

PhD in BIOINGEGNERIA / BIOENGINEERING - 40th cycle

THEMATIC Research Field: BIOLOGICAL VALIDATION OF PATIENT-SPECIFIC MICROSTRUCTURAL AND RADIOBIOLOGICAL MODELS - MINIONS ERC

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	External-beam radiotherapy has been established as best practice care in different cancer cases, although current models applied in the clinics to tune the treatment plan dosimetry, as a function of the expected tumour response and radiation-induced toxicity, do not make use of patient- specific information, but rely on radiobiological parameters typically derived from in-vitro experiments, thus abdicating from describing the in-vivo complexity of the pathology. The ERC project MINIONS is a cutting-edge research programme that investigates and integrates a set of activities to implement patient-specific microstructural and radiobiological models in personalized radiotherapy treatment planning and adaptation towards a detailed description of tumour characteristics of each patient and thus significantly improved tumour control probability. The main challenge of MINIONS is to create, for the first time, a fast patient specific models able to describe the microscopic characteristic of the tumour and its interaction with the radiation beam starting from advanced Magnetic Resonance Imaging (MRI) data and to validate these models relying on patient-specific in-vitro experiments. The main purpose of the PhD project, which will be part of MINIONS, is therefore to validate the models implemented in MINIONS relying on microscopic analysis of biological specimens and radiobiological experiments on cell cultures. The activities will be conducted in collaboration with clinical institutions involved in MINIONS.



Methods and techniques that will be developed and used to carry out the research	 The activities of the project, in collaboration with clinical institutions, will consist in: 1. Performing data collection: biological specimens will be collected in oncological patients at the collaborating clinical institutions before surgery, along with in-vivo advanced MRI data before surgery and before and after the radiotherapy treatment. 2. Performing different histo-pathological and molecular examinations on the biological specimens to evaluate the microstructural and biological characteristics of the tumour. 3. Performing cell culture/organoids from the pathological specimen. 4. Performing irradiation of the cell culture with X-rays or charged particle beams. 5. Performing analyses of the morphological and radiobiological characteristics of the cells after irradiation. 6. Validating the patient-specific MRI-based microstructural and radiobiological models developed in MINIONS by comparing model estimates with patient-specific in-vitro experiments. Specimens and cell lines available in biobank repositories will be eventually considered to support and improve the pipeline described above. The academical and clinical institutions collaborating in the MINIONS project are: The European Institute of Oncology (IEO, Milano, Italy) The National Center for Oncological Hadrontherapy (CNAO, Pavia, Italy)
Educational objectives	Educational objectives include that: - The PhD student will be involved in educational courses provided by the PhD school of Bioengineering at



	 Politecnico di Milano; By working in a collaborative environment involving different high-standing research units, the PhD students will be able to interact with professionals coming from different sectors to make the most of microstructural and radiobiological models available for applications in external beam radiotherapy. The PhD student will be able to understand the main concepts of cellular morphology and biology, diffusion magnetic resonance imaging and radiation interactions The PhD student will learn how to validate microstructural and radiobiological models. The PhD Student will participate in national and international conferences and schools. He/she will be also involved in producing manuscripts to be submitted in top-ranked peer-reviewed indexed journals.
Job opportunities	After the PhD, different job opportunities will be available as Postdoc or Research Scientist in national or international institutions. Positions as biologist or bioengineer will be also possible within clinical institutions making use of the developed tools to improve patient care and clinical workflows.
Composition of the research group	1 Full Professors 1 Associated Professors 0 Assistant Professors 12 PhD Students
Name of the research directors	Prof. Chiara Paganelli

Contacts

Prof. Chiara Paganelli

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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)	

POLITECNICO DI 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 CartCasLab (https://www.cartcas.polimi.it/) is composed of 1 Full Professor and 1 Associate Professor with up to 12 PhD students.

Currently, two PhD students are already involved in the MINIONS project developing in-silico microstructural and radiobiological models.

Clinical partners are composed of clinicians, radiologists, pathologists, biologists and radiobiologists, with a strong experience on the topic.

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 and those of the MINIONS project.

Collaboration with clinical partners is supported by the MINIONS project.