Mechanics of Highly- Deformed Elastic Shells:

Probing Localized and Extended Deformations using Computational Mechanics

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Emergence of new technological applications, in addition to the constantly growing interest in biological materials has accentuated the importance of studying the mechanics of highly-deformed shells. The key challenge is the intricate interplay of physics and geometry, which leads to a mechanical response which is much different from the response of solid objects. The quest to understand the underlying phenomena has spawned theoretical and experimental studies, which have helped in understanding the underlying mechanisms of deformation and response of shells. In this talk, we use numerical simulations to study the response of shells when they are deformed deeply into the nonlinear regime. We use computational models to study the mechanics of highly-deformed elastic shells in several classical problems: indentation of elastic spherical caps by a flat rigid plate and a rigid sharp indenter, pure bending of circular and oval cylinders and indentation of cylindrical and toroidal shells. These assays are used to highlight some of the key aspects of the mechanics of highly-deformed elastic shells and the mechanisms that lead to localization of deformation in shells.