Abstract Submitted
for the MAR12 Meeting of
The American Physical Society

Low-Dimensional Generalized Coordinate Models of Large-Deformation Elastic Joints[1] LAEL ODHNER, AARON DOLLAR, Department of Mechanical Engineering, Yale University — In the field of robotics, it is increasingly common to use elastic elements such as rods, beams or sheets to allow motion between the rigid links of a robot, rather than conventional sliding mechanisms such as pin joints. Although these elastic joints are simpler to manufacture, especially at meso- and micro-scales, representational simplicity is sacrificed. It is far easier to compute the Lagrangian of a robot using joint angles as generalized coordinates, rather than by considering the large-deformation continuum behavior of elastic joints. In this talk, we will discuss our work toward finding accurate, low-dimensional discretizations of elastic joint mechanics, suitable for use in generalized coordinate models of robot kinematics and dynamics. We use modally parameterized backbone curves to describe the kinematic configuration of the elastic joints, and compute the energy associated with deformation using rod and shell theory. In the plane, only three smooth deformation modes are sufficient to describe Euler-Bernoulli bending of 90 degrees to within 1 percent. Parametric models for the three-dimensional motion of sheet hinges are more complex, but can be simplified significantly using boundary conditions and constraints imposed by ruled surface assumptions.

[1]This work is supported by National Science Foundation grant IIS-0952856.

Lael Odhner
Department of Mechanical Engineering, Yale University

Date submitted: 11 Nov 2011 Electronic form version 1.4