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Stress localisation in annular sheets GERT VAN DER HEIJDEN, EUGENE STAROSTIN, University College London — For very thin sheets stretching is much more costly in terms of energy than bending. The limiting behaviour of thin sheets is therefore governed by geometry only and thus applies to a wide range of materials at vastly different scales: it is equally valid for a microscopic graphene sheet and a macroscopic solar sail. We derive new geometrically-exact equations for the deformation of annular strips. We use a formulation in which the inextensibility constraint is used to reduce the problem to a suitably-chosen reference curve (here the circular centreline). The equations are therefore ODEs, which allow for a detailed bifurcation analysis. Closed conical solutions are found for centreline lengths L less than $L_c = 2\pi\kappa_g$, where κ_g is the geodesic curvature of the strip. For such 'short' strips we find in addition a second branch of stable solutions easily reproduced in a paper strip. For 'long' strips ($L > L_c$) we find modes of undulating solutions. All non-conical solutions turn out to feature points of stress localisation on the edge of the annulus, the outer edge for short solutions and the inner edge of long solutions. Our theory may be used to investigate singularities of constrained or loaded sheets more general than conical ones.

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