**Some possible presentation topics**

Students registered for Mechanics in Spring 2018 are required to give a 25-minute presentation on a topic related to this course's material. Here are a few suggestions of possible topics:

1. Hair can be modelled as an inextensible one-dimensional elastic body. This is developed in Chapter 4 of *Elasticity and Geometry: from hair curls to the nonlinear response of shells*, by B. Audoly and Y. Pomeau (available in the CIMS library and also online through Bobcat).

2. The mechanics of elastic ribbons (including, for example, a Mobius band) can be reduced to the study of a one-dimensional variational problem for the configuration of the ribbon's midline (viewed as a parametrized curve in 3-space). The paper *A corrected Sadowsky functional for inextensible elastic ribbons* by L Freddi, P. Hornung, M.G. Mora, and R. Parroni, J Elasticity 123 (2016) 125-136 identifies the variational problem. (It also gives references to earlier work; you may find it more convenient to present one of the earlier papers.)

3. To explore the stress-strain law of an elastic solid experimentally, it is useful to consider "universal elastic deformations" – i.e. deformations that can be achieved (using only boundary loads or tractions) in *any* elastic material. Linear (constant-strain) deformations are examples, but are there others? The foundational paper in this area is by J. Ericksen, *Deformations possible in every isotropic, incompressible, perfectly elastic body*, Zeit. Angew. Math. Phys. 5, 1954, 466–489. In the book by Antman, Section 14.9 gives an overview and some references. For a 25-minute presentation, perhaps the following paper would be a suitable target: J. Knowles, *Universal states of finite anti-plane shear: Ericksen's problem in miniature*, Amer Math Monthly 86 (1979) 109-113

4. In fracture mechanics, a widely-used model says that a crack will propagate if its "energy release rate" is larger than a critical value. The energy release rate is the rate at which the elastic energy decreases as the crack gets longer. It turns out to have a simple formula, involving a path-independent integral. The following paper gives a careful account of this fact: M. Gurtin, *On the energy release rate in quasi-static elastic crack propagation*, J Elasticity 9 (1979) 187-195

5. It is an experimental observation that when rubber membranes break under tension, they tend to do so by "cavitation" (i.e. the appearance of large holes). John Ball has suggested that this can be modeled using an elastic energy function with suitable behavior at large strain. The foundational paper is J. Ball, *Discontinuous equilibrium solutions and cavitation in nonlinear elasticity*, Phil Trans R Soc Lond A 306 (1982) 557-611. Its Section 5 discusses cavitation in the context of incompressible elasticity, with a focus on some specific elastic energy laws ("examples") in Section 5.6. A presentation could, perhaps, focus on one such example, explaining just enough of the background to present the example.

6. Alternatively, a project could present material from a particular section of one of the books listed on my syllabus.

Please let me your tentative choice of topic by March 28, by email or in person. (I am available after spring break for consultation, to help you choose a topic that's limited enough to be presentable in 25 minutes yet ambitious enough to be interesting.)