



SUPERVISOR INFORMATION	
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Department	Department of Electrical and Computer Engineering
Field(s) of research	Biomedical Engineering; Artificial Intelligence; Computer Vision; Medical Imaging
PROJECT PROPOSAL	
Title (optional)	Deep Patient Phenotyping for Coronary Artery Disease Risk Stratification
Brief project description	
<p>CAD is the leading cause of death worldwide, responsible for over 9M deaths. CAD involves the reduction of blood flow through the coronary arteries to the heart muscle, leading to myocardial ischemia and infarction. The early detection of CAD is thus crucial as it can substantially decrease mortality/morbidity. Computed tomography coronary angiography (CTCA) is the recommended non-invasive exam for diagnosis as it can image the coronary arteries to assess the degree of stenosis. On the other hand, non-contrast cardiac CT (CCT) allows coronary artery calcium burden (CAC) assessment, which is a well-known prognostic for CAD.</p> <p>However, in spite of the value of these techniques, CAD risk stratification remains challenging. CAC has several limitations as it does not account for individual plaque features and disregards non-calcified stenosis. Moreover, both CAC and CAD-RADS focus on stenosis alone and disregard major aspects of atherosclerosis, plaque formation and rupture. Previous studies have, however, suggested that additional prognostic information can be derived from CT, namely regarding more complete calcium burden descriptions, metabolic radiomics descriptions, and hemodynamic metrics.</p> <p>The main hypothesis of the proposed project is thus that the prognostic value of CT can be improved by developing automatic tools for patient profiling, which will enable the identification of patient phenotypes and the development of risk stratification tools.</p> <p>To achieve this vision, artificial intelligence methods will be developed to extract plaque-specific, metabolic and hemodynamic patient profiles. The methods developed will rely on deep learning architectures for the segmentation of plaque and adipose tissues and multimodal registration for the segmentation of coronary arteries. Finally, these profiles will be evaluated through clustering techniques to identify patient phenotypes and supervised learning to perform risk stratification.</p>	