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# QUALITY AND VALIDATION OF COMPUTATIONAL CARDIO-VASCULAR BIOMECHANICS

**FRANCK NICOUD[*] AND DOMINIQUE THEVENIN[†]**

[*] Montpellier Institute of Mathematics and Modeling – I3M CNRS 5149
University Montpellier 2, Place Bataillon, CC51, 34095 Montpellier cedex 5, FRANCE
franck.nicoud@univ-montp2.fr – http://www.math.univ-montp2.fr/~nicoud/

[†] Lab. of Fluid Dynamics & Technical Flows
Universitaetsplatz 2, D-39106 Magdeburg, GERMANY
thevenin@ovgu.de - http://www.ovgu.de/isut/LSS

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## ABSTRACT

Computational Fluid Dynamics is now a well-established technique to get insight about haemodynamics in the cardio-vascular system. Huge progresses have been made during the last decade in terms of blood dynamics under in vitro and in vivo conditions and the number of published papers in the domain has drastically increased. These fast progresses have been made possible thanks to the experience gained since the 80's in other research fields like aerodynamics where CFD is being used as a key ingredient of any design and/or research effort. However, cardio-vascular blood flows share very specific properties that are not always present in other research fields. Notably: they are dominated by unsteadiness because of the pulsatile nature of the heart flux; they are often neither laminar nor turbulent but rather transitional because of the moderate Reynolds number; they take place in 3D complex geometries which are most often time varying; the blood pressure results not only on the local dynamics but also on long distance interactions through the pressure waves system that results from the coupling between the blood flow and the wall dynamics; the rheology of the fluid is extremely complex, including shear thinning and thixotropic effects; in the presence of endovascular prosthesis such as stents, multi-scaled effects become predominant since the small scales generated by the stents struts can influence the vascularisation of distal arteries; key input parameters of the simulations (e.g. distal impedance, wall stiffness, …) are often not known with enough accuracy because they are both patient specific and not measurable ... Another specificity of computational cardio-vascular biomechanics is that validation is extremely challenging because of the lack of resolved and accurate measurements under in vivo conditions. Nowadays, many (published) studies rely on rather crude assumptions so that some of the features cited above are not properly accounted for. In order to avoid partial or even erroneous descriptions of the blood flow complexity, high quality blood flow descriptions are then required. The objective of this mini-symposium is to offer to the biomechanical community the opportunity to share experience/ideas regarding the ways to improve the overall quality of blood flow computations as well as to validate these simulations. Contributions are expected and encouraged in the following areas: accurate numerical methods for transitional flows including direct or large eddy simulations, advanced boundary conditions, multiscale computations, accurate blood rheology, tuning of the input parameters through data assimilation.