logistics activities through the use of augmented reality technologies, industrial IoT systems and advanced control algorithms.

### EsaLab@Poliba

European Space Agency (ESA) and Politecnico di Bari signed an agreement in December 2019 in order to allow Politecnico di Bari to be part of the European EsaLab network.

The objective is to encourage and support collaboration between ESA and Politecnico on topics of aerospace and the new space economy in terms of research, training and technological transfer.

### BAKER HUGHES PUMP LAB

Baker Hughes, an energy technology company that provides solutions in over 120 countries around the world, and the Politecnico di Bari signed a scientific collaboration agreement in July 2021 in order to create the Baker Hughes Pump Lab.

The laboratory, which is located inside the Baker Hughes factory with a branch in the Politecnico spaces, has been created with the aim of facilitating the exchange of information between the industrial world and the academic one to work on the

## PUBLIC-PRIVATE JOINT LAB

evolution of advanced technologies and to identify interdisciplinary innovation ideas.

The “Pump Lab” is initially dedicated to the development of the design of vertical water pumps for which the license was acquired in 2020, to the energy efficiency of centrifugal pumps, to energy recovery machines, to design refinement for Reverse Osmosis and desalination systems.

Furthermore, a particular focus is on technologies for the energy transition, such as the development of pumps for the capture and treatment of CO<sub>2</sub>, and the Internet of Things, with the connection of networked systems for Centrifugal Pumps through the development of forecasting algorithms.

## COGNITIVE DIAGNOSTICS

Politecnico di Bari and the Italian company, “Comau”, specialized in industrial automation, have signed in October 2021 a five-year agreement for the joint creation of the new public-private laboratory, called “Cognitive Diagnostics”.

“Cognitive Diagnostics” has been created to respond to the growing demand for flexible automation, adaptable to any production context and capable of making the work processes of Factory 4.0 more efficient thanks to the use of enabling technologies.

In particular, the new laboratory will allow Comau to deepen the study of innovative vision systems and platforms that allow simpler robot programming, facilitating and speeding up the management and control processes of operators (“low code programming”). On the basis of the agreement, to promote the training and professional inclusion of specialized figures, Comau will collaborate in the

University’s teaching activities by participating in tutoring moments in training internships and company internships. Finally, the laboratory’s strategic asset will be the internationalization of the research paths conducted within it, also through participation in European and international projects.

The image shows the exterior of a long, modern building under a blue sky with scattered white clouds. The building features a prominent green horizontal stripe running along its length. On this stripe, the word "POLITECNICO" is written in large, white, sans-serif capital letters. Below the stripe, the building's facade is white and contains several windows with dark frames and horizontal blinds. A glass entrance door is visible on the left side, with a small ramp and a metal handrail leading to it. The foreground consists of a light-colored paved area, possibly a parking lot or driveway. The overall scene is bright and clear.

**POLITECNICO**

DI BARI

PRINCE



## MAIN RESEARCH PROJECTS

Politecnico di Bari has been involved in different European research projects both as lead partner and as project partner. The academic staff has reached up a great experience and good competences in preparing targeting projects proposals as well as in achieving the projects objectives.

In the last three years, Politecnico di Bari has been taking part in more than 15 European projects for a total of three million euros.

Politecnico di Bari has participated in different programmes aiming at supporting and enhancing collaborative and multidisciplinary research and strengthening the collaborations at international level such as:

- European FP7 framework
- Horizon2020
- Horizon Europe
- INTERREG
- IPA Adriatic Cross-border Cooperation Programme
- Trans-European Transport Network Executive Agency
- South East Europe
- MISE - Ministry of Economic Development
- MAECI - Ministry of Foreign Affairs
- MIUR - PONRI - Ministry of Research and Universities

### ROBOTIC FLUIDS FOR ARTIFICIAL MUSCLES, WEARABLE COOLING, AND ACTIVE TEXTILES

Acronym ERC-Project: ROBOFLUID

Grant agreement ID: 101116856



#### Short description:

Fluid circulation is ubiquitous in both living creatures and machines, and it serves multiple functions: temperature regulation, transport of nutrients, mechanical actuation. A beating heart is a soft pump that keeps animal alive through blood circulation.

ROBOFLUID will merge fluids capabilities with electrical control to equip robots and wearables with the superpowers of fluids. By untangling the interaction between intense electric fields and fluid mechanics, ROBOFLUID will develop a new class of solid-state fluidic devices where flow is directly driven in situ by electrical signals, and where fluid velocity, pressure and temperature are used to sense the device status and the environment.

The large number of components required to operate conventional fluidics (pumps, valves, tubing, plugs), have prevented its use in untethered systems. ROBOFLUID will overcome this limitation by means of solid-state pumps where fluids are directly accelerated by electric fields. Similarly, to robotic hearts, robotic fluids will drive (1) new strong and robust artificial muscles, (2) wearable coolers and (3) active textiles for movement support and haptics.

ROBOFLUID will leverage our experience with soft robotics, electroactive materials and solid-state pumping based on Electrohydrodynamics (EHD). By bringing these fields together and bridging them with emerging active fibers technologies for

wearables, we aim to create new scientific understanding of fluid mechanics and field emission in liquids under high electric fields and to create new ground-breaking functionalities for robots and wearables.

We will create (1) robust, high-power-density fluidic muscles that will make low-cost dexterous robotic hands possible, (2) wearable coolers to reduce energy consumption from air conditioning and to protect fragile people during extreme heat waves, (3) textile artificial muscles to facilitate daily actions in the elderly and to enable remote physical interactions.

ROBOFLUID has been funded by the European Research Council (ERC), under the action Starting Grant 2023 with 1.5 M€ and it will have a duration of 5 years. Thanks to ROBOFLUID we will establish an international research group and a new laboratory in Soft Robotics, located in the Department of Mechanics Mathematics and Management (DMMM) at Polytechnic Università di Bari.

#### Contact person

Vito Cacucciolo

vito.cacucciolo@poliba.it

Tel: +39 080 5963311



**TOWARDS FUTURE INTERFACES WITH TUNE-ABLE ADHESION BY DYNAMIC EXCITATION**

Acronym ERC-Project: SURFACE

Grant agreement ID: 101039198



**Short description:**

Understanding the adhesive interactions between mechanical components is of fundamental importance in the development of miniaturized mechanical components (MEMS), in pick-and-place manipulation of objects by robotics arms, in the field of human-robot interaction, in bio-engineering for tissue regeneration and wound closure.

Through evolution, nature has developed optimal topographies which are able to adhere to almost any kind of counter-surfaces in both dry and wet conditions, as demonstrated by the astonishing adhesive capabilities of geckos, frogs and octopus. These adhesive performance are often mediated by the presence of multiscale structures, ranging from the millimetre to the nanometre scale, which not only can efficiently adhere, but also can be efficiently detached, resulting in an optimal design for both hanging and walking/running on ceilings and walls. Although in the recent years bio-inspired artificial interfaces have been developed, these are usually "slow", in a sense that once the interface sticks to the counter-surface it requires some effort to be detached.

More recent research has shown that using high-frequency micrometric vibrations, macroscopic adhesion can be efficiently and rapidly tuned, from very sticky states up to detachment. This behaviour is related to the viscoelastic nature of polymeric materials (silicones, elastomers), which have a frequency-dependent behaviour in

terms of both modulus and dissipation.

SURFACE aims at studying the adhesive properties of polymeric micro-structured interfaces subjected to micro-vibrations. Commonly, the design of bio-inspired adhesive surfaces has followed a quasi-static approach, ignoring the effects due to dynamic excitations (vibrations). SURFACE main objective is to design micro-structured surfaces where macroscopic adhesion can be actively adjusted by means of dynamic excitations with proper frequency and amplitude. By exploiting the coupling between geometric and dynamic effects, SURFACE aims to considerably increase the maximum adhesive tension that the surface is able to sustain macroscopically, and to allow active regulation of the adhesive force exchanged upon contact at the timescale of the order of milliseconds. To this end SURFACE plans: (i) to develop efficient numerical algorithms capable of studying soft surfaces subjected to dynamic loading, (ii) to reveal the mechanisms that allow the coupling between the geometry of the interface (topography) and the viscoelastic effects (due to the soft material) in order to determine the interfacial stickiness, (iii) exploit machine learning and artificial intelligence to derive surrogate models representative of the physical behaviour of the interface, (iv) to fabricate polymeric interfaces with multiscale topography and to demonstrate experimentally the adhesive capabilities of the interfaces.

SURFACE has been funded by the European Re-

## MAIN RESEARCH PROJECTS

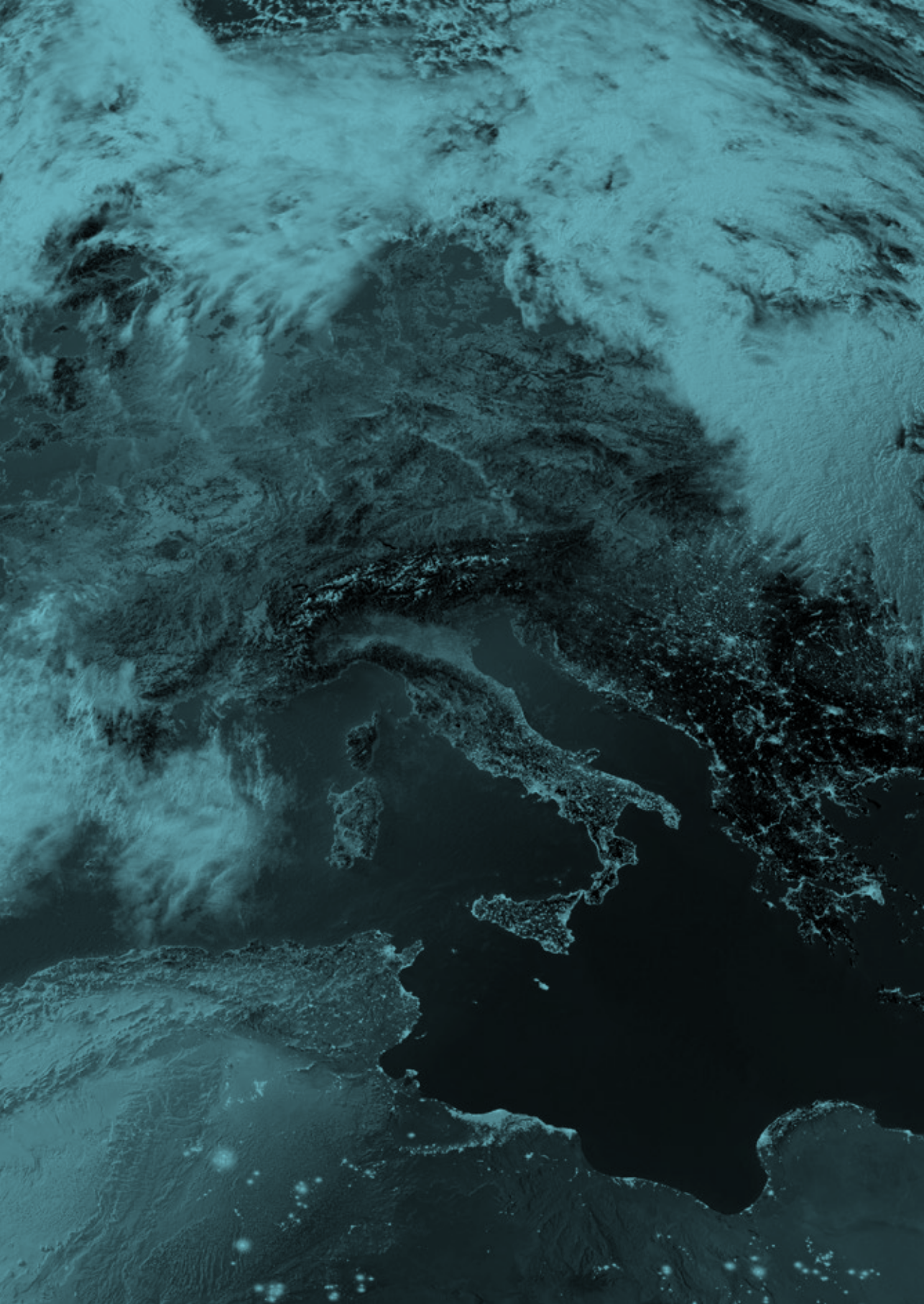
search Council (ERC), under the action Starting Grant 2021 with 1.5 M€ and it will have a duration of 5 years. Thanks to SURFACE we have established an international research group and a new laboratory, the TriboDynamics Lab, located in the Department of Mechanics Mathematics and Management at Polytechnic Università di Bari.

### Contact person

Antonio Papangelo  
antonio.papangelo@poliba.it  
Tel: +39 3803418061

## MAIN RESEARCH PROJECTS





Within the framework of the National Recovery and Resilience Plan (NRRP), Mission 4 Component 2 Investment 1.3 - Ministry of University and Research (MUR); funded by the European Union - NextGenerationEU, the Politecnico di Bari is involved, as a Spoke, as an Affiliate and as a Co-Proponent, in the realization of no. 2 National Centres, no. 3 Extended Partnerships and no. 4 Research Infrastructures, as follows:

- National Centre for HPC Research, Big Data and Quantum Computing (Centro nazionale di Ricerca HPC, Big Data and Quantum Computing)
- National Centre for Sustainable Mobility (Centro Nazionale per la Mobilità Sostenibile)
- PE NEST - Network 4 Energy Sustainable Transition
- PE RESTART - REsearch and innovation on future Telecommunications systems and networks, to make Italy more smart
- PE 3A Italy
- PE SPACE IT UP
- BRIEF - BioRobotics Research and Innovation Engineering Facilities"
- CTA+ - Cherenkov Telescope Array Plus
- KM3NeT4RR - Kilometer Cube Neutrino Telescope for Recovery and Resilience

More information at the following link:

<https://www.poliba.it/it/content/pnrr>











The products of the research of Politecnico di Bari (publications, patents...) are managed, made visible and searchable through the new Catalogue of Research.

The catalogue of research is a system of research integrated data management, purchased by the University in order to ensure maximum visibility and dissemination of its scientific production.

It is an Open File Access that collects and gives access to the bibliographic information and, in accordance with the policies of copyright of the publishers, to the full texts of the scientific products where permitted.

The University has adopted, since December 2015 with decree of the Rector, the policy of Politecnico di Bari on the open access (Open Access) to scientific literature based on the principle for which the results of research financed with public funds must be publicly available.

The products of the research of the University are available at the following link:

<https://iris.poliba.it/>





Poliba Alumni is the association of graduates of the Politecnico di Bari, strongly desired by the University's Governance. The Association, led by a Board of 7 Alumni, essentially aims to create and maintain stable relationships between members, promoting initiatives in their favor, carrying out cultural activities, encouraging meetings and networking experiences among Alumni.

The Alumni Association intends to contribute to the inclusion of graduates of the Politecnico di Bari in the world of work and to provide support, including material support, for university development projects with particular reference to the Educational Offer, to the Students, to the Research. The Association also aims to promote the development of the University, improve and strengthen the information service for students and members; contribute to giving visibility and prestige to the Politecnico di Bari.

"Much of the value of the Politecnico lies in the value of its Alumni. It is fundamental to put them in contact with each other, to enhance and support them".

One of the objective of the Association is to create a network to share experiences with an advantage not only for young graduates, but also for professionals who have graduated from Poliba and who intend to continue to build a virtuous network of contacts and knowledge. inside and outside the Polytechnic.

The advantages reserved for Alumni are:

- Concessions for participation in training courses organized by the Association;
- Participation in the calls for study awards made available by our supporters and partners;
- Concrete help in employment research, through direct contact with companies;
- Creation of an international professional network;
- Registration and / or renewal registration methods;
- To join and support the Poliba Alumni Association it is necessary to register and pay the annual membership fee.

Past president

Anna Matteo (2016-2019)

Mariarita Costanza (2020-2023)

President

Michele Mossa

Website

<https://alumni.poliba.it/home>

Contacts

[presidentalumni@poliba.it](mailto:presidentalumni@poliba.it)

[alumni@poliba.it](mailto:alumni@poliba.it)



Boosting Innovation in Poliba - BINP is the incubator promoted by the Politecnico di Bari, participated by the University itself, by the Associazione Nazionale Costruttori Edili of Bari-BAT and Confindustria of Bari-BAT. BINP is a limited liability consortium company (scarl) under private law, non-profit, and is active in the promotion of entrepreneurial projects, startups, spin-offs, and open innovation strategies to support the local ecosystem. The incubator is located within the Oplà spaces of the Politecnico di Bari. The approximately five hundred square meters environment is equipped with offices and modular open space solutions. BINP synergistically unites universities, businesses, and institutions to face the innovation challenges of the future together.

As a business incubator, BINP represents an ecosystem that promotes contamination between the world of research and industry to support the economic and employment growth of the area. BINP synergistically unites universities, businesses, and institutions to face the innovation challenges of the future together. As an Open Innovation hub, BINP offers Open Innovation, Corporate Entrepreneurship and Venture Clienting paths to local companies looking for solutions and innovative technologies, thus allowing them to be more competitive in constantly changing scenarios.

Partnership, calls and projects:

Since its birth, BINP has signed several partnerships with the purpose of collaborating on activities mainly related to i) selection and acceleration of entrepreneurial initiatives by research teams and spinoffs, ii) tech incubation and business creation paths, iii) scouting of startups, spinoffs and research teams for investment opportunities, iv) development and management of open innova-

tion activities. Partnerships include, among others: Cassa Depositi e Prestiti Venture Capital, Intesa Sanpaolo, Fondazione Golinelli, Scientifica VC, Acquedotto Pugliese S.p.A., Star Tech Ventures, MITO Technology.

The projects developed by BINP are related to business and tech incubation, investments in the pre-seed and seed phase, mentorship and scouting activities, in the fields of: sustainability, biotech & drug discovery, life science & digital health, digital technologies, aerospace, environmental risks. Finally, BINP is carrying on open innovation activities with Acquedotto Pugliese, Tersan Puglia and Elsea.

#### President

Antonio Messeni Petruzzelli (2022 – 2025)  
Tel: +390805963452  
[antonio.messenipetruzzelli@poliba.it](mailto:antonio.messenipetruzzelli@poliba.it)

#### Managing Director

Sirio Vurro  
[sirio.vurro@binp.it](mailto:sirio.vurro@binp.it)

#### Website

[www.binp.it](http://www.binp.it)

#### Contacts

[hello@binp.it](mailto:hello@binp.it)



The Industrial Liaison Office (ILO) of Politecnico di Bari is the organizational structure designed to support the university staff in the exploitation of research outcomes.

The mission of ILO of Politecnico di Bari is to strengthen the interaction and cooperation between research structures, territorial production system and public institutions ensuring the transfer of competences and technologies from the academic structures to the different regional, national and transnational productive contexts.

The ILO of Politecnico di Bari continuously works in the creation of collaborative relationships between university and industrial organizations by gathering the technological innovation instances coming from the market and matching with the University's capacities, skills and technologies.

The ILO provides a range of different services with the specific objective to promote entrepreneurship, transfer of skills from university to firms and create new firms from academic spin-offs.

The ILO provides the following services:

- Scouting of technologies, skills, competences and so on: the ILO staff gives assistance and support to researchers in the process of protecting their invention;
- Networking: the ILO creates opportunities to facilitate and enhance knowledge transfer from universities to businesses;
- Organization of seminars, meetings and events focusing on technological transfer: the ILO supports the dissemination of scientific studies and new technologies by interacting with different stakeholders in the region;

- Communication: provision of the necessary tools for creating short advertising spots to promote activities not only of the academic departments but also of the involved companies;
- Assistance in the creation of spin-offs companies: the aim is to exploit the results of academic research and to boost competitiveness and economic and social development of the region;
- Promotion of spin-off companies: the ILO staff carries on specific activities to promote and create opportunities for spin-off companies.

### Contact persons

Lucrezia Cuccovillo  
Tel: +390805962539  
lucrezia.cuccovillo@poliba.it  
ilo@poliba.it







**Supervisor**

Mariangela Turchiarulo

**Editorial Board**

Antonella Palermo

**Design and Layout project**

Flora Franchini, Gabriele Montagna

**Photos**

Ennio Cusano

**Print**

Dedalo Litostampa Srl

Viale Luigi Jacobini , n. 5 - 70123 Bari



poliba.it



Politecnico  
di Bari

