



PhD in BIOINGEGNERIA / BIOENGINEERING - 39th cycle

Number of scholarship offered	9
Department	DIPARTIMENTO DI ELETTRONICA, INFORMAZIONE E BIOINGEGNERIA

Description of the PhD Programme	
<p>The PhD Programme aims at developing scientific profiles who intend to practice their major activities in the field of Bioengineering. It addresses theoretical and experimental activities in 4 major research areas: Biomimetic Engineering and Micro-nano Technologies, Rehabilitation Engineering and Technology, Technologies for Therapy, and 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, Neuro-prostheses, 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, Biomedical signal and image processing, E-Health, Bioinformatics, functional genomics and molecular medicine. Research focuses both on theoretical models, methods and technologies to support design of applications, software and hardware systems, together with tools and prototype device development. The involvement of industrial and clinical partners reinforces the mix between theory and application which is the strength of this PhD. Stage periods in distinguished research institutes in Italy and abroad are an essential feature of the PhD candidate training. Scientific and research activities of PhD Bioengineering candidates are strongly grounded on research laboratories located inside and outside the Departments in cooperation with other research institutions and university hospitals. Publications in scientific peer-reviewed journals, participation to international projects and the numerous collaborations confirm the excellence level of the activities carried out in this PhD programme.</p>	



PhD in BIOINGEGNERIA / BIOENGINEERING - 39th cycle

THEMATIC Research Field: ADVANCED MRI ASSESSMENT OF BRAIN TOXICITY AFTER HADRONTHERAPY FOR SKULL BASE AND PARANASAL SINUSES CANCER

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

Particle therapy (also known as hadrontherapy) with protons or carbon ions (PT) is an advanced form of radiotherapy offering new opportunities to improve cancer care and research. In patients with skull-base and paranasal sinus cancers, radiation-associated brain toxicity (BT) is a possible late complication of particle radiotherapy occurring in about 15-20% of cases. Due to the rarity of these tumors and to the limited number of particle therapy facilities worldwide, data on BT due to PT are scarce; moreover, neither clinical guidelines and treatment approaches nor BT classification criteria are well-defined, leading to diagnostic and treatment heterogeneities. The aim of the project is therefore to exploit advanced Magnetic Resonance Imaging (MRI) acquisitions to derive imaging features/biomarkers that, together with clinical information, can be used to implement patient-specific predictive models of development and long-term outcomes of BT.

Methods and techniques that will be developed and used to carry out the research

The main activity of the project will consist in defining and implementing advanced quantitative MRI protocols, parallelly to conventional clinical MRI acquisitions, to detect BT in skull-base and paranasal sinus cancers. Among advanced quantitative MRI, Diffusion Tensor Imaging (DTI) will be explored. Dedicated image processing solutions will be developed to properly reconstruct quantitative MRI. Also, routinely-acquired Compute Tomography (CT) and dose maps for



	<p>Compute Tomography (CT) and dose maps for radiotherapy treatment planning will be collected for the analysis. Imaging features will be derived from the collected imaging data, exploiting first-order statics and radiomics pipelines. Imaging features will be then used to implement predictive models of BT, relying on conventional statistical approaches as well as machine learning methods. Clinical information, including demographic information, tumor histology, treatment modality, neurological examination and neurocognitive assessment will be correlated with the derived imaging features and/or adopted to empower the implemented predictive models. To achieve the aim of the project, a prospective study acquiring approximately 50 patients treated with particle therapy is foreseen in collaboration with the National Center for Oncological Hadrontherapy (CNAO, Pavia, Italy) and Fondazione Istituto Neurologico Nazionale Casimiro Mondino (Pavia, Italy).</p>
Educational objectives	<p>During the PhD project the candidate will have to attend educational courses provided by the PhD school of Bioengineering and Politecnico di Milano. Participation to national and international conferences is also foreseen.</p>
Job opportunities	<p>After the PhD, different job opportunities will be available as Post-Doc or Research Scientist in national or international institutions. Careers in medical image processing are recently evolving in many enterprise organizations, including job opportunities such as data scientists, big data engineers and machine learning engineers. Also, possible collaborations with clinical institutions specialized in particle therapy can be established.</p>
Composition of the research group	<p>1 Full Professors 0 Associated Professors 1 Assistant Professors 3 PhD Students</p>
Name of the research directors	PROF. GUIDO BARONI

Contacts

*Prof. Guido Baroni,
Politecnico di Milano*



Guido.baroni@polimi.it

Additional support - Financial aid per PhD student per year (gross amount)	
Housing - Foreign Students	--
Housing - Out-of-town residents (more than 80Km out of Milano)	--

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

Additional information: educational activity, teaching assistantship, computer availability, desk availability, any other information
<p>The PhD student will be involved in educational activities along with teaching assistantship covering topics of advanced image processing, image feature extraction, machine learning and others mathematical modelling for BT prediction. A shared desk and computer will be given to the student at the CartCasLab for the time needed to carry out the research.</p> <p>The research group will be composed by 1 full professor, 1 assistant professor of Politecnico di Milano, along with other PhD students involved in collateral projects. Medical doctors and physicists of the National Center for Oncological Hadrontherapy (CNAO, Pavia, Italy) and Fondazione Istituto Neurologico Nazionale Casimiro Mondino (Pavia, Italy) will also cooperate in the project.</p>



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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	<p>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:</p> <ul style="list-style-type: none"> • Biomimetic Engineering and Micro-Nano Technologies • Rehabilitation Engineering and Technology • Technologies for Therapy • Physiological Modelling and non-Invasive Diagnostics. <p>More specific areas include, but are not limited to:</p> <ul style="list-style-type: none"> • 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



	<ul style="list-style-type: none"> • E-Health • Bioinformatics, functional genomics and molecular medicine • Artificial intelligence in medicine. <p>More information available at:https://www.phdbioengineering.polimi.it/</p>
<p>Methods and techniques that will be developed and used to carry out the research</p>	<p>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.</p>
<p>Educational objectives</p>	<p>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/</p>
<p>Job opportunities</p>	<p>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.</p>
<p>Composition of the research group</p>	<p>17 Full Professors 24 Associated Professors 15 Assistant Professors 165 PhD Students</p>
<p>Name of the research directors</p>	<p>Any faculty member can act as research director</p>



Contacts

PhD Coordinator:

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PhD Programme ? BIO ? Secretary:

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Additional support - Financial aid per PhD student per year (gross amount)

Housing - Foreign Students

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**Housing - Out-of-town residents
(more than 80Km out of Milano)**

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Scholarship Increase for a period abroad

Amount monthly

700.0 €

By number of months

6

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.



PhD in BIOINGEGNERIA / BIOENGINEERING - 39th cycle

PARTENARIATO PNRR Research Field: DEVELOPMENT OF PREDICTIVE MONITORING FROM ROUTINELY COLLECTED VITAL SIGNS FOR RISK STRATIFICATION IN CRITICALLY ILL PATIENTS

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	
<p>Motivation and objectives of the research in this field</p>	<p>It is estimated that annually 31.5 million people have sepsis and 19.4 million have severe sepsis, with a hospital mortality of 17% and 26%, respectively. Among survivors, a high percentage experiences physical and psychological sequelae, including cognitive impairment. Sepsis has therefore been called a "hidden" healthcare disaster. Survivorship from sepsis is increasing, but the burden of survivorship is high: among 3-years severe sepsis survivors, up to 75% suffer from functional disability and about 17% suffer from cognitive impairment. The ensuing definition of new targets will enable to overcome the shortcomings of current therapies, which are mainly based on empirical evidence and not to act on the root causes. Critical care physicians rely heavily on the monitoring of hemodynamic signals, or measures which convey system-wide information on the cardiovascular status or organ functionality of the patient, but they do not provide any insight into any specific mechanisms. The effectiveness of interventions such as fluid resuscitation and vasopressor administration is limited. Fluid and vasopressors may restore blood pressure within minutes, but the target of hemodynamic stability alone doesn't assure the fully recovery. This project has the ambitiousness to provide new models for complex data collected at different biological levels so to have algorithms for a better stratification of the patients integrating standard clinical scores and indices and to</p>



	<p>provide new therapy target</p> <p>This project research is in the framework of?ANTHEM: AdvaNced Technologies for Human-centrEd Medicine?Codice PNC0000003 CUP B53C22006720001PIANO NAZIONALE COMPLEMENTARE (PNC)Decreto Direttoriale n. 931 del 6 giugno 2022 AVVISO PER LA CONCESSIONE DI FINANZIAMENTI DESTINATI AD INIZIATIVE DI RICERCA PER TECNOLOGIE E PERCORSI INNOVATIVI INAMBITO SANITARIO E ASSISTENZIALE da finanziare nell?ambito del PNC</p>
<p>Methods and techniques that will be developed and used to carry out the research</p>	<p>Hemodynamic signals, such as invasive arterial blood pressure (ABP), are continuously recorded in intensive care unit (ICU) patients and may contain dynamic signatures of the cardiovascular status of the subject, they can give insights on vascular function and blood flow propagation, adding important and complementary information to the static hemodynamic indices typically measured (e.g. mean values). The morphological characteristics of the ABP and flow convey the changes in cardiac properties and in arterial properties and represent an important source of information to investigate the interactions among heart, conduit vasculature and microvascular beds.The project consist in improving cardiovascular models to extract useful indices to better stratify critically ill patients so to tailor the therapy and prevent long term sequaleae of the pathology.The techniques involve clinical monitoring, mathematical modelling and machine learning techniques.The candidate will work with top faculty and researchers from hospitals, e.g. Humanitas Hospital.</p>
<p>Educational objectives</p>	<p>The PhD candidate will work with top faculty and researchers from clinical research unit and hospitals, and assist in experimental setting-up and/or data acquisition in order to gain familiarity with the clinical context. The candidate will work in international and multidisciplinary team and will enhance the communication skills by presenting results at internal meetings and national or international conferences.</p>



Job opportunities	The doctor of philosophy in bioengineering prepares students for bioengineering careers in industry, government or academia. An advanced degree in this area provides numerous opportunities to work in health care, biomedical industry, government regulatory agencies and academia.
Composition of the research group	0 Full Professors 1 Associated Professors 1 Assistant Professors 1 PhD Students
Name of the research directors	PROF. MANUELA FERRARIO - PROF. MARTA CARRARA

Contacts	
Prof. Manuela Ferrario, Politecnico di Milano Manuela.ferrario@polimi.it	
Prof. Marta Carrara, Politecnico di Milano Marta.carrara@polimi.it	

Additional support - Financial aid per PhD student per year (gross amount)	
Housing - Foreign Students	--
Housing - Out-of-town residents (more than 80Km out of Milano)	--

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

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 signal processing, mathematical modeling and machine learning. A shared desk and a computer will be given to the student at B3Lab for the time needed to carry out the research. The research group will be composed by 1 associate professor and 1 assistant professor from Politecnico di Milano, along with other PhD students involved in related projects. The candidate will be involved in the activities of B3Lab. The candidate will collaborate with medical doctors involved in the project.



This project research is in the framework of ANTHEM: Advanced Technologies for Human-centred
Medicine? Codice PNC0000003 CUP B53C22006720001 PIANO NAZIONALE
COMPLEMENTARE (PNC) ? Decreto Direttoriale n. 931 del 6 giugno 2022 ?? AVVISO PER LA
CONCESSIONE DI FINANZIAMENTI DESTINATI AD INIZIATIVE DI RICERCA PER
TECNOLOGIE E PERCORSI INNOVATIVI IN AMBITO SANITARIO E ASSISTENZIALE? da
finanziare nell'ambito del PNC



PhD in BIOINGEGNERIA / BIOENGINEERING - 39th cycle

PARTENARIATO PNRR Research Field: PHYSIOLOGICAL BARRIERS-ON-CHIP FOR THE EVALUATIONS OF ENVIRONMENTAL DETERMINANTS ON HEALTH

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	<p>Organ-on-Chip (OoC) technology combines the use of microfluidics, biomaterials, and advanced cell cultures in order to generate and monitor miniaturized replicas of human tissues and organs in vitro. It is an enabling technology involving interdisciplinary expertise from the fields of engineering, physics, and cell/molecular biology. Application areas include environmental assessment, toxicological evaluation of chemical agents, drug screening and disease modeling, among others. The aim of the project is to introduce physiological barriers on chip models (e.g. lung-on-chip and gut-on-chip platform) able to recapitulate the mechanisms of absorption of molecules/particles.</p> <p>This project research is in the framework of "ANTHEM: AdvANced Technologies for Human-centrEd Medicine" Codice PNC0000003 CUP B53C22006720001PIANO NAZIONALE COMPLEMENTARE (PNC)Decreto Direttoriale n. 931 del 6 giugno 2022 AVVISO PER LA CONCESSIONE DI FINANZIAMENTI DESTINATI AD INIZIATIVE DI RICERCA PER TECNOLOGIE E PERCORSI INNOVATIVI IN AMBITO SANITARIO E ASSISTENZIALE da finanziare nell'ambito del PNC</p>
Methods and techniques that will be developed and used to carry out the research	The design and the development of new advanced microscale in vitro platforms will consider state-of-the-art technologies, micro- and nano-fabrication. Computational



	<p>technologies, micro- and nano-fabrication. Computational modeling will be used to optimize geometrical parameters. The design and the development of new advanced microscale in vitro platforms will consider state-of-the-art technologies, micro- and nano-fabrication. Computational modeling will be used to optimize geometrical parameters. Advanced cell culture protocols will be designed and optimized. The developed microphysiological systems will be used to assess the mechanisms of absorption of environmental determinants. The research will be implemented at the MiMic Lab, Department of Electronics, Information and Bioengineering of Politecnico di Milano, while secondment periods are envisioned.</p>
Educational objectives	<p>To train the PhD student in organs-on-chip technology, microfluidics, microfabrication, soft-lithography, cell culture applications, micro-bioreactors. http://www.biomech.polimi.it/mimiclab https://www.polifab.polimi.it/</p>
Job opportunities	<p>The candidate will develop interdisciplinary knowledge and skills ranging from tissue engineering to cellular biology, besides working on cutting-edge methodologies and research. This will make the PhD candidate a highly attractive individual on the job market.</p>
Composition of the research group	<p>0 Full Professors 1 Associated Professors 1 Assistant Professors 5 PhD Students</p>
Name of the research directors	<p>PROF. MARCO RASPONI</p>

Contacts	
<p><i>Prof. Marco Rasponi</i> marco.rasponi@polimi.it, +39-02-2399-3377</p>	

Additional support - Financial aid per PhD student per year (gross amount)	
Housing - Foreign Students	--
Housing - Out-of-town residents (more than 80Km out of Milano)	--



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

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

- 1. Educational activity:** The student will be encouraged to attend to courses with subjects in tissue engineering, cell and tissue culture, micro and nanofabrication either at POLIMI or abroad in International Schools.
- 2. 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.
- 3. Computer and desk availability:** the student will be allowed to access facilities of both CBLab and μ BSLab of the DEIB.

The research will be carried out by an interdisciplinary consortium, bringing both basic and translational research expertise and long-lasting experience in the drug development process. Politecnico di Milano (IT) - POLIMI unit has access to microfabrication facilities. It has renowned experience in developing and studying biological models within custom-designed microfluidic devices for cell cultures and tissue engineering, with a focus in the field of cartilage tissue engineering. The PhD student will join the MiMic Lab group, led by Prof. Marco Rasponi (<http://www.biomech.polimi.it/mimiclab>), and which counts on the following composition:

Number of Associate Professors: 1

Number of Assistant Professor: 1

Number of PhD students: 5

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