PhD in BIOINGEGNERIA / BIOENGINEERING - 39th cycle

THEMATIC Research Field: AI-CORPS - TRUSTWORTHY, INTEGRATED ARTIFICIAL INTELLIGENCE TOOLS FOR PREDICTING HIGH-RISK CORONARY PLAQUES

<table>
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<th>Monthly net income of PhD scholarship (max 36 months)</th>
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<td>€ 1400.0</td>
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<td>In case of a change of the welfare rates during the three-year period, the amount could be modified.</td>
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Context of the research activity

Coronary artery disease (CAD) is among the leading cause of death and disability. Identification of patients at high risk of cardiovascular events is pivotal. However, current risk stratification based on imaging and known biomarkers is suboptimal. This PhD position is granted in the framework of a FRRB project AI-Corps - Trustworthy, integrated Artificial Intelligence tools for predicting high-risk CORonary PlaqueS - in collaboration with centro Cardiologico Monzino and the project objective is to develop a multicriteria decision model for non-invasive assessment of vulnerable atherosclerotic patients and to evaluate its ability to predict the occurrence of an adverse event in intermediate-to-high risk patients with suspected or known CAD. The planned workflow consists in using a retrospective cohort of patients undergoing clinically indicated coronary angiography (CCTA) to develop an integrated application for automatic coronary artery segmentation, quantitative plaque analysis, biomechanics and fluid dynamics.

Motivation and objectives of the research in this field

The project will consist of 2 tasks. The first one will consist in the development of a 3D U-Net architecture to segment CCTA images and extract both plaque and vessel lumens. The second Task will consist in running CFD simulations using the geometries extracted in Task 1 to automatically compute the coronary Flow Fractional Reserve and in particular the 3D pressure fields at specific regions of interest.
### Educational objectives

The PhD candidate will learn 1) how to process clinical images using deep learning techniques and to assess the quality of the obtained results; 2) how to run CFD simulation using semiautomated pipelines and 3) how to relate to clinicians in order to make the process of transferring skills and information effective in both directions.

### Job opportunities

The PhD student will acquire useful skills for a future employment in: a) academic contexts, b) in research contexts in clinical laboratories, c) in companies that deal with image processing and data mining, d) in companies that offer simulation services.

### Composition of the research group

- 1 Full Professors
- 2 Associated Professors
- 2 Assistant Professors
- 3 PhD Students

### Name of the research directors

PROF. ALBERTO CESARE LUIGI REDAELLI

### Contacts

**Alberto Cesare Luigi Redaelli**
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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 hosted in the doctoral open space and will receive a laptop for daily activities; he will also have access to the biomechanics research laboratory and to the computational facilities of the research group.