

Challenges in Mechanics

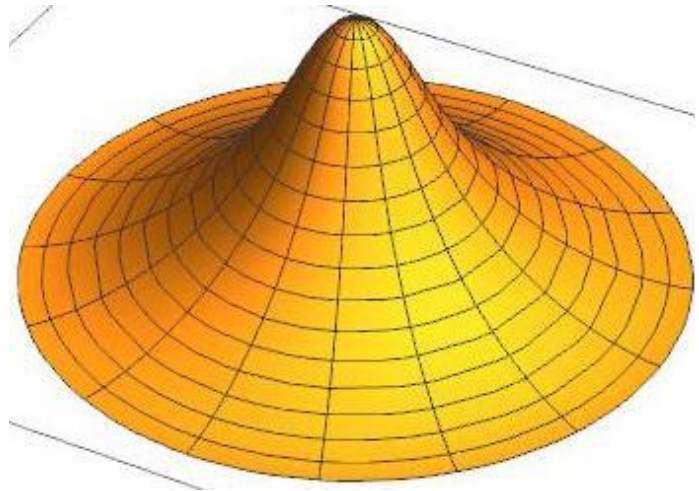
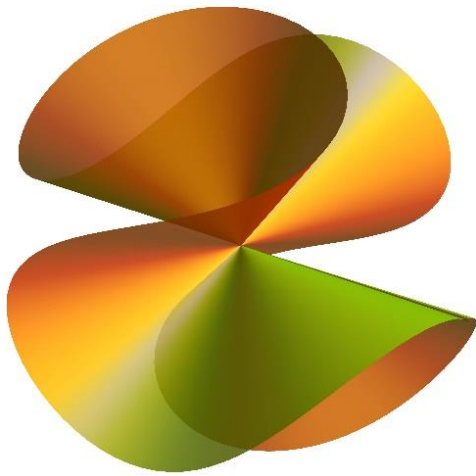
a series of seminars between Pisa and Roma

May 9, 2019, 3:00 pm

Inducing curvature in materials gives a “metric mechanics”

Mark Warner

Cavendish Lab, University of Cambridge, UK



Abstract

Liquid crystalline elastomers and glasses, change *shape* by 100s% following changes in temperature or illumination. *Shape* change, that is elongation along a particular direction, rather than simply change of volume, can be imaginatively arranged to induce intrinsic curvature in initially flat spaces. Light-induced curvature suggests new mechanics paradigms to be exploited in strong actuation of slender materials without Euler failures¹. I will give, with many demonstrations, examples of the materials and geometry arising^{2,3}. Deformations can be large. Hence in-plane, in-material trajectories, along with integral curves of the director field, are substantially advected and distorted with the change. Calculating these distortions of in-material lengths will specify the evolving topography⁴– both forward from a given director field, and inversely giving the director field required to obtain a desired shape.

¹Guit et al., Nature Comms 9, 2531 (2018).

²Modes et al., Phys.Rev. E 81, 060701(R) (2010) & Proc.Roy.Soc.A467, 2128 (2011)

³Mostajeran et al., Proc.Roy.Soc.A472, 2189 (2016)

⁴Warner and Mostajeran, Proc.Roy.Soc.A474, 2210 (2018)

Biblioteca DISG - sede Geotecnica, via Eudossiana 18, Roma

contact person: paola.nardinocchi@uniroma1.it

The series of seminars Challenges in Mechanics aims to bring together researchers from diverse backgrounds in structural mechanics, applied mathematics, and materials science. Emphasis will be given to rigorous mechanical theories, and the mechanical design of new materials and structures will also be explored. The series is organized in 6 seminars to be held at the Department of Structural and Geotechnical Engineering (Sapienza Università di Roma), at the Department of Civil and Industrial Engineering (Università di Pisa) and at the Institute of BioRobotics (Scuola Superiore Sant'Anna di Pisa). **Organisers:** Antonio De Simone (a.desimone@santannapisa.it), Paola Nardinocchi (paola.nardinocchi@uniroma1.it), Roberto Paroni (roberto.paroni@unipi.it).