F4 Computational Models for Improved Assessment of Diastolic Function from Echocardiography

HOST ORGANISATION

Oslo University Hospital
(OUS), Oslo, Norway

PHD AWARDING INSTITUTION

University of Oslo
(UiO), Norway

Supervisory Team

Lead Supervisor

- Dr. Espen Remme (Oslo University Hospital)

Co-Supervisors

- Prof. Pablo Lamata (King's College London)
- Dr. Jurica Sprem (GE Healthcare)

Project Description

Heart failure affects millions of people worldwide, and around half of all cases are linked to problems with the heart's ability to relax and fill properly during diastole. Although echocardiography is the most commonly used imaging technique for assessing cardiac function, many of the key factors responsible for diastolic dysfunction—such as myocardial stiffness, impaired relaxation, and elevated filling pressures—cannot be measured directly using current non-invasive methods.

This project aims to improve the assessment of diastolic function by combining echocardiographic measurements with patient-specific digital twin technology. The doctoral candidate will develop mathematical models that link clinically acquired echocardiographic data to the underlying physiological and mechanical properties of the heart. By integrating imaging information with computational models, the project seeks to estimate clinically important parameters that are otherwise difficult to measure without invasive procedures.

While the main focus of the project is the integration of conventional echocardiographic measurements with computational models of cardiac function, there will also be opportunities to investigate emerging ultrasound modalities such as blood speckle tracking (BST). BST provides information about intracardiac flow dynamics and can be used to derive parameters such as intraventricular pressure gradients, energy loss, and flow vortices. The clinical utility of these measurements and their relationship to filling pressures and diastolic function will be explored.

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The candidate will participate in the collection and analysis of animal and clinical datasets, including echocardiographic studies with simultaneously recorded invasive pressure measurements. These data will be used to develop, calibrate, and validate the proposed modelling approaches. Ultimately, the project aims to create more accurate and clinically useful tools for diagnosing and monitoring heart failure, supporting earlier intervention and more personalised patient care.

Planned Secondments

- King's College London, United Kingdom (2 months): training in advanced cardiac digital twin and heart modelling technologies.
- Maastricht University, Netherlands (1 month): training in the CircAdapt cardiovascular modelling platform and model personalisation methods.

Desirable Project-Specific Qualifications and Skills

We seek a motivated, creative, and enthusiastic candidate with a strong interest in interdisciplinary research at the interface of engineering, mathematics, and medicine.

- Applicants should hold a Master's degree (or equivalent) in Cybernetics, Electrical Engineering, Informatics, Physics, Mathematics, Biomedical Engineering, Medical Technology, or a related discipline.
- A strong academic record is required with a weighted average grade of B or higher.
- Experience with scientific programming (e.g., Python, MATLAB, or similar languages) is advantageous.
- Knowledge of mathematical modelling, computational mechanics, or data science is considered an advantage.
- Interest in cardiovascular physiology, echocardiography, medical technology, or computational medicine is desirable.
- Experience with experimental, pre-clinical, or clinical research, including data collection, validation studies, or analysis of biomedical data, is an advantage.
- Previous research experience, including scientific publications, conference presentations, or research projects, is beneficial.
- Excellent written and oral communication skills in English are required.
- The successful candidate should be able to work independently while also contributing effectively within a multidisciplinary research team.

Please direct any query regarding this project to:
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Applicants are required to use this website to submit their application for this position: https://2411.webcruiter.no/Main2/Recruit/Public/5167521419