Some fluid-structure interaction problems in the viscous limit

Zhong Zheng

In this talk, I will discuss some fluid-structure interaction problems at low Reynolds numbers, motivated by geophysical processes: (i) Inspired by shale gas recovery process, we study the fluid-driven cracks in an elastic matrix in both the viscous and toughness regimes, depending on whether the resistance for crack propagation comes from viscous drag for the fluid flow or from opening the crack tip. We also study the elasticity-driven backflow process following fluid injection, and obtain a simple scaling law for the backflow rate of the fracking fluids. (ii) I will also introduce our fundamental study on the buoyancy-driven spreading of a thin viscous film over a thin elastic membrane. We focus on the time evolution of the shape of the liquid-air interface and the deformation of the stretching membrane, and present a transition from an early-time gravity-current regime to a late-time (quasi-steady) membrane-stretching regime.