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An analytical method for determining material parameters from inflation tests of thick nonlinear materials THERESA K. TONGE, THAO D. NGUYEN, Johns Hopkins University — The inflation test is a widely used method for applying a biaxial stress state to polymers and biological tissues. The stress response is determined by assuming the inflated specimen can be modeled as a membrane. However, neglecting the effect of bending can generate large errors for thick specimens and in particular for those exhibiting highly nonlinear material behavior. We have developed a novel thin shell method to analytically determine material properties from the inflation test while accounting for bending. The method assumes a linear strain gradient from bending to calculate the in-plane stress resultants from the constitutive relations for the stress response. These stress resultants are fit to the experimentally determined stress resultants calculated from the applied pressure and measured local curvatures. We have applied the method to fit an anisotropic constitutive model to inflation tests of human skin tissue. We have used Finite Element Analysis to validate the method as well as the resulting material parameters for the constitutive model. This thin shell method is sufficiently general to be applied to determine material properties for other thick, nonlinear materials such as aortic valves or gastrointestinal tissues.

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