Numerical Simulation of the Combined Bending, Stretching, and Wrinkling of Thin Sheets

MICHAEL TAYLOR, Harvard University, DAVID STEIGMANN, University of California, Berkeley, KATIA BERTOLDI, Harvard University — A two-dimensional theory of plates and shells derived from three-dimensional finite elasticity is presented. The approach is based on a systematic small thickness expansion of the exact three-dimensional strain energy density of the plate or shell. The theory involves the small thickness explicitly and accounts for both bending and stretching in a unified framework. Thus, wrinkling instabilities in thin sheets are accommodated as a natural outgrowth of the model. The plate model is demonstrated numerically via a specially designed finite difference code utilizing the method of dynamic relaxation. The code is used to simulate several equilibrium deformations of thin sheets and plates undergoing finite deformation with wrinkling.