Meeting: 1003, Atlanta, Georgia, SS 9A, AMS-MAA-SIAM Special Session on Research in Mathematics by Undergraduates, I

1003-74-228 **James B. Collins*** (collinjb@jmu.edu), Department of Mathematics and Statistics, Harrisonburg, VA 22807, and **Matthew K. Watts** (wattsmk@jmu.edu), Department of Mathematics and Statistics, Harrisonburg, VA 22807. *New Developments for Analysis of Intracranial Saccular Aneurysms: I. Biomechanical model, II. Computational algorithm, and III. Scientific visualization.* Preliminary report.

Biomechanics has great potential to advance diagnostic and therapeutic health care. Nonlinear continuum mechanics is an excellent framework for formulating mathematical models to capture complex behaviors of biological tissues. Intracranial saccular aneurysms are an important open vascular disorder problem commonly studied in continuum biomechanics by radial stretching motions combined with membrane theory approximations. Instead, we consider a finite, thin-walled sphere using the fully 3-D exact governing equations of nonlinear elastodynamics. We compare results for the classic neo-Hookean model, a simple Fung biological tissue model, and a new strain energy capturing anisotropy that suggests ways to control growth. This leads to analytically intractable ODE-BVPs underscoring the need for accurate, efficient, and adaptable numerical methods especially since singularities and bifurcation phenomena are not uncommon. We incorporate a new algorithm (Algebraic-Maclaurin-Pade'(AMP)) to approximate the solution that routinely outperforms Runge-Kutta based methods. We also develop adaptive time-stepping for AMP, attaining more efficiency for the same accuracy as with fixed time-stepping. Finally, we develop animations of the aneurysm dynamics from our computed numerical data. (Received August 31, 2004)