DEPARTMENT OF ENGINEERING FOR INNOVATION – UNIVERSITY OF SALENTO

**12 INTERNSHIP POSITIONS AVAILABLE FOR YEAR 2022** at the following laboratories.

| LABORATORIES<br>*Click the Lab's name for more information* | Places Available | Period |
|---|---|---|
| **GREEN ENGINE**<br>Combustion & Propulsion | 1 | January – April<br>April – July<br>September - December |
| **GREEN ENGINE**<br>Aerospace Propulsion & Flow Diagnostic | 1 | January – April<br>April – July<br>September - December |
| **BIOCLIMATIC EGNINEERING** | 1 | January – April<br>April – June<br>September - December |
| **COMPOSITE MATERIALS** | 1 | January - July |
| **POLYMERIC MATERIALS** | 1 | June – September<br>*(Blended)* |
| **TRANSPORT PHENOMENA** | 1 | January - July |
| **MATECH-CCULT** | 1 | September - December |
| **APPLIED ELECTROCHEMISTRY & SPECTROELECTRO CHEMISTRY** | 1 | May – December<br>(*Blended available*) |
| **SYDA LAB**<br>Systems, Data and Applications Laboratory | 1 | All year EXCEPT July and August |
| **DIDA LAB**<br>Technologies for Scientific Education Laboratory | 1 | All year EXCEPT July and August |
| **AVR LAB**<br>Augement and Virtual Reality Laboratory | 1 | All year EXCEPT July and August |
| **EUMER**<br>European and Maritime Environmental Resarch | 1 | All year EXCEPT 15 July – 15 Septembr |

# INTRODUCTION

The Department of Engineering for Innovation (DEfI) at University of Salento is located at the University campus near Lecce, the capital of Salento area, on the heel of Italy's boot.
Whoever ventures here, is received by the 'Salento way', a simple mix of culture, nature, history which seasons wild and sunny beaches, gorgeous baroque, tempting food and wine.

Always at the crossroads between East and West, Salento has been a passage of people and shelter for civilizations since ancient times, when Brindisi was the last harbor of Romans' highway to the east, welcoming people from the Mediterranean sea.

This history is at the root of local culture and today social engagement, open education, inclusion and internationalization are cornerstones of the University strategy, ' the University between two seas'.
DEfI specializes in the vision focusing on Technological Transition, Sustainability, Resilience, BioEngineering. Researchers at DEfI work for harmonizing multidisciplinary research teams both inside the Department and outside the University: this brochure shows the several different multi-perspective engineering fields DEfI researchers are involved in.

With this background, routed on open and reliant international cooperation, DEfI offers education and exchange opportunities for study, traineeship and research, both in virtual and blended modes:

- **4** Bachelor Degree Programs (Information, Industrial, Civil and Bio-Medical Engineering - in Italian)
- **7** Master Programs, 5 of them are in English: Aerospace Engineering, Communication Engineering & Electronic Technologies, Computer Engineering, Management Engineering and Materials Engineering & Nanotechnology. Masters in Civil and Mechanical Engineering complete the current offer.
- **2** Phd Schools in Engineering of Complex Systems and Material, Structure and Nanotechnology Engineering, open to international students.

Thanks to its education programs and the continuous technology transfer activities, DEfI has contributed to the industrial base of the region's economy, which has been growing incrementally for 25 years now. Alongside highly capital-intensive large-scale plants - such as steel-making, petrochemicals, aerospace, energy -, a network of small and medium-sized firms has gradually expanded. As a result, highly specialized areas have developed, able to compete on the international stage: the local sectors include food processing and vehicles; footwear, textiles, wood and furniture, engineering, rubber and information technologies in all its facades.

With a state-of-the-art contribution to the development of new technologies, investment in human capital, research infrastructures and high-quality education programs, DEfI envisions the development of a pole of excellence at the service of local community needs and global challenges, cultivating talented engineers, regardless of wherever they come from and wherever they may go.

For more info visit: https://international.unisalento.it/departments/engineering

# COMBUSTION AND PROPULSION

*The aim of the Green Engine Research Network is to create a labs network in order to support the research activities and the development of new technologies for combustion and related materials for high-temperatures, with particular attention to the environmental impacts.*

The research activity involves the design, modeling and experimental characterization of industrial combustion processes, in particular with liquid fuels (diesel). The testing activity aims to study the combustion and relative flame instability in a lean and ultra-lean regime characterizing the phenomenon with flame imaging techniques both in the visible and in the UV field and with the analysis of emissions. These analyses shall also be accompanied by pressure, temperature, gaseous and particulate emissions measurements at the exhaust and in dilution. Furthermore, the research aims to study of techniques for stabilizing lean and ultra-lean flames with gaseous fuels (methane). These tests are carried out both in the atmospheric environment (open chamber) and in the closed and pressurised chamber (up to 10 bar.) Experimental techniques are used as advanced laser diagnostic techniques (Stereo PIV; LDV, hotwire) and high-speed VIS, UV and NIR visualizations combined to advanced decomposition techniques.

## LAB'S INSTRUMENTATION & FACILITIES

The research activities mainly involve experimental and computational investigations of different combustion and propulsion phenomena to gain insights into efficient and environmentally friendly combustion.

▪ Low emission Combustor for non premixed and premixed combustion with liquid fuel ▪ NIR camera (High Resolution InGaAs / FLIR NIR camera) ▪ Fast non-intensified camera (CCD - MEMRECAM GX-3) ▪ Intensified camera (LaVision camera PicoStar HR) ▪ Fast intensified camera (Hisense M320 camera equipped with intensifier) ▪ Photomultiplier (Thorlabs 180-650 nm) ▪ IFA 300 Constant Temperature Anemometer System TSI ▪ Oscilloscopes (PicoScope 5000 Series eTektronix TDS2024C) ▪ High voltage amplifiers (PVM500 Plasma Resonant and Dielectric Barrier Corona ▪ Driver, Trek MODEL 40/15 and NANOSECOND PULSE GENERATOR NPG-18/3500(N)) ▪ High voltage measurement probe, for use in plasma actuator tests (Tektronix P6015A) ▪ Probe for current measurement, for use in plasma actuator tests (Bergoz Current Transformer CT-D1.0-B) ▪ Smoke generators.

## REFERENCES, COLLABORATIONS, CONSORTIA, SPIN-OFFS AND OTHER

ACBoilers; Apulian Aerospace District; ACARE; EASN; CNR- IMM; DiTNE; AvioAero

## PROJECTS AND ACTIVITIES

▪ GREEN ENGINE NETWORK. Technologies for sustainable propulsion: Apulia labs network to support research activities on new technologies for combustion, propulsion and related materials for high-temperatures

▪ MEA More Electrical Aircraft. The project aims to develop hybrid propulsion architectures for UAV applications and General Aviation.

▪ MALET. The aim is to validate technologies in order to develop a propulsion system for Unmanned Aerial Vehicle (UAV) that performs high-altitude missions for a long duration.

▪ SMEA. developing models of monitoring, diagnostics and functional prognostics and performance, with particular reference to engine applications in the aeronautical field as well as to the structural integrity of its components
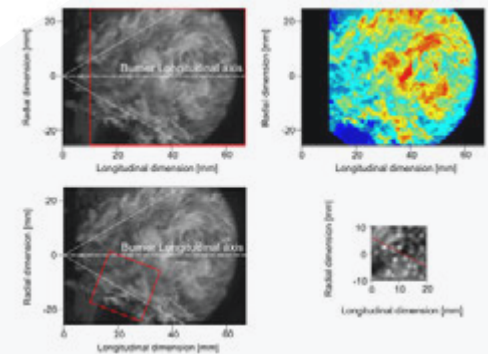
# GREEN ENGINE
## AEROSPACE PROPULSION AND FLOW DIAGNOSTIC LAB

*The research activity concerns studies on aeronautic and space propulsion systems, fluid dynamics, combustion, micropropulsion systems, plasma-assisted active control, experimental flow diagnostic techniques, CFD.*

The research activity involves the design, modeling and experimental characterization of aerospace propulsion devices, including both air-breathing engines and rocket engine.

The studies regard the gas dynamics of internal flows, thermodynamics, and combustion processes associated with those devices.

Experimental techniques are used as advanced laser diagnostic techniques (Stereo PIV; LDV, hotwire) and high speed VIS, UV and NIR visualizations combined to advanced decomposition techniques for cold flow and reactive flow characterization.

Furthermore, research is supported by the use of computational modeling and simulations of fluid flow, turbulence, and combustion in propulsion and energy systems. Scientific activities have focused on: lean aeroengine combustion, rocket combustion, plasma assisted combustion, active flow control in turbomachinery, two-phase conventional and cryogenic flows, micropropulsion, active flow control, aeroengine modeling for performance estimation and diagnostic with machine learning techniques.

### LAB'S INSTRUMENTATION & FACILITIES

The research activity involves the design, modeling and experimental characterization of aerospace propulsion devices, including both air-breathing engines and rocket engine.

▪ Subsonic Wind Gallery ▪ NIR camera (High Resolution InGaAs / FLIR NIR camera) ▪ Fast non-intensified camera (CCD - MEMRECAM GX-3) ▪ Intensified camera (LaVision camera PicoStar HR) ▪ Fast intensified camera (Hisense M320 camera equipped with intensifier) ▪ Photomultiplier (Thorlabs 180-650 nm) ▪ IFA 300 Constant Temperature Anemometer System TSI ▪ 2D LDV/PDPA DANTEC DYNAMICS System equipped with a FlowLite 2D (high Power) 2.2 mm 532/561 laser ▪ Stereo PIV DANTEC DYNAMICS System equipped with a Double pulse Nd: YAG laser (model: NANO L 200-15, minimum power: 200 mJ/pulse standard, 532 nm) and two FlowSense EO 4 M camera ▪ Oscilloscopes (PicoScope 5000 Series eTektronix TDS2024C) ▪ High voltage amplifiers (PVM500 Plasma Resonant and Dielectric Barrier Corona Driver, Trek MODEL 40/15 and NANOSECOND PULSE GENERATOR NPG-18/3500(N)) ▪ High voltage measurement probe, for use in plasma actuator tests (Tektronix P6015A) ▪ Probe for current measurement, for use in plasma actuator tests (Bergoz Current Transformer CT-D1.0-B) ▪ Magnum 850 smoke generator (fog fluid: Pro Smoke High Density-Martin, characterized by a particle size of 1-1.5 lm and a particle density at room temperature of 0.95 kg/m3).

### REFERENCES, COLLABORATIONS, CONSORTIA, SPIN-OFFS AND OTHER

KU-Leuven (Belgium); Aerospace Apulian District; CNR  Italian National Research Council; Von Karman Institute for Fluid Dynamics, Belgium; EPFL; Center for Research in Sustainable Aviation, University of Toronto; Department Of Aeronautics And Astronautics, Chair Of Aero Engines Technical University Of Berlin; NATO STO Science and Technology Organization Technical Team.

### PROJECTS AND ACTIVITIES

▪ Plasma assisted combustion: lifted flame plasma assisted (funded project under H2020 Clean Sky "Chairlift"). Numerical and experimental characterization of nanosecond and sinusoidal plasma discharges for lean combustion (national PON funded projects).

▪ Micropropulsion: Design of microresistojet and electrical microthrusters.

▪ Space Propulsion: Characterization of flows in a ram-ep engine for missions at Very Low Earth Orbit using DSMC. Application of plasma actuators. (national funded project).

▪ Characterization of rocket engine flow and noise: development of diagnostics techniques and simulations (national funded project).

# BIOCLIMATIC ENGINEERING LABORATORY

*In the research network liemp - laboratory for indoor energy efficiency and monumental preservation between University of Salento and CNR*

The aim is to create a competitive model for the provision of solutions and services in the field of energy engineering and technical physics for the generation and conversion of energy and the use of energy and environmental monitoring systems for existing and new buildings. It offers research and development services, certification assistance, consultancy, design, training and communication. One of the strengths of the laboratory is the development of innovative applications on real end-user needs related to construction sector.

The improvement of the built environment can only be achieved through the involvement of all the actors in the construction chain. This is why the Laboratory's services are directed to Research and Training Bodies and Institutes, companies in the building and plant engineering sector, urban and territorial planning bodies, designers, builders, craftsmen, end users of the building and new generations.

## LAB'S INSTRUMENTATION & FACILITIES

▪ Hot wire anemometer for omnidirectional air speed measurements (LSI Lastem) ▪ M-Log ELO009 Acquisition for thermoflow meter, no radio (LSI Lastem) ▪ Thermozig for measurement and acquisition of transmittance on walls (OptiVelox) ▪ Digital thermohygrometer (RS-1360) ▪ S-Log ELR200 radio sensors (LSI Lastem) ▪ Portable anemometric probe (LSI Lastem) ▪ ThermoCam (Flir) ▪ HD 9221 Photo-radiometer for illuminance, irradiance and luminance (Deltha OHM) ▪ Glass Buddy for flat glass analysis (Bohle) ▪ Merlin Lazer for glass analysis (Merlin) ▪ DPA154 Class 1 pyranometers (LSI Lastem) ▪ Transmittance meter and data acquisition (Thermozig) ▪ SC 310 Sound Level Meter and Spectrum Analyser (CESVA) ▪ CB006 class 1 acoustic calibrators (CESVA) ▪ MI005 Tapping machine (CESVA) ▪ AP601 noise generator (CESVA) ▪ BP012 omnidirectional dodecahedral loudspeaker (CESVA) ▪ Globe Thermometer (LSI Lastem) ▪ n. 4 Sensors PAR; n.3 RLOG; n.1 MLOG (LSI Lastem) ▪ Bluetooth modulator (CESVA) ▪ Heliophanometer (LSI Lastem) ▪ Radiometer (LSI Lastem) ▪ ESR 007 Radiometer UV-B (LSI Lastem) ▪ ESR 009 Radiometro UV-A (LSI Lastem) ▪ DPA154 Class 1 pyranometers (LSI Lastem) ▪ TME Needle probe (TME) ▪ TME General purpose probe (TME) ▪ TME Surface probe (TME) ▪ Portes soufflantes retrotec (Retrotec) ▪ Natural ventilation wet bulb temperature sensor, PT 100 output (LSI Lastem) ▪ Contact temperature sensor, via radio (LSI Lastem) ▪ Psychrometer (LSI Lastem) ▪ Heat flow meter (LASERCOMP) ▪ Climatic chamber (BIEMME).

## REFERENCES, COLLABORATIONS, CONSORTIA, SPIN-OFFS AND OTHER

BEAMS ACADEMY (costituenda società srl); Building, Energy and Materials Solutions; Università della Calabria; Università di Palermo; Politecnico di Torino; Zephir – Passivhaus Italia; EURAC Research Centre – Bozen; Joint Research Centre in Ispra; Politecnico di Bari; Collegio dei Geometri Laureati della Provincia di Lecce; Collegio dei Geometri Laureati della Provincia di Taranto; Ordine dei Periti Industriali e dei Periti Industriali Laureati della Provincia di Lecce; Ordine degli Ingegneri della Provincia di Lecce; Etra Investigación y Desarrollo s.a.; Thales Italia spa; Barcelona Digital; Institute of communication and computer systems - national technical University of Athens; Fraunhofer Iwes Advancing Energy Systems; Sodexo facilities management.

## PROJECTS AND ACTIVITIES

▪ THEREV ▪ TEMPUS Project - Promotion of Academic-Industrial Links on Mechanical Engineering (PALME) ▪ TEPLAN. Incenerimento di rifiuti a bordi nave mediante plasma. CETMA ▪ ENEL 2007 – Serra Cortina ▪ PASSIVE HOUSE 2007-2008 per i climi del mediterraneo ▪ BEAMS ▪ LIEMP. Laboratorio per l'Efficienza Energetica Abitativa e la Tutela Monumentale ▪ NASO 2012. Nanomateriali per l'Edilizia Sostenibile ▪ NAMASTE 2012. NAnoMAteriali per l'edilizia SosTEnibile ▪ CNT-APPs. Murature affette da patologie di umidità da risalita capillare: interventi con Tecnologia a Neutralizzazione di Carica.

# COMPOSITE MATERIALS

*Research activities on composite materials have been performed for more than 30 years, involving processing and material characterization.*

Research activities on composite materials are strongly multidisciplinary, involving competencies ranging from materials chemistry to transport phenomena, solid mechanics and physic and mechanical properties. Composite materials are always approached according to an holistic approach as start point for a deeper insight in specific problems. During the last 30 years research activities have been performed on: chemorheology of thermosetting matrices; crystallization; FEM analysis of heat transfer, Darcy's flow, cure kinetics and viscosity during fabrication of thermosetting matrix composites; FEM analysis of heat transfer, crystallization, melting processes during fabrication of thermoplastic matrix composites; resin infusion and compression moulding of thermosetting matrix composites; experimental and modelling of induction and ultrasonic welding, compression moulding, autoclave lamination, filament winding, pultrusion; graphene and nano-clay nanocomposite synthesis and characterization.

## LAB'S INSTRUMENTATION & FACILITIES
The laboratory research activity is focused on characterization, processing and process modelling of composite and nanocomposite materials.
▪ Strain controlled cone and plate and parallel plate rheometers, equipped with: tools for dynamic mechanical analysis (DMA); tools for dielectric analysis (DEA); tools for ultrasonic dynamic mechanical analysis (UDMA) ▪ Stress controlled rheomether (Bholin) ▪ Capillary rheometer, Gottfert ▪ Thermal analysis (DSC, TGA, STA) ▪ Mechanical testing and impact testing ▪ FTIR and Raman spectrophotometers ▪ Scanning Electron Microscope SEM Zeiss equipped of EDX ▪ Wide angle X-ray Diffractometer, RIGAKU Ultima ▪ Optical microscope equipped with heater and Stereomicroscope ▪ Ultrasonic welding equipment ▪ Hydraulic press for compression moulding, (Fmax 30 t, Tmax 340 °C) ▪ Several ovens up to 250 °C and 600 ° and environmental chamber ▪ Filament winding equipment with 3 axis and a mandrel of 1.5 m.

## REFERENCES, COLLABORATIONS, CONSORTIA, SPIN-OFFS AND OTHER
Prof. Maffezzoli tutored about 200 MSc and 15 PhD students. Many of them works in applied research at CETMA consortium. Start up companies Salentec and Cetmacomposites have been funded by his former PhD students. The most recent collaborations with industrial partners and research institutions include: Leonardo Areostructures, Vestas and GKN Fokker; National Institute of Standard and technology (USA) and TU Delft (Holland)

## PROJECTS AND ACTIVITIES
Project supported at regional, national and international levels have been performed during last 30 years including all the former described activities. More recently collaborations with Leonard aerostructures regarded permeability measurement of carbon fibre preforms. The obtained results have been used in modelling of the vacuum assisted infusion of an aeronautic panel, stiffened with stringers. This collaboration involved also the study of resin flow in autoclave processing. Process modelling has been performed either for thermosetting matrix composites either for thermoplastic matrix ones. These activities have been coupled with material characterization and modelling of their behaviour, i.e. cure kinetic and rheology for thermosetting matrices, crystallization and melting in thermoplastic matrices
The study of welding by induction and US led to two patents and several scientific papers in collaboration with CETMA and TU Delft.

# POLYMERIC MATERIALS

*The research activity is mainly devoted to processing and characterization of polymers, nano-composites, bio-polymers and recycled materials.*

Polymeric Materials Lab is part of the Materials Science and Technology area, of the Engineering for Innovation Department. The main research's fields of the group are based on the design and production of small to medium scale prototypes with innovative materials (polymers, composites, nano-composites, biomaterials and recycled materials). The Polymeric Materials staff is able to provide innovative solutions for several industrial applications. Characterization of innovative materials and the prototypes serves as a guideline towards the optimization and improvement of the development of innovative materials and components.

## LAB'S INSTRUMENTATION & FACILITIES

Offer transversal and multi-disciplinary skills towards the design and optimization of the processing steps required to develop innovative plastic products, as well as the processing of lab to medium scale prototypes.

▪ Injection molding device (Boy XS) ▪ Pneumatic injection molding (RAY-RAN, mod PR3400) ▪ Compresion  molding (CAMPANA P7/91/PL) ▪ Rotational molding (Salentec) ▪ Batch mixer (HAAKE RHEOMIX 600) ▪ Single screw extrusion (HAAK RHEOMEX 302P) ▪ Twin screw extrusion (HAAKE Rheomex OS PTW16) ▪ Caldendering device ▪ Capillary rheometer (GOTTFERT RHEO-TESTER 1000) ▪ Parallel and cone and plate rheometr (ARES) ▪ Lloyd dynamometer.

## REFERENCES, COLLABORATIONS, CONSORTIA, SPIN-OFFS AND OTHER

Relationships with local, national and international companies and research institutions, aimed to the technological transfer products synthesis and / or processes, included in European and/or national Unisalento patents.

CETMA; ENEA (Brindisi research center); Salver; Technologycom; Leonardo areostructures; Leonardo Elicopters; Cetmacomposites; Salentec; Vestas; ALENIA, ALPAK s.r.l.; Magneti Marelli; Enel; Sistemi Energia; Ital Cementi; Master Italy; Medinok; Arter; SAATI S.p.A.; Telcom S.p.A.; Alfaedile; Centro Ricerche Fiat; METECNO; TECNECO Filtri; Inoxstyle; SIC Divisione Elettronica; Edilsud; IRPLAST srl; Italplastica srl; Chetta srl; Flexoplastic srl; Cartarredo SE.MA. srl; MASMEC s.r.l.; OGLE S.r.l.; S.A. INSERPLASA (Spagna); SOLTECO MADERA PLASTICA S.L. (Spagna); CICLOPLAST (Spagna); KOMMI; SERICHIM.

## PROJECTS AND ACTIVITIES

The lab activities are aimed at the development of innovative materials and prototypes through proper processing design and prototypes characterization. The lab activities are intended to provide a fast and efficient technology transfer to different industrial fields, as highlighted by the cooperation with different national and international companies. The current projects are national PON projects, called SPIA, DITECO, TRANSISTOR. Former European and national projects (CIP – EIP – ECO- INNOVATION – 2009 and 2012, Horizon 2020 research and innovation programme, MIUR _ Programma OperativoNazionale DM 29123) led to the development of innovative materials and products, and in some cases to the full scale industrial transfer.

# TRANSPORT PHENOMENA

*The research activity is mainly devoted to experimental measurements and model predictions of the transport properties of polymers, composites, nano-composites, ceramics, biomaterials and recycled materials.*

Transport Phenomena Lab is part of the Materials Science and Technology area, in the Engineering for Innovation Department. The main research's fields of the group are based on development and transport properties characterization of innovative materials (polymers, composites, nano-composites, ceramics, biomaterials and recycled materials). The Transport phenomena staff develop innovative experimental solutions for several industrial applications (surface treatments, buildings, chemical, automotive, aerospace, biomedical, renewable energies, circular economy). The laboratory has the capacity to create their own prototypes, that generally pass through a metrological qualification before leading possibly to an industrial product.

## LAB'S INSTRUMENTATION & FACILITIES
Offer transversal and multi-disciplinary skills in all those fields in which the analysis of transport properties of materials is required (automotive, aerospace, buildings, cultural heritage, biomedical, energetic applications).
▪ Thermal analysis (thermogravimetric analysis TGA-DTA ,TGA/DSC1 Star and System, METTLER Toledo; differential scanning calorimeter with UVlamp (UV_DSC), differential scanning calorimeter DSC 822, Mettler Toledo; thermomechanical analysis TMA Perkin Elmer Thermomechanical Analyzer TMA) ▪ Permeabilimeter (EX012-01 Multiperm O2/H20) ▪ Color analyzer (Konica Minolta CR-410)▪ Shore D surface hardness (DIGITAL MANUAL HARDNESS CHECK Gibrite Instruments s.r.l.).

## REFERENCES, COLLABORATIONS, CONSORTIA, SPIN-OFFS AND OTHER
ALENIA, ALPAK s.r.l., Magneti Marelli, Enel, Sistemi Energia, Dell'Anna Muia s.r.l.., Ital Cementi, ACOMON, Master Italy, Medinok, Arter.

## PROJECTS AND ACTIVITIES
The lab is suitable to the performance of service activities in innovation and technology field by consulting requests from national and international companies, including in national projects, too. The current projects are national PON projects, called SPIA, DITECO, TRANSISTOR.
▪ Main Transport Phenomena Activities are:
▪ Coatings for wood, metals, fabrics, concrete, natural and artificial stones
▪ Bio-composites for renewable energies
▪ Recycling of organic waste materials, plastic and carbon ashes
▪ Conductive fabrics
▪ Kinetic characterization and model prediction of thermal and photo-polymerizabale thermosetting resins

# MATECH-CCULT
## MATERIALS AND TECHNOLOGIES FOR CONSTRUCTIONS AND CULTURAL HERITAGE GROUP

*The Group carries on research activities on polymers, composites and other materials, especially for applications in Construction Industry and Cultural Heritage Conservation, with a strong interdisciplinary approach and applicative character, in close collaboration with several Italian and International Universities, Research Institutions, Museums and Companies.*

The main expertise and proficiency of the Group are: the physical (thermal, mechanical, bulk and surface, transport) properties, the structure-property relationship, and the aging, weathering and durability of polymeric materials and blends, toughened resins, thermosetting adhesives, composite matrices, construction materials, materials for Cultural Heritage, functional protective coatings for Industry, Constructions and Cultural Heritage. A strong focus is always maintained on the development and analysis of innovative materials (cold-curing structural adhesives/matrices for FRP composites, organic-inorganic hybrids/nano-composites, sustainable and eco-efficient mortars, etc.) employed in Industry, Constructions and Cultural Heritage protection, as witnessed by the patent of three hybrid (organic-inorganic) materials. The lab available for the Group members is well equipped with a wide range of analytical techniques, some of which have capabilities unique in the research laboratories present in South Italy.

### LAB'S INSTRUMENTATION & FACILITIES
Instrumentations and Facilities present in the Laboratory of Transport Phenomena and Durability:
▪ DSC Mettler operating from -150°C to 600°C ▪ Simultaneous thermal analyzer (STA), DSC-TGA, Mettler operating in air, nitrogen or vacuum up to 1450°C ▪ Photo-DSC Mettler, operating from 0°C to 600°C ▪ Thermo-mechanical analyzer (TMA), Perkin Elmer, operating up to 1000°C ▪ Hg UV lamp (UV HG 200 ULTRA) ▪ Permeability measurements to water vapor and oxygen, Masterlab.
Access to the following instruments:
▪ Dynamometer LLOYD LR5K machine with different lead cells, equipped with an oven ▪ Charpy and Izod impact pendulum equipped with a load cell ▪ Optical Microscope, equipped with a hot-stage ▪ Scanning Electron Microscope SEM Zeiss, equipped with an environmental chamber and EDS analyzer ▪ Wide angle X-ray Diffractometer, RIGAKU Ultima+ ▪ X-ray fluorescence spectroscopy, XRF, BRUKER AXS.
▪ Varian Cary 500 UV-Vis-NIR spectrophotometer ▪ UV weathering chamber QUV (Q-Lab), equipped with a UV-B type lamp ▪ Strain controlled cone and plate and parallel plate rheometer, Rheometric ARES, equipped with DMTA ▪ Capillary rheometer, Gottfert ▪ Dynamic light scattering (DLS Zetasizer) ▪ ShoreD durometer ▪ Pencil hardness instrument ▪ Planetary mill and blade mill for ceramics and polymers. ▪ Dynamic contact angle COSTECH instrument, equipped with a video-camera ▪ Colorimeter, Konica Minolta CR-410.

### REFERENCES, COLLABORATIONS, CONSORTIA, SPIN-OFFS AND OTHER
APT; Assorestauro; Auxilium Terrae Foundation; ICPIC; TICHE Foundation;  École Polytechnique Fédérale de Lausanne; Loughborough University of Technology; University of Minho; Brno University of Technology; Warsaw University of Technology; University Carlos III; Lublin University of Technology; Al Akhawayn University; University of Rovira i Virgili; Italian Universities: Bari, Napoli Federico II, Roma La Sapienza, Trento; (CNR); Chemical-Physical Processes; SuPerconducting and other INnovative materials and devices; CNR-Nanotech; Vicat; HeidelbergCement – Global Product Innovation Department; Ibix s.r.l.; Kimia S.p.A.; Colorobbia S.p.A.; Decor – Martena; Plastik S.p.A.; Sipre.

### PROJECTS AND ACTIVITIES
▪ Prometeos – Original and Sustainable Products, Methodologies and Technologies for Diagnostic and Conservation of Historical Buildings
▪ It@cha - Italian Technologies for Advanced Applications in Cultural Heritage
▪ Applied Innovation Technologies for Diagnosis and Conservation of Built Heritage – A.I.Te.C.H
▪ Protection, consolidation and cleaning of stones characteristic of Apulia region.

# APPLIED ELECTROCHEMISTRY AND SPECTROELECTROCHEMISTRY

*Electrochemical preparation and kinetic, structural, compositional, optical and corrosion characterization of metals and alloys.*

The research activities are mainly focused on electrodeposition and corrosion of metals and on the development of materials for electrochemical energy conversion and storage.

By means of in situ and operando electrochemical and spectroelectrochemical approaches, the research group developed methods for understanding at the molecular level:

- corrosion systems for petrochemical, biomedical, electronic and industrial application;
- processes underlying the operation and durability of the different active components of devices such as batteries, fuel cells and supercapacitors.

The investigated systems are, in particular, Proton-Exchange Membrane Fuel Cells (PEMFC), Zn-air Batteries (ZAB) and Fuel Cells (ZAFC), but the methodology can be extended to all types of batteries.

## LAB'S INSTRUMENTATION & FACILITIES

The research activities are mainly focused on electrodeposition and corrosion of metals and on the development of materials for electrochemical energy conversion and storage.

- Spectrometers for in situ electrochemical measurements: FT-IR, Raman, VIS-UV spectral electroreflectance • VIS-UV spectroellipsometer for in situ electrochemical measurements • Potentiostats for electrochemical measurements and impedance spectroscopy • Rotating-disk electrode • MultiMode Scanning Probe Microscope (SPM) system for surface characterization including Atomic Force Microscope (AFM) and Electrochemical Scanning Tunneling Microscope (ECSTM) • Proton Exchange Membrane Fuel Cell (PEMFC) testing system • Zinc-air fuel cell (ZAFC) testing system.

## REFERENCES, COLLABORATIONS, CONSORTIA, SPIN-OFFS AND OTHER

Department of Energy - Polytechnic University of Milan; ELETTRA Synchrotron Light Laboratory; Diamond Light Source, Harwell science and Innovation Campus - Didcot, Oxfordshire; Université Paris-Sud (XI), Laboratoire de Chimie Physique, CNRS; Nuovo Pignone Tecnologie; Baker Hughes; GE Company.

## PROJECTS AND ACTIVITIES

- CALIPSOplus (Horizon 2020)-beamtime in collaboration with ELETTRA Synchrotron Light Laboratory (Trieste) for the following research activity
- PON 2007-2013. CSEEM-Center for Sutainable Energy, Environment and Mobility.
- PON 2007-2013. SMATI-Advanced materials development and innovative technologies for turbo machines for use in extreme conditions.
- Galileo Program in collaboration with Baker Hughes–General Electric. Development of innovative methodologies and advanced design for centrifugal compressor stages.
- PRIN 2008. Synthesis processes, study of phase transformations and properties of innovative magnetic materials.
- PRIN 2005. Layers for perpendicular magnetic recording by electrolytic deposition.
- PO Puglia FESR 2007-2013. Green Engine-Technologies for sustainable propulsion.

# SYDA LAB
## SYSTEM AND DATA LABORATORY

*SYDA Lab (Systems, Data and Applications) is the Department's Lab devoted to the research activities about database and big data management*

SyDa Lab has been active in the research about databases, big data management and its application in complex organizations for more than 20 years. The scientific topics have been to the study of novel approaches and edge and cloud architectures for delivering data services. The main research activities concern: models and tools for managing polymorphic databases; novel approaches to big Data for data science and analysis; models and tools to support data governance and accountability in data management; data service architectures models for edge computing; models and tools Data Security and Privacy by Design.
The main research field applications are smarticities and intelligent communities and critical infrastructures (like railways, postal offices, etc.). Specific attention is devoted to the data analysis coming from institutional sources (i.e. open data) for environmental monitoring and protection, especially in relationship with the impact with health and wellbeing.

### LAB'S INSTRUMENTATION & FACILITIES
The lab develops models and methodologies for the management of data in complex scenarios where heterogeneous data sources provide multi-format data, at different speed and require different frequency for processing.
- Computers and cloud big data platforms.

### REFERENCES, COLLABORATIONS, CONSORTIA, SPIN-OFFS AND OTHER
SYDA Lab has been involved in several industrial projects with national and international organizations, like Italian Railways, Italian Postal services, enterprise systems integrators, both at local and national levels. Moreover it collaborates with other European and US Universities on topic related the data service computing and data modelling.
The lab is suitable to part of an international network about big data and service computing. Moreover researchers actively participate and collaborate with national with industrial partners in research and innovation projects. Specific agreements have been signed with some enterprises like Expleo for developing novel approaches to the polymorphic data models, and with institutions like Apulia Region for the development of Service management approaches for the transportation services, and the Observatory of environment and healthcare of ASL Lecce.

### PROJECTS AND ACTIVITIES
SyDa Lab collaborates with enterprise and institutions in project related the big data collection, processing and analysis in scenarios related with edge and cloud computing. Some flagship project are:
- Cloud for Europe: for the development of Federated broker of a cloud of public services
- Data Factor: for the development of a platform for getting value from open data exploiting data science approaches
- APOLLON: Development of a cloud analyzer of real time urban pollution data for the impact on citizens health
- SARA: development of a analyzer of Environmental, Agriculture and Health data
- TEBAKA: An integrated digital platform solution for crops of grain, vines and olive oil
- SLAMA in outsourcing scenario: Methods and tools for reporting SLAs in IT and process outsourcing scenarios (main partners: Italian Railways and Italian Postal Services)
- The Apulian Unified Chart of Mobility Services: Definition of a systematic framework for managing the quality delivered by mobility providers
- Data-Driven Models for the Resilience of Critical Entities in cyber-physical social systems for supporting decision making

# DIDA LAB
## TECHNOLOGIES FOR SCIENTIFIC EDUCATION LABORATORY

*DidaLab is devoted to research activities related to technology enhance learning mainly oriented to STEMs (Science, Technologies, Engineering, Mathematics) topics.*

DidaLab has been active for more than 20 years in the design of digital tools for enhancing scientific education and in the development of novel approaches to include them in scientific education. Specifically the research activity has been devoted to the development of collaborative virtual and remote labs for engineering education and its inclusion in didactical activities. The lab provides both a knowledge base of literature and industrial references about technology enhanced learning in STEMs and own lab equipment for experiments which involve digital tools (like LEGO MindStorm, sensors and mobile devices for measuring physical phenomena, like sound, air quality, water quality, ph, colorimeter). Teachers, lectures and students and enterprises who are passionate of digital technologies and want to get closer on how digital tools can be employed for education are the DIDAlab's best target.

### LAB'S INSTRUMENTATION & FACILITIES
The lab develops Open Education Resources related to methodologies, models and digital tools for augmenting lecturers in scientific topics.
• Mobile devices and IoT, sensors to be connected computer for measurement of an electronic microscope and a telescope for scientific experiments • Lego Mindstorm kits for robotic experiments with students.

### REFERENCES, COLLABORATIONS, CONSORTIA, SPIN-OFFS AND OTHER
Relationships with local, national and international schools and universities, aimed to validate and transfer the research activies.
GOLC (Global Online Laboratory Consortium), schools in Italy and technical universities abroad, university of Udine for the aspects related to physics education for teachers.

### PROJECTS AND ACTIVITIES
WeColLab a platform which let students remotely control lab equipment like a telescope, an electronic microscope in a collaborative video environment.
• City SoundScape: a MOOL (Massive Online Open lab) which collaboratively involves students in experiments about sound and noise using their mobile phones.
• Apollon: a smartcity project which extends the MOOL for air quality monitoring and develop novel approaches to include mobile and IoT devices in citizen science initiatives.
• EuSecure: development of a MOOC blended with simulations and practical activities about security, sustainability and resilience in EU
  The Department's Virtual Labs for Industrial Engineering Education: 3D Printing, centrifugal pumps and Pelton turbine, Combustion Test.
• Rig & LDV ones
The lab promotes Open Education activities to support UN' Agenda 2030 for inclusion and good school.

# AVR LAB
## AUGMENTED AND VIRTUAL REALITY LABORATORY

*The research activities of AVR Lab are mainly focused on the applications of Extended Reality (XR) technology in medicine and surgery, cultural heritage, education and industry. The AVR Lab is also engaged in the design and development of advanced human-machine interfaces.*

The Augmented and Virtual Reality Laboratory is a research laboratory of the Dept. of Engineering for Innovation. The research activities concern the application of Extended Reality technology in medicine and surgery, cultural heritage, education, and industry and the design and development of advanced human-machine interfaces for touchless and gesture-based interaction.
The AVR Lab is involved in the research activities of DREAM, a multidisciplinary laboratory located in the Hospital of Lecce and focused on improving the efficiency and quality of healthcare services. In particular, the AVR Lab is involved in the design and development of realistic simulators for surgical training, platforms for the preoperative surgical planning and Augmented Reality-based systems for intraoperative surgery.
The AVR Lab is a member of the European Association for Extended Reality (EuroXR) and organizes annually the Salento AVR, the International Conference on Augmented Reality Virtual Reality and Computer Graphics.

### PROJECTS AND ACTIVITIES
The research activities of AVR Lab are focused on the investigation of human behavior trying to understand how the use of Extended Reality technology can enhance human capabilities using simulations of life situations replica and mixed reality.
The research activities of the Augmented and Virtual Reality Laboratory (AVR Lab) are mainly focused on the use of Virtual, Augmented and Mixed Reality technologies in medicine and surgery, cultural heritage, education and industry. The AVR Lab is also engaged in the use of advanced human-machine interfaces in order to provide natural and simple interactions with virtual objects and improve the user performances.

- Applications of XR in Medicine: Design and development of systems to support surgeons in diagnosis, preoperative planning and intraoperative procedures.
- Applications of XR in Cultural Heritage: Definition of new educational paradigms to enjoy artistic assets and reconstruction of historical/contemporary sites for educational purposes or, simply, to allow realistic navigation in environments that normally could not be explored.
- Applications of XR in Education: The definition of immersive learning environments in order to promote expanded education opportunities and improve understanding through serious games and advanced visualizations.
- Applications of XR in Industry: Development of immersive collaborative environments in order to optimize productivity, enhance learning, reduce errors and increase collaboration among designers and engineers.
- Human-Computer Interaction: Systems able to detect the movements of the user's hand and to associate the execution of relevant commands.

# EUMER
## EUROPEAN MARITIME & ENVIRONMENTAL RESEARCH

*Research targets are achieved through 2D/3D physical and numerical modeling of coastal processes, coastal defense structures, sub-surface flows and open channel hydraulics.*

The European Maritime & Environmental Research (EUMER) Lab at the Department of Engineering for Innovation, University of Salento is 2,500 m2 facility that provides physical model testing capabilities at appropriate scales for device testing, environmental modeling and coastal engineering, combined with a broad expertise in numerical modeling.

EUMER aims to deliver practical solutions to the most complex water-related challenges: from climate change to renewable energy, coastal management, environmental impact, and port engineering and management.

The multidisciplinary research center experts hold a proven track record of securing significant external grants from international funders, and developing innovative partnerships with educational institutions, industries and other maritime organizations.

Fields of applications spans from climate change, coastal defences and management, environmental impact assessment, port engineering and management, renewable energy, and any field in which practical solutions to complex water-related challenges are needed.

### LAB'S INSTRUMENTATION & FACILITIES
Research targets are achieved through 2D/3D physical and mathematical modeling of coastal processes, defense structures and sub-surface flows and open channel hydraulics.
- Electro-mechanical HR-Wallingford wave motion generation system - 16 resistive probes for measuring wave characteristics - 8 pressure transducers for measuring pressure - 1 current meter for measuring measurement of water currents - 1 mechanical profiler for surveying the bottom - 1 electromechanical sieve for selecting aggregates equipped with 10 sieves - 2 Mavic Air drones for surveying 3D and 2D models.

### REFERENCES, COLLABORATIONS, CONSORTIA, SPIN-OFFS AND OTHER
The experts of EUMER hold a proven track record of securing significant external grants from International funders, and developing innovative partnership with educational institutions, industry and other maritime organization. The EUMER laboratory also offers support for the teaching activities of the Civil Engineering (Bachelor and Master) and Ph. D. courses, including experimental/numerical tests and practical application with the direct involvement of the students.

Delft Hydraulics Institute (Delft, The Netherlands); HR Wallingford, UK; CWP, Dubai, UAE; United Arab University, Al Ain, UAE; Euro-Mediterranean Center on Climate Change (CMCC); Delaware University (USA)Institute of atmospheric sciences and climate (ISAC) National Research Council of Italy; University of Calabria; Polytechnic University of Bari; University of Naples Federico II.

### PROJECTS AND ACTIVITIES
Research activities mainly deal with physical and numerical studies on: coastal meteocean; wave, beach and structure interaction; stability of armoured layers; floating structures dynamics; navigation safety and mooring of ships in harbors; offshore structure response under extreme waves conditions; coastal morphodynamics and sediment transport; pollutant dispersion; networks for the supply, distribution and discharge of water.
- project Eco-Smart Breakwater: aimed at developing a new mantle element for reef dams.
- project START , (rapid mapping and control systems of the coastal and marine territory)
- Project INNO-DUNECOST: experimental tests on a small-scale physical model conducted in the 2D wave channel, for assessing the efficiency of innovative technologies for the stability of coastal dunes