Center for Fluid Mechanics, Division of Applied Mathematics
Fluids and Thermal Systems, School of Engineering
Joint Seminar Series

TUESDAY – NOVEMBER 19, 2013
3:00pm
Barus & Holley, Room 190

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Needham, MA

Non-linear Dynamics in Simple Fluid Networks

A classic problem in the field of hydraulics is determining the distribution of flow rates inside a piping network for fixed inlet conditions. In 1936, a structural engineer named Hardy Cross revolutionized the analysis of turbulent hydraulic networks by developing a method by which one could reliably solve these problems by hand. While computers have made the Hardy Cross method obsolete, the problem can again become intractable if one considers networks filled with a fluid comprised of two phases.

When the fluid in the network has two phases, non-linear phenomena including multiple equilibrium states and sustained spontaneous oscillations can emerge. Such behavior might be attributed to the complicated geometry of the network, the complex rheology of the constituent fluids, or, in the case of microvascular blood flow, biological control. However, I will show that the simplest network geometries containing two miscible Newtonian fluids of differing viscosities in laminar flow are found to exhibit these non-linear phenomena. I will discuss our ongoing efforts to understand these network flows with a combination of mathematical analysis, direct simulation, and simple table-top experiments.