MSc Internship – 2026.

Title: **Multi-chamber segmentation and tracking in 2D echocardiography with deep learning.**

Team: MYRIAD = « Modeling & analysis for medical imaging and Diagnosis »

Supervision: Nicolas DUCHATEAU (Associate Professor) - Olivier BERNARD (Full Professor)
Collaboration with Sherbrooke University, Canada: Pierre-Marc JODOIN (Full Professor), Thierry JUDGE (PhD student)

Context: Cardiac diseases progressively deteriorate the shape and deformation of the cardiac muscle (the myocardium) across the cycle. Both characteristics can be assessed using dynamic imaging modalities, such as 2D echocardiography, and quantification tools are used to track the myocardium across the cycle [AMZ-19]. However, segmentation and tracking are performed independently, while they could benefit from each other. Besides, current analyses mostly focus on the left ventricle, resulting in a suboptimal assessment of the interactions with the other cardiac chambers such as the right ventricle and the left atrium, despite their importance in several diseases (hypertension, dilated cardiomyopathies, asynchronous heart, etc.).

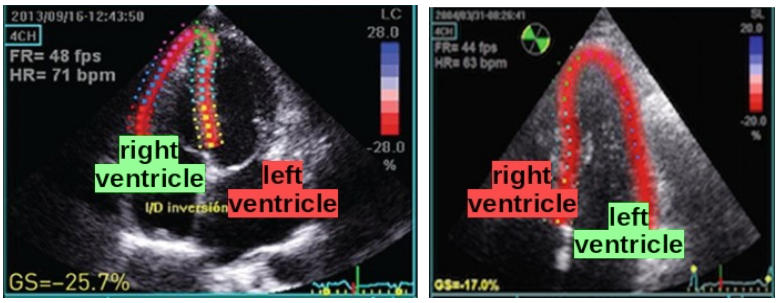

Figure: Tracking-based delineation of the left and right ventricles on 4-chamber views. Adapted from [CIP-19]

We have developed state-of-the-art segmentation and tracking tools based on deep learning specific to 2D echocardiography and the left ventricle. Segmentation relies on reinforcement learning to generalize the results of state-of-the-art models such as U-Net to challenging and unannotated image sequences [JUD-24]. Tracking relies on deep learning-based optical flow estimation trained on highly realistic synthetic images with ground truth speckle motion [JUD-25], which we obtain from a unique ultrasound simulation model developed at our lab (SIMUS).

Objectives: This internship will specifically target the extension of segmentation and tracking:
- to other chambers of the heart (right ventricle and left atrium),
- to jointly perform segmentation and tracking at the same time,
- the evaluation of these extended methods against existing academic and commercial software.

We will use existing studies 2D echocardiographic from our clinical collaborators, mostly 2- and 4-chamber images, from a large database of patients with potentially both myocardial shape and deformation alterations due to disease.

Practical information:
- Location: DOUA campus, CREATIS lab, Villeurbanne
- Duration: 6 months, starting February-March 2026
- Exploratory subject that can be continued within a PhD thesis

Profile:
- MSc student with an applied mathematics and/or computer science background.
- Good programming skills in Python.
- Good English
- Motivated to work on medical applications.

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

---

Bibliography:

[AMZ-19] Amzulescu et al. *Eur Heart J Cardiovasc Imaging*. 2019;20:605-19.
[CIP-19] Cipani et al. *Textbook of Echocardiography for Intensivists and Emergency Physicians, Springer.* 2019;71-8.
[JUD-24] Judge et al. *Proc. MICCAI, LNCS* 2024;15009:235-44.
[JUD-25] Judge et al. *Proc. IUS* 2025.