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Wrinkling and Buckling of Isotropic Biological Tissues

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The problem of the wrinkling and buckling of membranes characterized by an isotropic Tong-Fung type constitutive behavior has been formulated and solved within the framework of finite strain hyperelasticity. The formulation has been guided by the theories proposed by Wu and Canfield (Quart. Appl. Math, 1981) and Pipkin (IMA J. Appl. Math., 1986). A criterion for the wrinkling based on the natural width, which defines the natural contraction of a membrane loaded in uniaxial tension, has been introduced. The out of plane geometric nonlinearities have been treated as constitutive nonlinearities through a modification of the elastic potential (relaxed energy density). Close form solutions have been found for the natural width and the relaxed energy density. The model has been implemented in a finite element code and applied to simulate procedures of reconstructive surgery where the extrusion of the edges of the wound may occur after the suture due to the buckling and wrinkling of the skin.

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