Stage de fin d'études / Master 2 – 2021-2022.

Title: Multiparametric functional atlas of the aorta.
Team: MYRIAD = « Modeling & analysis for medical imaging and Diagnosis »
Supervision: Nicolas DUCHATEAU (Associate Professor / U. Lyon 1), Monica SIGOVAN (CNRS researcher).

Context: The study of organs from multiple points-of-view (namely, multiple descriptors extracted from different types of medical images or even from biophysical simulations) is key to provide a complete picture of complex diseases. Specifically, vascular diseases, namely atherosclerosis and aneurysms, modify the vessel wall tissue morphology and its mechanical characteristics and thus its function. Blood flow plays an important role in vascular diseases and should also be considered when analyzing the disease. Medical imaging techniques enable measurement of morphological parameters such as vessel diameter, vessel wall thickness and tissue composition [MEC-20]. They also enable direct measurement of blood flow [SIG-18]. We have recently proposed to exploit the dynamic information from medical imaging and combine it with mechanical modeling for an advanced analysis of the vessel wall mechanical properties. Combining together this multi-parametric information should provide a comprehensive picture of vascular diseases.

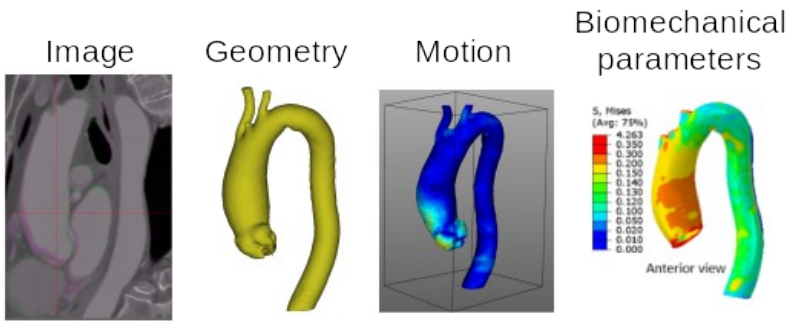

Figure: Different types of image-based and simulation-based functional information available for the aorta.

Objectives: We have advanced expertise on functional analysis of the aorta [SIG-15, ZHA-21] and statistical atlases built for other organs [DUC-11, MOC-20]. Through this internship, we aim at building a multiparametric functional atlas of the aorta. This means transporting the data from multiple acquisitions of a given individual into a single anatomical reference (intra-subject atlas), and generalizing this to a population (inter-subject atlas) to allow the statistical analysis of these data at each point of the aorta. This requires :
- Registration and/or parameterization of the aortic anatomy to get intra- and inter-subject anatomical correspondences,
- Transport techniques to redefine the functional data (scalars, vectors, etc.) on the anatomical reference,
- Statistical analysis to evaluate the added value of this advanced location over more standard descriptors used in the clinic.

Practical information:
- Location: DOUA campus, CREATIS lab, Villeurbanne
- Duration: 6 months, starting February-March 2022

Profile:
- MSc student with applied mathematics and/or image processing background
- Good programming skills: Python (preferred) and/or Matlab and/or C++
- Good English
- Motivated to work on medical applications

Contact: Send your CV, motivation letter, and academic record to: nicolas.duchateau@creatis.insa-lyon.fr

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Bibliography:
[DUC-11] Duchateau N, De Craene M, ..., Frangi AF. *Med Image Anal.* 2011;15:316-28.
[MEC-20] Mechtouff L, Sigovan M, ..., Nighoghossian N. *J Nucl Cardiol.* 2020. In press.
[MOC-20] Moceri P, Duchateau N, ..., Sermesant M. *Eur Heart J Cardiovasc Imaging.* 2020. In press.
[SIG-15] Sigovan M, Dyverfeldt P, ..., Hope MD. *Magn Reson Imaging.* 2015;33:695-700.
[SIG-18] Sigovan M, Si-Mohamed S, ..., Boussel L. *Eur Radiol.* 2018;28:3355-61
[ZHA-21] Zhang R, Sigovan M, Clarysse P. *Proc. STACOM-MICCAI, LNCS*. 2021. In press.