**Digital Twins, Data Assimilation, and Model Reduction for Surgical Planning and Vascular Diagnostics**

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**Text:** In this work we discuss the guiding principles for creating digital twins in cardiovascular applications, specifically the planning of surgeries and computer-guided non-invasive diagnostics.

Although both applications share numerous elements (e.g., high-fidelity physical models and certain types of clinical data), they differ drastically in others: Currently, computer-guided cardiovascular surgical planning has been only achieved in non-emergency cases for which several weeks are available to perform the computational analysis. Conversely, non-invasive diagnostics requires computational speed, given that typically the available time frame is in the order of hours or even minutes.

Here, we discuss modeling components such as data assimilation and model reduction which are of fundamental importance for the overall modeling effort. Lastly, we present specific examples of cardiovascular digital twins for surgical planning and non-invasive diagnostics.