

L. Mahadevan

I. Interaction between fluids and solids I - Soft hydraulics

Abstract: Rocks, clays, gels, tissues, and sponges are all examples of fluid-infiltrated soft porous media. Understanding their behavior requires a generalization of Darcy flows through rigid porous media. I will discuss a heuristic derivation of the equations of motion for such media and discuss examples of the rich phenomenology that results in systems that range in scale from microns to megameters including the dynamics of cells, the mechanics of plant organs, the erosion and channelization in frangible media and magmatic flows etc.

1. Animal cell hydraulics

G. Charras, T. Mitchison and L. Mahadevan, *Journal of Cell Science*, 122, 3233, 2009.

2. Physical limits and design principles for plant and fungal movements,

J. Skotheim and L. Mahadevan, *Science*, 308, 1308-10, 2005.

3. Melt channelization in mantle

I. Hewitt and A. Fowler, *J. Geophys. Research*, 114, 2009.

II. Interaction between fluids and solids II - Elastohydrodynamics

Abstract: Flags flap and convert uniform motion to oscillatory flow; fish do the converse. These are just two examples of a class of problems that involve the coupling of slender elastic objects to fluid flow. I will discuss how a combination of asymptotic analyses, scaling and computation allows us to understand the dynamics of these systems, including how flags flap and fish swim close to and far from a boundary, how carpets may fly, the physics of weeping lubrication, elastohydrodynamic adhesion etc.

References:

1. Fluid-flow induced flutter of a flag,

M. Argentina and L. Mahadevan, *Proceedings of the National Academy of Sciences (USA)*, 102, 1829-34, 2005.

2. Soft lubrication: the elastohydrodynamics of conforming and non-conforming contacts,

J. Skotheim and L. Mahadevan, *Physics of Fluids*, 17, 092101, 2005

3. A generalized theory of viscous and inviscid flutter

S. Mandre and L. Mahadevan, *Proceedings of the Royal Society of London (A)*, doi:10.1098/rspa.2009.0328, 2009.

4. Flapping and bending bodies interacting with fluid flows

M. J. Shelley and J. Zhang, *Annual Reviews of Fluid Mechanics*, 2011.