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John H. Dillon Medal Lecture: Buckling Instabilities of Polymer Multilayers

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Soft polymer networks, such as gels and elastomers, can undergo a wide variety of geometry-dependent mechanical shape instabilities when subjected to compressive stress, providing opportunities to tailor the structure and properties of stimuli-responsive materials. These include global buckling modes of unsupported sheets as well as local surface modes such as wrinkling and creasing. The introduction of two or more elastic layers provides a multi-dimensional parameter space in terms of the contrasts in stiffness, geometry, and pre-strain between the layers, yielding a rich landscape of behaviors. Our group has recently focused on two examples. In the first case, we consider the role of mismatch strain in creasing and post-wrinkling bifurcations, which allows for fine control over both the types of surface modes that appear and their hysteretic behavior. In the second case, we consider the buckling of unsupported elastic trilayers as a route to define self-folding and responsive three-dimensional objects.