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REDUCED-ORDER MODELLING OF THE CARDIOVASCULAR SYSTEM APPLIED TO PRACTICAL PROBLEMS IN TODAY'S MEDICINE AND BIOLOGY

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MINI SYMPOSIUM PROPOSAL

Keywords: *Arterial and venous pulse wave propagation, one-dimensional (1D) and lumped parameter (0D) models, systemic, cerebral, pulmonary and coronary circulations, neurological, cardiovascular and congenital heart disease.*

Strategies based on reduced-order models, generally consisting of one-dimensional (1D) and/or lumped parameter (0D) equations, offer an efficient way to simulate vascular networks hæmodynamics and interactions between the heart and the vasculature, providing useful insights into the physiological underpinnings of clinical observations. While the basic methodology is well-established, there has been an increasing number of different approaches over the last decade, and focus is now shifting to experimental and clinical validation of these models, to quantification of uncertainty, and to possible clinical applications.

This symposium aims to address many of these aspects, with a particular emphasis on applications of reduced-order models, as well as on important fundamental advances. Possible topics include but are not limited to:

- Reduced-order methods for modelling the heart, valves and ventriculo-vascular coupling, modelling of congenital heart disease, modelling of the coronary circulation and mechanisms of myocardium-vessel interactions (*e.g.* with application to estimation of fractional flow reserve–FFR), modelling of the pulmonary circulation (*e.g.* with application to pulmonary hypertension), modelling of the intra/extra cranial venous system (*e.g.* with application to chronic cerebro-spinal venous insufficiency).
- Patient-specific modelling: to what extent is it possible to personalize a model for a given application (*e.g.* cerebral flow, coronary circulation, arterio-venous anastomosis, etc.)? Validation and robustness of patient-specific models.

- Models incorporating homeostatic mechanisms (auto-regulatory, baroreflex mechanisms, including orthostatic stresses, etc.) and their use in practical applications.
- Open-loop and closed-loop models, geometrical representation: Pros/cons of increasing model complexity? What are the modelling issues related to termination of open-loop systems (boundary conditions)?
- Emerging modelling methods for aiding with decision-making (*e.g.* pulse wave analysis, aneurysm detection, monitoring CO_2 balance during laparoscopic procedures, etc.) or refinement of model-based techniques (such as wave intensity analysis or cardiac output estimation) for obtaining clinically useful information from hæmodynamic measurements.
- Uncertainty quantification and sensitivity analysis in reduced-order models.
- Software development for clinical applications.