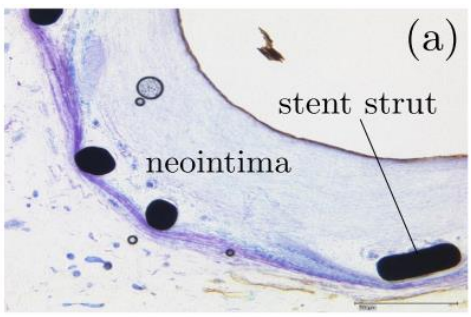
KTH SOLID MECHANICS KEYNOTE SEMINAR; Wednesday, November 24th, 16.00; https://kth-se.zoom.us/j/65889129048

Stefanie Reese's KEYNOTE seminar "Multi-physics modeling of in-stent restenosis: theoretical aspects and finite element implementation"

Percutaneous coronary intervention (PCI) is a minimally invasive procedure wherein the plaque built up within the coronary arteries as part of an inflammatory pathosis termed atherosclerosis is pressed against the arterial walls using balloon angioplasty, and subsequently, a supporting scaffold called a stent is placed to restore normal blood flow within the artery. Endothelial denudation and overstretch injuries caused during the PCI procedure kick start a myriad of signaling cascades within the arterial wall resulting in uncontrolled tissue growth, eventually recreating obstructions to the blood flow. The process is labeled in-stent restenosis and the mechanism associated is termed neointimal hyperplasia. An attempt is made herein to model the complex phenomenon of restenosis by tracking the pathophysiology's significant contributors [1, 2]. These include the platelet-derived growth factor (PDGF) and the transforming growth factor (TGF)-β, which are released into the arterial wall post platelet aggregation and degranulation. Additionally, the evolutions of the extracellular matrix and the smooth muscle cells are tracked since the local smooth muscle cell densities define the growth kinematics, and the local collagen concentrations in the extracellular matrix alter the compliance of the wall. A fully coupled multi-physical finite element system is hence set up that can provide insights with enough fidelity to adapt PCI parameters and alleviate the risks associated with restenosis [3].

[1] Budu-Grajdeanu, et al. Theor. Biol., 5:2, 2008.
[2] Escuer, et al. J. R. Soc. Interface, 16:20190313, 2019.
[3] Manjunatha, et al. (in press).
[4] DFG project meeting, 2021

Stefanie Reese is Full Professor at RWTH Aachen University and Director of the Institute of Applied Mechanics (IFAM) in Aachen, Germany, which she established in 2010. After receiving her Dr.-Ing. degree in 1994 from the Technische Universität Darmstadt and postdoc stays at the University of California at Berkeley (USA) and the University of Capetown (South Africa) she became in the year 2000 Professor at the Ruhr University Bochum. From 2005 until 2009 she was Full Professor (W3) at the Technische Universität Carolo - Wilhelmina at Braunschweig. She has received several prizes and is member of three academies, among these the National Academy of Science and Engineering. Since 2010, she is Fellow of the International Association for Computational Mechanics (IACM). She is Associate editor of the open access journal Advanced Modeling and Simulation of Engineering Sciences and holds membership in several editorial boards, e.g. in Computer Methods in Applied Mechanics and Engineering. In 2015, she became Treasurer of the European Mechanics Society (Euromech). Since, 2020, she is speaker of the review panel "Mechanics and Constructive Mechanical Engineering" of the German Science Foundation.



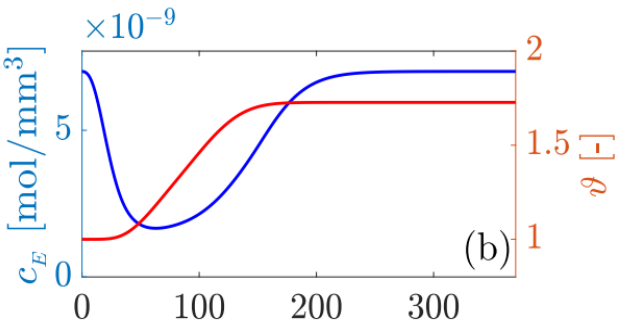


Fig. 1: (a) Restenosis in rat aorta (b) evolution of ECM and growth stretch