POLITECNICO DI MILANO

PhD in BIOINGEGNERIA / BIOENGINEERING - 41st cycle

Number of scholarship offered	6
Department	DIPARTIMENTO DI ELETTRONICA, INFORMAZIONE E BIOINGEGNERIA

Description of the PhD Programme

The PhD Programme aims at developing scientific profiles who intend to practice their majoractivities in the field of Bioengineering. It addresses theoretical and experimental activities in 4 major research areas:Biomimetic Engineering and Micro-nano Technologies, RehabilitationEngineering and Technology, Technologies for Therapy, and Physiological Modelling and non-Invasive Diagnostics. More specific areas include, but are not limited to: Molecular and cellularengineering, Biomaterials, Tissue engineering, Bio-artificial interfaces and devices, Neuro-prostheses, Movement analysis, Cardiovascular and respiratory system bioengineering, Centralnervoussystemsignalandimageprocessingforrehabilitation,Biomechanics,Computationalfluid dynamics, Computer assisted surgery and radiotherapy, Artificial organs, Implantable devices,Biomedical signal and image processing, E-Health, Bioinformatics, functional genomics andmolecular medicine. Research focuses both on theoretical models, methods and technologies tosupport design of applications, software and hardware systems, together with tools and prototypedevice development. The involvement of industrial and clinical partners reinforces the mixbetween theory and application which is the strength of this PhD.Stage periods in distinguishedresearch institutes in Italy and abroad are an essential feature of the PhD candidatetraining. Scientific and research activities of PhD Bioengineering candidates are stronglygrounded on research laboratories located inside and outside the Departments in cooperationwith other research institutions and university hospitals. Publications in scientific peer-reviewedjournals, participation to international projects and the numerous collaborations confirm theexcellence level of the activities carried out in this PhD programme.

POLITECNICO DI MILANO

PhD in BIOINGEGNERIA / BIOENGINEERING - 41st cycle

OPEN SUBJECT Research Field: BIOINGEGNERIA / BIOENGINEERING

Monthly net income of PhDscholarship (max 36 months)
€ 1400.0 In case of a change of the welfare rates during the three-year period, the amount could be modified.

Context of the research activity	
Motivation and objectives of the research in this field	The PhD programme in Bioengineering aims at developing scientific profiles who intend to carry on most of their professional activity in the field of Bioengineering.It addresses theoretical and experimental activities in four major research areas: • Biomimetic Engineering and Micro-Nano Technologies • Rehabilitation Engineering and Technology • Technologies for Therapy • Physiological Modelling and non-Invasive Diagnostics. More specific areas include, but are not limited to: • Molecular and cellular engineering • Biomaterials • Tissue engineering • Bio-artificial interfaces and devices • Neuroprostheses • Movement analysis • Cardiovascular and respiratory system bioengineering • Central nervous system signal and image processing for rehabilitation • Biomechanics • Computational fluid dynamics • Computer assisted surgery and radiotherapy • Artificial organs • Implantable devices • Microfluidic and lab-on-a-chip systems • Biomedical signal and image processing

	• E-Health • Bioinformatics, functional genomics and molecular medicine • Artificial intelligence in medicine. More information available at:https://www.phdbioengineering.polimi.it/
Methods and techniques that will be developed and used to carry out the research	Research focuses on theoretical models, methods and technologies to support the design of applications, software and hardware systems, together with tools and prototype device development. The involvement of industrial and clinical partners strengthens the mix between theory and application, which is the strength of this PhD programme. Internships at prestigious research institutes in Italy and abroad throughout the world are essential elements in the training of doctoral students. The scientific and research activities of doctoral students are strongly rooted in research laboratories located inside and outside the Departments, in collaboration with other research institutions and university hospitals.
Educational objectives	The supervisor and his research team support the development of the research. Seminars and courses encourage an interdisciplinary approach. The laboratory activity completes the research programme. Students are also encouraged to spend a period of study abroad (with the availability of additional financial support). More information available at: https://www.dottorato.polimi.it/en/
Job opportunities	Employment opportunities include research positions both in academic and private institutions, in Italy and abroad, and in industry. Spin-offs and startups from research results are encouraged. Employment in this sector offers several interesting opportunities.
Composition of the research group	17 Full Professors 24 Associated Professors 15 Assistant Professors 165 PhD Students
Name of the research directors	Any faculty member can act as research director

POLITECNICO DI MILANO

Contacts
PhD Coordinator: Prof. **Raffaele Dellacà** Department of Electronics, Information and Bioengineering email: raffaele.dellaca@polimi.it phone: +39 02 2399 9005 PhD Programme BIO Secretary: **Marco Simonini** Department of Electronics, Information and Bioengineering email1: phd-bio@polimi.it email2: marco.simonini@polimi.it phone: +39 02 2399 3632 **Chiara Zitta** Department of Electronics, Information and Bioengineering email1: phd-bio@polimi.it email2: chiara.zitta@polimi.it phone: +39 02 2399 9091

Additional support - Financial aid per PhD student per year (gross amount)	
Housing - Foreign Students	--
Housing - Out-of-town residents	--

Scholarship Increase for a period abroad	
Amount monthly	700.0 €
By number of months	6

Stage and period abroad	
Institution or company where the candidate will spend the period abroad (name and brief description)	
By number of months abroad	0

Additional information: educational activity, teaching assistantship, computer availability, desk availability, any other information
The PhD student will be involved in educational activities along with teaching assistantship covering topics of imaging in small animal models and bioengineering of the respiratory system. A shared desk and computer will be given to the student for the time needed to carry out the research.

POLITECNICO DI MILANO

PhD in BIOINGEGNERIA / BIOENGINEERING - 41st cycle

THEMATIC Research Field: DECODING FACIAL EXPRESSIONS AND BRAIN ACTIVITY: INTEGRATED CAPACITIVE, EOG AND EEG SENSORS IN SMART EYEWEAR FOR THE ANALYSIS OF HUMAN ACTIVITY AND ATTENTIVE STATES

Monthly net income of PhDscholarship (max 36 months)
€ 1500.0 In case of a change of the welfare rates during the three-year period, the amount could be modified.

Context of the research activity	
Motivation and objectives of the research in this field	This PhD project aims to develop a novel smart eyewear platform for comprehensive biophysiological monitoring by using capacitive, EOG and EEG sensors. The primary objective is to achieve seamless electronic integration of these multi-modal sensors, potentially through a modular add-on design, enabling the collection of synchronized facial expressions, eye movement and brain activity data. A core focus of this research is the development of robust sensor fusion techniques, leveraging the complementary information from these modalities to enhance data quality and analytical capabilities.
Methods and techniques that will be developed and used to carry out the research	The research employs a multi-phase approach to develop and validate capacitive/EEG/EOG sensors for non-invasive monitoring of facial expressions and eyelid movements. Initially, a comprehensive review of existing literature and patents on integrative sensor technologies will be conducted. A microcontroller-based platform will be developed, incorporating miniature digital converters for precise sensor data acquisition, alongside the design and prototyping of a PCB for sensor integration. Multiple transducers will be arranged in an array and tested for performance in detecting facial expressions. In the subsequent phase, a wearable prototype will be

	created, integrating these sensors for head-mounted use. Optimal sensor positioning will be investigated to maximize sensitivity and accuracy, and the efficacy of the sensors in detecting a range of facial expressions will be validated through tests involving participants. Data will be collected and analyzed for consistency and reliability, and the developed platform will be benchmarked against available commercial devices and proprietary data to ensure robustness and efficacy.
Educational objectives	The PhD candidate will get in depth in: 1. Microcontroller technologies 2. Electronic design and prototyping 3. Non-contact sensor arrays for biomedical applications 4. Firmware development 5. Data acquisition and analysis
Job opportunities	The PhD will disclose professional careers in the fields of: 1. Electronic design 2. Sensor system development and integration 3. Biomedical data science 4. SW development tools
Composition of the research group	2 Full Professors 0 Associated Professors 2 Assistant Professors 1 PhD Students
Name of the research directors	Luca Mainardi - Pietro Cerveri

Contacts

Prof. Luca Mainardi

luca.mainardi@polimi.it

https://www.deib.polimi.it/ita/personale/details/252284

Prof. Pietro Cerveri

pietro.cerveri@polimi.it

https://unipv.unifind.cineca.it/get/person/064943

Additional support - Financial aid per PhD student per year (gross amount)	
Housing - Foreign Students	--
Housing - Out-of-town residents	--

Scholarship Increase for a period abroad	
Amount monthly	750.0 €
By number of months	6

Stage and period abroad	
Institution or company where the candidate will spend the period abroad (name and brief description)	
By number of months abroad	0

Additional information: educational activity, teaching assistantship, computer availability, desk availability, any other information

Educational activity: The student will be encouraged to attend to courses at POLIMI or abroad 2 / 3 in International Schools.
Teaching assistantship: There are various forms of financial aid for activities of support to the teaching practice.
The PhD student is encouraged to take part in these activities, within the limits allowed by the regulations.
Computer and desk availability: the student will be allowed to access facilities of the DEIB.

Matteo Rossi: https://www.deib.polimi.it/ita/personale/dettagli/917634
Andrea Farabbi: https://www.deib.polimi.it/ita/personale/dettagli/1023790
Athul Krishnan: https://www.deib.polimi.it/eng/people/details/2243966