Speaker: Maria Neuss-Radu

Title: Mathematical modeling and simulation of the evolution of plaques in blood vessels

Abstract:
In this talk, a model is developed for the evolution of plaques in arteries, which is one of the main causes for the blockage of blood flow. Plaque rupture and spread of torn-off material may cause closures in the down-stream vessel system and lead to ischemic brain or myocardial infarctions. The model covers the flow of blood and its interaction with the vessel wall. It is based on the assumption that the penetration of monocytes from the blood flow into the vessel wall, and the accumulation of foam cells increasing the volume, are main factors for the growth of plaques. The dynamics of the vessel wall is governed by a deformation gradient, which is given as composition of a purely mechanical matrix, and a matrix modeling the biologically caused volume growth. An equation for the evolution of the metric is derived quantifying the changing geometry of the vessel wall. The model is simulated and the results of the simulations are discussed in view of their relevance for the medical application.

The presented results are obtained jointly with Yifan Yang (University of Heidelberg), Willi Jäger (University of Heidelberg), and Thomas Richter (University of Erlangen-Nuremberg).