High fidelity simulation of the aorta using finite element method

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Blood flow in human aorta, its major branches and the coronary arteries is studied using computational fluid dynamics in physiological conditions. Thus, pulsatile blood flow is studied, as well as how to model its effects in the rest of the cardiovascular system. Using impedance laws to link flow and pressure we are able to compute the response of the rest of the system that is not directly simulated. The method of the lumped-parameter models allows us to solve ordinary differential equations at the boundaries in order to obtain realistic flows in the aorta. To apply boundary conditions a modified weak formulation is used by adding a backflow stabilization term. Variational Multiscale Method is used to solve the Navier-Stokes equations needed for accurate simulation of the blood flow. Quantities of interest such as wall shear stress (WSS) and oscillatory shear index (OSI) are also computed to identify regions of risk for the patient.