CREATIS Centre de Recherche en Imagerie Médicale

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PhD proposal 2021

Title of the PhD project:	**Structural and kinematic analysis of the arterial wall in ultrasound image sequences using deep learning**
University:	Université Claude Bernard Lyon 1, France
Doctoral school:	ED 160 EEA de Lyon, head Philippe DELACHARTRE
Discipline:	image processing
Laboratory:	CREATIS CNRS 5220, INSERM U1294 (head O. Beuf)
Supervisor:	M. Maciej ORKISZ, team MYRIAD
Co-supervisor:	M. Hervé LIEBGOTT, team ULTIM
Keywords:	ultrasound imaging, convolutional neural networks, segmentation, motion estimation, simulation

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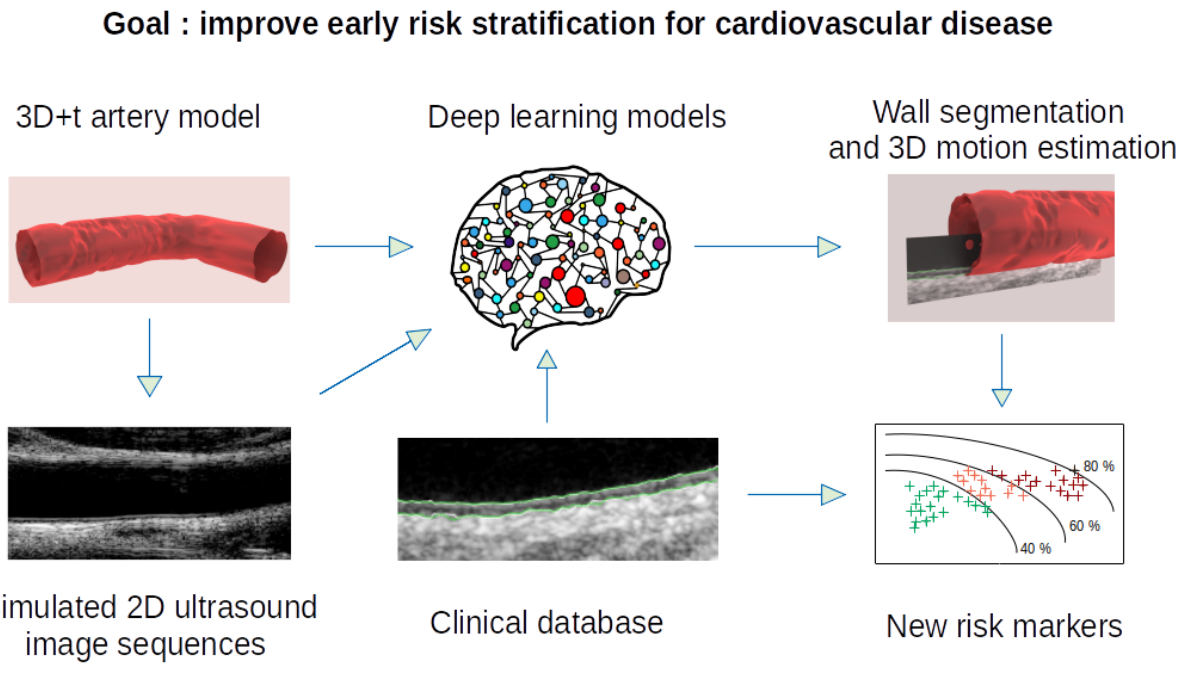

Scientific field and context: Ultrasound (US) imaging is well suited for cardiovascular disease screening. In particular, it allows the observation of thickening and pathological changes in the distensibility of the arterial wall. Recently, it has been shown that longitudinal wall motion and variations in wall thickness during the heart beat provide additional information on the biomechanical state of the wall, which may improve early detection of at-risk individuals. These phenomena are much more difficult to quantify and the validation of methods published to date is subject to uncertainties related to the use of manual tracings as a reference.

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Objectives of the thesis: The main goal of the thesis is to develop segmentation and motion estimation methods capable of delineating the arterial wall and finding all the components of its displacement, throughout sequences of US images representing an artery, typically a carotid artery. To do so, the candidate will also develop simulation methods to generate realistic US-image sequences incorporating all the movements of interest, with the dual objective of training the models and creating perfectly controlled references to validate the proposed segmentation and motion estimation methods.

Expected innovative contributions: The main contribution will be a deep-learning-based motion estimation method capable of finding not only global displacements, but also local tissue deformations. In order to do this, a model will be developed relating the tissue motion to the changes in visual appearance of the characteristic US-image texture, called speckle. Another contribution will be a simulation method for generating very realistic sequences with perfectly controlled deformations, both to train the model and to create the ground truth necessary to validate the estimation method.

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PhD thesis funding: Doctoral contract (3 years) at UCBL (University of Lyon). Please note that the applicant selected by the supervisors will have to defend her/his candidacy face to the institutional final-selection committee.

Expected candidate profile (prerequisite): image processing, machine learning, programming, interest for biomedical field and biomechanical modeling for health sector.

Application: Send to the supervisors your resume, transcript of records, and contacts of two references, preferably including your MSc project supervisor.

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Bibliography examples:

Sami Qorchi, Didier Vray, Maciej Orkisz, Estimating arterial-wall deformations from automatic key-point detection and matching, Ultrasound in Medicine & Biology, 2021, in press, DOI: 10.1016/j.ultrasmedbio.2021.01.001

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