TEMPLE UNIVERSITY

Department of Mathematics

Analysis Seminar

Room 617 Wachman Hall

Monday, February 26th, 2024, 2:30 p.m.

Two recent homogenization results for dielectric elastomer composites.

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Abstract: First, we will discuss the periodic homogenization for a weakly coupled electroelastic system of a nonlinear electrostatic equation with an elastic equation enriched with electrostriction. Such coupling is employed to describe dielectric elastomers or deformable (elastic) dielectrics. We will show that the effective response of the system consists of a homogeneous dielectric elastomer described by a nonlinear weakly coupled system of PDEs whose coefficients depend on the coefficients of the original heterogeneous material, the geometry of the composite and the periodicity of the original microstructure. The approach developed here for this nonlinear problem allows obtaining an explicit corrector result for the homogenization of monotone operators with minimal regularity assumptions. Next, we will discuss the homogenization of high-contrast dielectric elastomer composites, The considered heterogeneous material consisting of an ambient material with inserted particles is described by a weakly coupled system of an electrostatic equation with an elastic equation enriched with electrostriction. It is assumed that particles gradually become rigid as the fine-scale parameter approaches zero. We will see that the effective response of this system entails a homogeneous dielectric elastomer, described by a weakly coupled system of PDEs. The coefficients of the homogenized equations are dependent on various factors, including the composite's geometry, the original microstructure's periodicity, and the coefficients characterizing the initial heterogeneous material. Particularly, these coefficients are significantly influenced by the high-contrast nature of the fine-scale problem's coefficients. Consequently, as anticipated, the high-contrast coefficients of the original yield non-local effects in the homogenized response.