POLITECNICO DI MILANO

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 handrontherapy) 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

	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).
Educational objectives	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.
Job opportunities	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.
Composition of the research group	1 Full Professors 0 Associated Professors 1 Assistant Professors 3 PhD Students
Name of the research directors	PROF. GUIDO BARONI

Contacts
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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)	--

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 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.

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.