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Advanced Computational Modeling Tools for Patient-specific Hemodynamic Analysis

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Advances in numerical methods and three-dimensional imaging techniques have enabled the quantification of cardiovascular mechanics in subject-specific anatomic and physiologic models. Research efforts have been focused mainly on three areas: i) pathogenesis of vascular disease, ii) development of medical devices, and iii) virtual surgical planning.
However, despite great initial promise, the actual use of patient-specific computer modelling in the clinic has been very limited. Clinical diagnosis still relies on traditional methods based on imaging and invasive measurements. The same invasive trial-and-error paradigm is often seen in vascular disease research, where animal models are used profusely to quantify simple metrics that could perhaps be evaluated via non-invasive computer modelling techniques. Lastly, medical device manufacturers rely mostly on in-vitro models to investigate the anatomic variations, arterial deformations, and biomechanical forces needed for the design of medical devices.

Our laboratory has been developing an integrated image-based computer modelling framework for subject-specific cardiovascular simulation CRIMSON (www.crimson.software) that can successfully bridge the gap between the research world and the clinic.

In this talk, we will provide an overview of the most novel features for the software, specifically the functions for parameter estimation and simulation of transitional stages, and highlight a series of future developments for the project.

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