Localized bulging and necking of a finitely deformed residually stressed solid cylinder

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In this talk we discuss the influence of residual stress on the stability of a solid circular cylinder subject to axial extension. The nonlinear theory of elasticity is used to derive the equations governing the linearized incremental deformations superimposed on a known finitely deformed configuration. Specialized to the neo-Hookean model with residual stress, the bifurcation analysis results in an exact bifurcation condition for zero and periodic modes, based on the Stroh formalism. The critical values of the residual stress and the axial force for localized necking or bulging to occur are identified. We use Maxwell's equal-area rule to characterize the two-phase deformation consisting of necked and bulged regions. It is shown that the Maxwell values of stretch identify the radii of the two regions, which are connected by a transition zone that translates along the cylinder. At the completion of two-phase deformation, the stretch is again uniform.