



PhD in MODELLI E METODI MATEMATICI PER L'INGEGNERIA / MATHEMATICAL MODELS AND METHODS IN ENGINEERING - 39th cycle

**PNRR 118 PA Research Field: DATA DRIVEN AND COMPUTATIONAL MODELLING OF
RADIATION DAMAGE ON THE TUMOUR MICROENVIRONMENT**

Monthly net income of PhDscholarship (max 36 months)

€ 1325.0

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**

Precision medicine increasingly leverages on the integration of two key technologies: (i) multi-scale and multi-physics computational models; (ii) improved personalised diagnostics, devices, and therapeutic strategies tailored to the individual patient pathophysiology. This interaction brings the concept of predictive models and “digital twin” closer to the clinical community. This fellowship aims at applying this approach to the analysis of the impact on radiation to the vascular microenvironment. The research will leverage on available data on the in-vivo damage to microvessels measured on head and neck cancer patients at the national Institute of Cancer (IRCCS-INT-Milan), combined with a multi-physics and multiscale model of the vascular microenvironment available at Politecnico di Milano. The primary objective of the research is to develop quantitative biomarkers for assessing the risk of microvascular damage of cancer patients subject to radiotherapy. A second objective is to envision adjuvant therapies to improve the outcome of radiotherapy. The proposed research activity meets the objectives of the National Recovery and Resilience Plan (PNRR) concerning the mission about the innovation and digitalization of the (Italian) national health system (Missione M6C2Innovazione, Ricerca e Digitalizzazione del Servizio Sanitario Nazionale).



Methods and techniques that will be developed and used to carry out the research	A preliminary study on the available data reveals that the images of the (sublingual) microvessels are a powerful predictor of the general microvascular health. In turn, this factor affects the risk of radiation damage. Exploiting machine learning based image analysis, we will develop a classification tool for patient stratification based on microvascular health. This data-driven approach will be then enhanced by bio-physics based indicators provided by a computational model of the vascular microenvironment already developed by the research team. Finally, thanks to the ability to solve the computational model in real time, based on reduced order modelling techniques, we will apply the data-driven and physics-based biomarkers into the clinical pipeline for radiotherapy of head and neck patients. Overall, for the methodological standpoint this fellowship combines image analysis tools, mathematical and computational modelling, statistical methods for patient stratification, blended into the unified environment of precision medicine provided by the collaboration with IRCCS-INT-Milano.
Educational objectives	To be able to critically analyse, model, ask and answer pertinent biological questions from data. To develop skills in statistical data analysis, scientific computing, machine learning and their application to precision medicine applied to oncology.
Job opportunities	The profile proposed here are broadly relevant for a range of employers including (but not limited to): public and private healthcare institutions, hospitals, clinical and pharmaceutical companies, technology, and biotech companies, as well as Research institutes in healthcare domain.
Composition of the research group	2 Full Professors 2 Associated Professors 1 Assistant Professors 0 PhD Students
Name of the research directors	Prof. Zunino, Prof. Paganoni, Dr. Rancati

Contacts	
paolo.zunino@polimi.it tiziana.rancati@istitutotumori.mi.it	



<https://zunino.faculty.polimi.it/>

<https://mox.polimi.it/people/people-details/?id=211>

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	662.5 €
By number of months	6

National Operational Program for Research and Innovation	
Company where the candidate will attend the stage (name and brief description)	Data Science Unit, Fondazione IRCCS Istituto Nazionale Tumori
By number of months at the company	6
Institution or company where the candidate will spend the period abroad (name and brief description)	to be defined
By number of months abroad	6

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

Educational activities (purchase of study books and material, funding for participation to courses, summer schools, workshops and conferences): financial aid per PhD student per year

1st year: max 1.800,47 euros

2nd year: max 1.800,47 euros

3rd year: max 1.800,47 euros

The PhD students are encouraged to take part in activities related to teaching, within the limits allowed by the regulations. 1 individual PC per student + several shared PC. Access to one cluster with 32 processors and 384 GB RAM, and to several multi-processor servers.