Department of Mathematics
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Scientific Computing Seminar

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Modeling fluid-structure interaction between a stented coronary artery on a moving heart*

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1:30 PM- 2:30 PM
Room 646 PGH

Abstract: This work is motivated by fluid-structure interaction between a coronary artery treated with a stent, pulsatile blood flow, and heart contractions. The fluid is modeled by the incompressible, viscous Navier-Stokes equations, and the vascular walls are modeled as multi-layered composite elastic structures approximating the multi-layered structure of arterial walls. To include the effects of heart contractions, external force was applied to model the change in artery curvature. The fluid and composite structure are fully coupled via kinematic and dynamic coupling conditions, which describe continuity of velocity and balance of contact forces. The contraction of the heart is modeled by adding a periodic external force to the structure's outer surfaces, and the presence of he stent is modeled by changing the density and elasticity of the structure coefficients in the inner-most layer, corresponding to the intima, where the stent is located. A loosely coupled partitioned scheme combined with an ALE approach is used to solve this nonlinear FSI problem. Four types of commercially available coronary stents are considered, and their performance compared and quantified. Based on the simulations, two out of four stents are considered to be more suitable for coronary angioplasty with stenting in curved, or tortuous arteries. Our results correlate well with clinical results.

* This is a joint work with Prof. Sunčica Čanić, Prof. Martina Bukač and Prof. Josip Tambača.