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Buckling of liquid crystal elastomers in confined geometries[1]
THANH-SON NGUYEN, ANDREW KONYA, ROBIN SELINGER, JONATHAN SELINGER, Kent State University — Liquid crystal elastomers (LCEs) are materials that combine the orientational order of liquid crystals with the elastic properties of polymer networks. Whenever the liquid-crystal order changes (by heating, cooling, or other stimuli), the shape of the polymer network changes. If the liquid-crystal director is nonuniform, then the polymer network is generally frustrated—i.e. the local director favors a certain local strain, but these strains are incompatible; they do not fit together to fill up space. As a result, the shape can become very complex, and it can only be calculated by numerical methods. In order to understand the phenomenon of frustration in LCEs, we consider simple systems where the liquid-crystal director is uniform but frustration is introduced by confinement, so that the sample cannot extend along the director. As the induced strain passes a critical threshold, the system releases part of the frustration by buckling. The simplicity of the system allows us to evaluate several properties of the buckling process analytically, including the threshold strain and the instability wavelength. The analytic results are compared with numerical finite-element simulations of the same geometries, and with related studies of other elastic sheets.

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Jonathan Selinger
Kent State University

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