

DEPARTMENT OF MATHEMATICS

**VIGRE Funding Report****(due 30 days after semester of support)****Semester/Summer and Year:**

Summer 2008

Name: Rebecca Vandiver

List the graduate courses you have taken this semester (including independent studies), your grades, and the instructors:

Course	Title	Grade	Instructor

List the title, date and location of any talks you have given, either here or elsewhere:

Schizogenous Aerenchyma Formation, stem hollowing, elastic cavitation, and differential growth in plants and elastic tissues (poster), IUTAM Symposium on Cellular, Molecular and Tissue Mechanics, Woods Hole, Massachusetts, June 2008.

If you are working on your dissertation, include a one paragraph description of your research progress. If you have not yet begun dissertation research, describe your progress toward finding a dissertation topic and advisor and beginning that research.

The growth formulation and analysis we have presented thus far uses the general framework of nonlinear elasticity which can be easily generalized to include effects necessary to obtain a precise picture of the material properties of specific biological structures, notably, anisotropic response. In particular, tissues such as blood vessels exhibit anisotropic behavior due to the fiber orientations which tend to have preferred directions. We use the multi-layer model for arteries introduced by Holzapfel, et al. (2002) which includes layer-specific histological features. It is a structural model in the sense that it incorporates information about the orientations of the collagen fibers in each layer. We have shown that the combination of radial and circumferential growth, an applied internal pressure and the anisotropic response plays an important role in stabilizing the structure.

List publications, if any.

Nonlinear Euler buckling, with A. Goriely, M. Destrade. Accepted for publication in Proceedings of the Royal Society A, 2008.

Morpho-elasto-dynamics: the long-time dynamics of elastic growth, with A. Goriely. Accepted for publication in Journal of Biological Dynamics, 2008.

Check all activities you completed during the funded period:

Academics:

- Independent Study
- Oral Comprehensive Exam
- Commence Thesis Research
- Conference attendance
- Conference participation
- Complete PhD

Professional development and outreach:

- AP Calculus Visit
- High School Workshops
- Undergraduate Research Project
- Undergraduate Research Seminar
- Super TA
- Mentoring junior graduate students for the qualifying exams
- RTG (help organize)
- Research Seminar (help organize)

Other (please specify)

Attach a brief statment about your academic progress and professional development during the period of support.

VIGRE Graduate Fellowship Report  
Summer 2008  
Rebecca Vandiver

This summer I was fortunate to receive a VIGRE Fellowship which allowed me to progress further in my research. The goal of my research is to study the development of residual stress induced by differential growth of biological cylindrical structures and elucidate its possible mechanical role in modifying material properties. The general formulation of growth I have presented uses the general framework of nonlinear elasticity which can be easily generalized to include effects necessary to obtain a precise picture of the material properties of specific biological structures, notably, anisotropic response. In particular, tissues such as blood vessels exhibit anisotropic behavior due to the fiber orientations which tend to have preferred directions. This summer I have used the multi-layer model for arteries introduced by Holzapfel, et al. (2004) which includes layer-specific histological features. It is a structural model in the sense that it incorporates information about the orientations of the collagen fibers in each layer. We have shown that the combination of radial and circumferential growth, an applied internal pressure and the anisotropic response plays an important role in stabilizing the structure.

I had the opportunity to attend an IUTAM Symposium on Cellular, Molecular and Tissue Mechanics in Woods Hole, Massachusetts. I presented a research poster titled, "Schizogenous aerenchyma formation, stem hollowing, elastic cavitation and differential growth in plants and elastic tissues." I had the privilege to hear presentations from leading researchers in my research area and gain knowledge of the recent advances in my area of study. It was especially beneficial to hear from people in other disciplines such as Bioengineering and Physics who provided me with important insight into my work and introduced me to additional problems and questions in my field of interest.