Electromechanics of Soft Materials

by **Luis Dorfmann**

The theory of electroelasticity has received considerable interest in the last few years because of the development of elastomeric and polymeric materials that respond to the application of an electric field. Such materials, often referred to as 'smart materials', are being used in a variety of applications, ranging from high-speed actuators, soft robotics to electromechanical transducers of various geometries.

The purpose of the course is to present a state-of-the-art overview of the continuum theory of electro-sensitive materials capable of large deformations. The presentations will include a review of vector and tensor algebra and basic equations necessary to describe nonlinear elastic material behavior. This is followed by a carefully crafted overview of the fundamental formulation of the three-dimensional theory of electroelasticity from several points of view. The lectures will also include solutions to boundary-value problems, which are amenable to experimental verification. A further aspect of the course will be a discussion of stability of equilibria in the presence of electroelastic coupling.

Outline of topics

Date	Time	Topic
5-23	9:30-11:30	Introduction, notation, basic vector and tensor operations
	2:30-4:30	Notation, basic vector and tensor operations
5-28	9:30-11:30	Continuum kinematics, equilibrium, energy balance
	2:30-4:30	Hyperelasticity, examples of strain-energy functions
5-30	9:30-11:30	Examples involving homogeneous and inhomogeneous deformations
	2:30-4:30	Electrostatics and Maxwell’s equations
6-04	9:30-11:30	Material properties, geometrical configurations
	2:30-4:30	Equations of electroelasticity, constitutive equations
6-11	9:30-11:30	Equations of electroelasticity, constitutive equations
	2:30-4:30	Boundary value problems of electroelastic solids
6-13	9:30-11:30	Boundary value problems of electroelastic solids
	2:30-4:30	Incremental equations and stability, Hessian approach
6-18	9:30-11:30	Instability of an electroelastic half-space
	2:30-4:30	Instability of an electroelastic plate
6-20	9:30-11:30	Bifurcation of a circular cylindrical tube