

**PhD position at the Center for Biomedical and Healthcare Engineering,
Mines Saint-Etienne – Laboratoire SAINBIOSE INSERM UMR 1059**

PREDICTING AORTIC WALL GROWTH AND REMODELING FOLLOWING LVAD IMPLANTATION

Keywords: Biomechanics, Growth and Remodeling, Heart Failure, Aorta, Left Ventricular Assist Device

Academic context - Heart failure (HF) remains a leading cause of morbidity and mortality. While Left Ventricular Assist Devices (LVADs) represent a promising treatment for these patients, they frequently induce severe complications such as thrombosis, hemolysis, and end-organ dysfunction. Improving LVAD performance and optimizing patient outcomes are crucial to advancing heart failure management and reducing its societal burden.

This PhD project will be part of a larger collaborative project between CEMEF UMR 7635, INPHYNI UMR 7010 and SAINBIOSE UMR INSERM 1059. The consortium aims at developing a new LVAD, which will be optimized by combining fluid-structure interaction (FSI) simulations, advanced blood rheology modeling, and multiscale analysis to account for the complex interplay between the pump, arterial tissue, and blood flow.

Scientific context – Implanting an LVAD fundamentally alters aortic hemodynamics by disrupting natural flow patterns and pulsatility. To prevent or limit long-term complications arising from the compliance mismatch between the rigid device and the native aorta, it is essential to predict how the aortic wall will adapt over time.

Building upon existing aortic growth and remodeling (G&R) models, this PhD project will focus on developing a computational framework to predict the aortic wall's response to LVAD-induced mechanical loading, ultimately leading to optimized surgical implantation.

Project summary - The approach will be divided into the following steps:

- Develop a growth and remodeling framework capable of simulating the pathological remodeling of the aorta
- Implement a fine description of the mechanical loading induced by the LVAD implantation into this growth and remodeling framework
- Validate and refine the model against in vivo imaging and histological data
- Optimize LVAD placement and operating conditions to limit adverse remodeling of the aorta

Student profile: Background mechanics and/or biomechanics. Curiosity for biomedical applications.

Administrative aspects: This PhD position will be fully funded for 3 years, starting in the fall of 2026.

If you are interested, send a curriculum vitae and a short cover letter describing potential previous research experience and interests. Please, submit via email with "PhD position TwinHeart" on the subject line to Stéphane Avril (avril@emse.fr) and Fanette Chassagne (fanette.chassagne@emse.fr).