POLITECNICO DI MILANO

PhD in BIOINGEGNERIA / BIOENGINEERING - 39th cycle

PNRR 118 PNRR Research Field: AUTOMATIC ANALYSIS OF CORONARY ANGIOGRAPHY USING DEEP LEARNING TECHNIQUES FOR THE LOCALIZATION AND CLASSIFICATION OF STENOSIS AND ATHEROSCLEROTIC PLAQUES

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	One of the main challenges in modern therapy for patients with coronary artery disease is the identification of non-obstructive and vulnerable plaques that can potentially cause acute coronary syndrome by rupturing with subsequent acute artery occlusion. Early identification and determination of the potential vulnerability level of these plaques are therefore essential for the evaluation of high-risk patients, preventing ischemia, coronary occlusion, and consequent heart attacks. Thanks to artificial intelligence tools such as Deep Neural Networks, innovative methodologies can be obtained to automatically detect and characterize plaques from volumetric data such as Coronary Computed Tomography Angiography (CCTA). From such analyses, it will be possible to provide the cardiologist with a detailed angiographic analysis of the coronary situation without the need for invasive analyses such as coronary angiography through cardiac catheterization.
Methods and techniques that will be developed and used to carry out the research	The PhD student's research activity will involve studying neural networks derived from graph theory (Graph Neural Networks) in order to dynamically reconstruct the coronary tree from volumetric tomographic data and extract the centerline that describes the various branches. Medical radiomics techniques will then be used to identify and classify different potentially vulnerable plaques as

	well as characterize them from a structural point of view.
Educational objectives	The purpose of the proposed doctoral activity is to train the student with advanced interdisciplinary knowledge in the fields of 3D tomographic image processing, pattern recognition based on modern Machine Learning techniques, and biomedical engineering techniques. The objective is to enable the candidate to effectively develop systems that can integrate state-of-the-art knowledge from the fields of Computer Vision, Deep Learning, Radiomics, and biomedical signal processing
Job opportunities	Upon completion of the Ph.D. program, the student will have a wide range of job opportunities in hospital research institutes and companies operating in the biomedical field of tomographic and radiographic analysis. The cross-disciplinary training will therefore be relevant and of significant value to both national and international companies/institutions.
Composition of the research group	1 Full Professors 1 Associated Professors 2 Assistant Professors 4 PhD Students
Name of the research directors	PROF. PIETRO CERVERI

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

National Operational Program for Research and Innovation	
Company where the candidate will attend the stage (name and brief description)	
By number of months at the company	0
Institution or company where the candidate will spend the period abroad (name and brief description)	University College Dublin, School of Medicine presso Dublino
By number of months abroad	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 A shared desk and computer will be given to the student for the time needed to carry out the research.