TEMPLE UNIVERSITY
Department of Mathematics

Applied Mathematics and Scientific Computing Seminar

Room 617 Wachman Hall

Wednesday, 18 September 2019, 4:00 p.m.

Morphoelastic Modeling of Intimal Thickening in Arteries

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Abstract. Atherosclerosis is a manifestation of cardiovascular disease consisting of the buildup of inflamed arterial plaques. Because most heart attacks are caused by the rupture of unstable "vulnerable" plaque, the characterization of plaques and their vulnerability remains an outstanding problem in medicine.

Morphoelasticity is a mathematical framework commonly employed to describe tissue growth. Its central premise is the decomposition of the deformation gradient into the product of an elastic tensor and a growth tensor. In this talk, I will present some recent efforts to simulate intimal thickening – the precursor to atherosclerosis – using morphoelasticity theory.

The arterial wall is composed of three layers: the intima, media and adventitia. The intima is allowed to grow isotropically while the area of the media and adventitia is approximately conserved. All three layers are modeled as anisotropic hyperelastic materials, reinforced by collagen fibers. We explore idealized axisymmetric arteries as well as more general geometries that are solved using the finite element method. Results are discussed in the context of balloon-injury experiments on animals and Glagovian remodeling in humans.