Modelling and simulation of the left heart

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Résumé

This talk presents ongoing work toward a unified numerical model of the left heart.
In the first part, we introduce a 3D electromechanical formulation of the left atrium, including fiber generation, active contraction driven by electrical activation, and a stabilized pressure–volume coupling with a reduced 0D model of the left ventricle.
This framework provides a robust basis for atrial–ventricular interaction.

In the second part, we summarize recent developments in left-heart hemodynamics, including mathematically consistent reduced valve laws and a partitioned fluid–structure interaction scheme coupling blood flow with ventricular mechanics.

These advances resolve limitations of purely kinematic uncoupling approaches and recover physiologically meaningful isovolumetric phases.

The ultimate goal is to combine both components-left atrium electromechanics and left-ventricular FSI-into a comprehensive left-heart model suitable for applications in normal and congenital anatomies.

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