Abstract Submitted
for the MAR12 Meeting of
The American Physical Society

Stretch-induced stress patterns and wrinkles in hyperelastic thin sheets RUI HUANG, VISHAL NAYYAR, K RAVI-CHANDAR, University of Texas at Austin — Wrinkles are commonly observed in stretched thin sheets and membranes. This paper presents a numerical/experimental study on stretch-induced wrinkling of hyperelastic thin sheets. The model problem is set up for uniaxial stretching of a rectangular sheet with two clamped ends and two free edges. A two-dimensional stress analysis is performed first under the plane-stress condition to determine stretch-induced stress distribution patterns in the elastic sheets, assuming no wrinkles. As a prerequisite for wrinkling, development of compressive stresses in the transverse direction is found to depend on both the length-to-width aspect ratio of the sheet and the applied tensile strain. Next, an eigenvalue analysis is performed to find the potential buckling modes of the elastic sheet under the prescribed boundary conditions. A nonlinear post-buckling analysis is performed to show evolution of stretch-induced wrinkles. The wrinkle wavelength decreases with increasing strain, in good agreement with the prediction by a scaling analysis. However, as the tensile strain increases, the wrinkle amplitude first increases and then decreases, eventually flattened beyond a moderately large strain, in contrast to the scaling analysis. Finally, experimental measurements with polyethylene sheets will be presented in comparison with the numerical results.

Rui Huang
University of Texas at Austin

Date submitted: 29 Nov 2011 Electronic form version 1.4