

Computational hemodynamics for Computer Aided Clinical Trials: looking at the theory, struggling with the practice

Alessandro Veneziani^{1,2*}

¹ Department of Mathematics & Computer Science, Emory University
Atlanta, GA, USA
e-mail: avenez2@emory.edu

² School of Advanced Studies IUSS
Pavia, IT
e-mail: alessandroveneziani@iusspavia.it

ABSTRACT

When we get to the point of including the huge and relevant experience of finite element fluid modeling collected in over 25 years of experience in the treatment of cardiovascular diseases, the risk of getting “lost in translation” is real. The most important issues are the *reliability* that we need to guarantee to provide a trustworthy decision support to clinicians; the *efficiency* we need to guarantee to fit into the demand coming from a large volume of patients in Computer Aided Clinical Trials as well as short timelines required by special circumstances (emergency) in Surgical Planning.

In this talk, we will report on some recent activities taken at Emory to make this transition possible. Reliability requirements call for an appropriate integration of measurements and numerical models, as well as for uncertainty quantification. In particular, image and data processing are critical to feeding mathematical models. However, there are several challenges still open, e.g. in simulating blood flow in patient-specific arteries after stent deployment; or in assessing the correct boundary data set to be prescribed in complex vascular districts. The gap between theory, in this case, is apparent and *good simulation and assimilation practices* in finite elements for clinical hemodynamics need to be drawn. The talk will cover these topics.

For computational efficiency, we will cover some numerical techniques currently in use for coronary blood flow, like the *Hierarchical Model Reduction* or efficient methods for coping with turbulence in aortic flows.

As Clinical Trials are currently one of the most important sources of information for medical research and practice, we envision that the suitable achievement of reliability and efficiency requirements will make *Computer Aided Clinical Trials* (specifically with a strong Finite-Elements-in-Fluids component) an important source of information with a significant impact on the quality of healthcare.

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