

# Large Deformation of Slender Structures: Liquid Crystal Networks

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We discuss modeling, numerical analysis and computation of liquid crystal networks (LCNs). These materials couple a nematic liquid crystal with a rubbery material. When actuated with heat or light, the interaction of the liquid crystal with the rubber creates complex shapes. Thin bodies of LCNs are thus natural candidates for soft robotics applications. We start from the classical 3D trace energy formula and derive a reduced 2D membrane energy as the formal asymptotic limit of vanishing thickness, including both stretching and bending energies, and characterize the zero stretching energy deformations. We design a sound numerical method and discuss its Gamma convergence. We present computations showing the geometric effects that arise from liquid crystal defects as well as computations of non-isometric origami within and beyond theory. This work is joint with L. Bouck (Carnegie Mellon University) and S. Yang (Beijing Institute of Mathematical Sciences and Applications), and the current student G. Benavides.