Abstract Submitted
for the DFD09 Meeting of
The American Physical Society

High-frequency self-excited oscillations in collapsible tube flows[1]
ROBERT J. WHITTAKER, SARAH L. WATERS, University of Oxford, UK, OLIVER E. JENSEN, University of Nottingham, UK, JONATHAN BOYLE, MATTHIAS HEIL, University of Manchester, UK — Experiments show that steady flow along an elastic-walled tube can become unstable to large-amplitude oscillations involving both the tube wall and the fluid. We consider a "Starling resistor" setup - a finite length elastic tube attached to rigid end sections, through which an axial flow is driven by either a steady flux at the downstream end or a steady pressure drop between the ends. We present a theoretical analysis of small-amplitude high-frequency long-wavelength oscillations. We first consider the fluid mechanics (with prescribed wall oscillations) and then the solid mechanics (to derive an appropriate tube law) in isolation. The two strands are then combined to investigate the full 3D fluid–structure interaction problem for self-excited oscillations. We determine the form of the normal modes and obtain expressions for the growth rate and frequency of the oscillations. The predictions from our modeling are compared with numerical simulations performed using the oomph-lib library.

[1]Supported by EPSRC

Oliver Jensen
University of Nottingham

Date submitted: 22 Jul 2009 Electronic form version 1.4