Department of Applied and Computational Mathematics and Statistics Colloquium

Alan E. Lindsay

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will give a lecture entitled:

Mathematical Modelling of Micro Electro Mechanical Systems (MEMS)

Abstract

Micro electro-mechanical systems (MEMS) are a combination of miniaturized circuitry and moving elastic components. By delicately balancing electrostatic and elastic forces on tiny scales, engineers have fashioned MEMS devices to perform a huge variety of tasks with precision and relatively low cost. However, if the electrostatic forces acting on the device are too large, they can overwhelm its elastic structures and cause failure. This event, known as the "pull-in instability", is crucial for the operation of certain devices (e.g. switches) but will compromise the utility of others (e.g. sensors). Mathematical modelling of this instability and consequences is the topic of this talk.

When certain physical assumptions are applied, the deformation of certain MEMS devices can be modelled as a fourth order PDE with a singular non-linearity. It is shown that the model captures the pull-in instability of the device and provides a prediction of the parameter thresholds for which it occurs. The bifurication structure of the equilibrium equations are analyzed and found to be surprisingly complex. When pull-in threshold is exceeded, equilibrium solutions are no longer present and the model exhibits finite-time singularities which can form at multiple locations simultaneously. Our analysis suggests that the formation of multiple singularities is a generic phenomenon in higher order PDEs.

Friday, February 22, 2012
4:00 p.m. to 5:00 p.m.
127 Hayes-Healy Center

Colloquium Tea **3:30 p.m. to 4:00 p.m.** **154 Hurley Hall**