F7 Models for the Non-Invasive Estimation of Central Blood Pressure and Flow Inefficiencies

HOST ORGANISATION

King's College London
(KCL), London, United Kingdom

PHD AWARDING INSTITUTION

King's College London
(KCL), London, United Kingdom

Supervisory Team

Lead Supervisor

- Dr. Adelaide de Vecchi (King's College London)

Co-Supervisors

- Dr. Alessandra Bavo (FEops/Materialise)
- Dr. Filip Lončarić (University of Zagreb)

Project Description

Many cardiovascular conditions, including valve disease and congenital heart disorders, are assessed using pressure measurements obtained through invasive catheter procedures. While these measurements provide valuable clinical information, they are costly, time-consuming and carry risks for patients. Developing reliable non-invasive alternatives could significantly improve diagnosis and patient care.

This project aims to develop new methods for estimating blood pressure and quantifying flow inefficiencies using medical imaging, machine learning, and computational modelling. The doctoral candidate will investigate how pressure differences can be calculated directly from magnetic resonance imaging (MRI) and ultrasound data, reducing the need for invasive measurements in selected clinical applications.

Building on technologies developed at King's College London, the project will focus on understanding how blood flow loses energy as it passes through narrowed valves or abnormal vascular structures. The candidate will develop methods to characterise pressure drops, viscous energy losses and momentum loss within the cardiovascular system, providing new biomarkers of valve and vascular function. The project will also explore practical ultrasound-based approaches, including planar wave imaging and contrast-enhanced ultrasonography, with the goal of supporting future clinical implementation.

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The research will draw on extensive imaging datasets from St Thomas' Hospital, including patients with aortic valve stenosis, congenital cardiovascular disorders and individuals participating in studies investigating the cardiovascular consequences of preterm birth. By combining fluid dynamics, machine learning, and advanced imaging analysis, the project seeks to develop clinically useful tools that support safer, more accessible and more personalised assessment of cardiovascular disease.

Planned Secondments

- FEops, Belgium (1 month): exposure to the commercial application of computational modelling technologies for planning transcatheter aortic valve implantation (TAVI) procedures.
- Maastricht University, Netherlands (2 months): experimental validation of flow inefficiency measurements and collaboration with related valve disease projects.
- IDIBAPS, Spain (2 months): access to clinical datasets and validation of developed algorithms against clinical and in-silico data.

Desirable Project-Specific Qualifications and Skills

- Degree in engineering, computer science, physics, mathematics, statistics or related quantitative discipline (UK 2:1 or equivalent).
- Working understanding of modelling, machine learning techniques and medical imaging principles. No specific medical knowledge is required.
- Bonus: experience coding in Python or equivalent programming language.

Please direct any query regarding this project to:
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