

## HILARY BART-SMITH

Mechanical & Aerospace Engineering Department  
University of Virginia, Charlottesville, VA 22904  
Tel: 434-924-0701, hb8h@virginia.edu

### PROFESSIONAL APPOINTMENTS

Associate Professor Mechanical & Aerospace Engineering, University of Virginia, 2007-present  
Assistant Professor, Mechanical & Aerospace Engineering, University of Virginia, 2002-2007  
Research Associate, Princeton Materials Institute, Princeton University, 2000-2002

### EDUCATION

<b>Harvard University</b> Ph.D., Engineering Sciences, 2000 Advisor: Professors A.G. Evans and J.W. Hutchinson S.M., Engineering Sciences, 1996	Cambridge, MA
<b>University of Glasgow</b> B.Eng., Mechanical Engineering, First Class Honors, 1995	Glasgow, UK

### AWARDS

Pi Tau Sigma Certificate of Appreciation for outstanding contributions to Mechanical Engineering Students of the University of Virginia, 2007  
NSF CAREER Award, 2003, "Development of a Biologically Inspired Morphing Structure"  
David and Lucile Packard Fellowship for Science and Engineering, 2003  
ASEE Frontiers in Education New Faculty Fellow, 2003  
University Teaching Fellow, University of Virginia, 2003-04  
Certificate of Distinction in Teaching, Harvard University, 1998, 1999  
The Royal Society of Edinburgh Research Fellowship Award - J M Lessells Scholarship, 1995  
"Frederic Barnes Waldron Best Student Prize" in Mechanical Engineering by the Institute of Mechanical Engineering, 1995  
George Russell Prize for Engineering, 1995  
Agnes Rhind Bursary for Excellence in Mechanical Engineering, 1994  
Matthew A. Muir Bursary award for Excellence in Engineering, 1993  
BASF Fellowship 1992-1995

### FUNDING

Total funded research for Bart-Smith to date \$9,918,969.

- **Office of Naval Research** "Fundamental Study of the Structural Response of Sandwich Panel Columns under Dynamic Load: Theory and experiment" \$309,947; 11/09-10/12 (PI: Bart-Smith)
- **Office of Naval Research MURI** "Towards a Mission-Configurable Stealth Underwater Batoid" \$6.5M; 05/08-04/13 (PI: Bart-Smith)
- **Virginia Space Grant Consortium** "VSGC Aerospace Graduate Research Fellowship" \$10,000; 07/08-06/09 (PI: Bart-Smith)
- **Virginia Space Grant Consortium** "VSGC Aerospace Graduate Research Fellowship" \$10,000; 07/07-06/08 (PI: Bart-Smith)
- **National Institute of Aerospace** "NIA/NASA Graduate Research Assistantship" \$106,814; 08/06-07/08 (PI: Bart-Smith)

- **Virginia Space Grant Consortium** "VSGC Aerospace Graduate Research Fellowship" \$5,000; 07/06-06/07 (PI: Bart-Smith)
- **Office of Naval Research** "Structural Response of Curved Sandwich Panel Columns" \$300,000; 06/06-05/09 (PI: Bart-Smith)
- **National Science Foundation** "Science and technology of nanoporous metal films" \$1,350,000; 09/05-08/09 (co-PI: Bart-Smith)
- **National Institute of Aerospace** "NIA Rising Stars Fellowship" \$48,899; 09/05-08/06 (PI: Bart-Smith)
- **Virginia Space Grant Consortium** "Photo curable polymers for space applications" \$8,500; 06/05-05/06 (PI: Bart-Smith)
- **National Institute of Aerospace** "NIA Rising Stars Fellowship" \$39,973; 09/04-08/05 (PI: Bart-Smith)
- **Virginia Space Grant Consortium** "Morphing structures and its application to flight control" \$8,500; 06/04-05/05 (PI: Bart-Smith)
- **National Science Foundation CAREER Award** "Development of a Biologically Inspired Morphing Structure" \$400,000; 05/04-04/09 (PI: Bart-Smith)
- **National Institute of Aerospace** "Control of Flapping Flight and Swimming " \$50,000; 04/04-12/04 (PI: Bart-Smith)
- **David and Lucile Packard Foundation Fellowship for Science and Engineering** "High Authority Morphing Structures" \$625,000; 10/03-09/08 (PI: Bart-Smith)
- **Office of Naval Research** "Marine Research for Advanced Ship Design" \$196,336; 05/03-04/06 (co-PI: Bart-Smith)
- **National Institute of Aerospace** "Control of Flapping Flight and Swimming" \$50,000; 01/03-10/03 (PI: Bart-Smith)

#### JOURNAL PUBLICATIONS

- Moored, K.W., and Bart-Smith, H., "Investigation of Clustered Actuation in Tensegrity Structures," *International Journal of Solids and Structures*, Volume 46, Issue 17, 15 August 2009, Pages 3272-3281.
- Zhu, J., Bart-Smith, H., Begley, M., Zangari, G., Reed, M., "Formation of Silicon Nanoporous Structures Induced by Colloidal Gold Nanoparticles in HF/H<sub>2</sub>O<sub>2</sub> Solutions," *Chemistry of Materials* 21 (13), pp 2721-2726, 2009.
- Moored, K.W., Smith, W., Hester, J.M., Chang, W., and Bart-Smith, H., "Investigating the Thrust Production of a Myliobatoid-Inspired Oscillating Wing," *Advances in Science and Technology*, Vol. 58, 2008, Pages 25-30.
- Bliss, T.K., Iwasaki, T., and Bart-Smith, H., "CPG Control of a Tensegrity Morphing Structure For Biomimetic Applications," *Advances in Science and Technology*, Vol. 58, 2008, Pages 137-142.
- Seker, E., Gaskins, J.T., Bart-Smith, H., Zhu, J., Reed, M.L., Zangari, G., Kelly, R., and Begley, M.R., "The effects of annealing prior to dealloying on the mechanical properties of nanoporous gold microbeams," *Acta Materialia*, Vol. 56, Issue 3, February 2008, Pages 324-332.
- Seker, E., Gaskins, J.T., Bart-Smith, H., Zhu, J., Reed, M.L., Zangari, G., Kelly, R., and Begley, M.R., "The effects of post-fabrication annealing on the mechanical properties of freestanding nanoporous gold structures," *Acta Materialia*, Vol. 55, Issue 14, August 2007, Pages 4593-4602.
- Biagi, R., and Bart-Smith, H., "Imperfection Sensitivity of Pyramidal Truss Sandwich Panels," *International Journal of Solids and Structures*, Vol. 44, Issues 14-15, July 2007, Pages 4690-4706.

- Côté, F., Biagi, R., Bart-Smith, H., and Deshpande, V., "In-Plane Response of Pyramidal Truss Sandwich Columns," *International Journal of Solids and Structures*, Vol. 44, Issue 10, 15 May 2007, Pages 3533-3556.
- Jones, T.C., Bart-Smith, H., Mikulas, M., and Watson, J., "Modeling and Analysis of Large Pretensioned Space Structures using Commercial FEM," *AIAA Journal of Spacecraft and Rockets*, Vol. 44, Jan-Feb 2007.
- Moored, K.W., and Bart-Smith, H., "The Analysis of Tensegrity Structures for the Design of a Morphing Wing," *Journal of Applied Mechanics*, Vol. 74, Issue 4, pp. 668-676, 2007.
- Zhu, J., Seker, E., Bart-Smith, H., Reed, M.L., Lye, W-K, Begley, M.R., Kelly, R.G., and Zangari, G., "Freestanding micro-beams comprised of dealloyed nanoporous metal: mitigation of tensile failure via thermal treatment," *Applied Physics Letters* 89, 133104, 2006.
- Begley, M.R., Bart-Smith, H., Scott O.N., Jones, M.H., and Reed, M.L., "Electro-mechanical Response of Elastomer Membranes Coated with Ultra-thin Metal Electrodes: Indentation with Spherical Indenters," *Journal of Mechanics and Physics and Solids*. Vol. 53, No. 11, pp. 2557-2578, 2005.
- Begley, M.R. and Bart-Smith, H., "The Electro-Mechanical Response of Highly Compliant Substrates and Thin Stiff Films with Periodic Cracks," *International Journal of Solids and Structures*. Vol. 42, pp. 5259-5273, 2005.
- Bart-Smith, H., Hutchinson, J.W., Fleck, N.A., and Evans, A.G., "Influence of Imperfections on the Performance of Metal Foam Core Sandwich Panels," *International Journal of Solids and Structures*. Vol. 39, pp. 4999-5012, 2002.
- Bart-Smith, H., Hutchinson, J.W., and Evans, A.G., "Measurement and Analysis of the Structural Performance of Cellular Metal Sandwich Construction," *International Journal of Mechanical Sciences*. Vol. 43, pp. 1945-1963, 2001.
- Bastawros, A-F., Bart-Smith, H., and Evans, A.G., "Experimental Analysis of Deformation Mechanisms in a Closed-Cell Aluminum Alloy Foam," *Journal of Mechanics and Physics of Solids*. Vol. 48, No. 2, pp. 301-22, 2000.
- Bart-Smith, H., Bastawros, A-F., Mumm, D.R. Evans, A.G., Sypeck, D.J., and Wadley, H.N.G., "Compressive Deformation and Yielding Mechanisms in Cellular Al Solids Determined Using X-ray Tomography and Surface Strain Mapping," *Acta Materialia*. Vol. 46, No. 10, pp. 3583-3592, 1998.
- Sypeck, D.J., Wadley, H.N.G, Bart-Smith, H., Koehler, S., and Evans, A.G., "Structure and Deformation of Aluminum Foams through Computed Tomography," *Review of Progress in Quantitative Nondestructive Evaluation*. Vol. 2, pp. 1443-1450, 1998.
- Sugimura, Y., Meyer, J., Bart-Smith, H., Grenstedt, J., and Evans, A.G., "On the Mechanical Performance of Closed Cell Al Alloy Foams," *Acta Materialia*. Vol. 45, No. 12, pp. 5245-5259, 1997.

In preparation

- Scott O.N., Begley, M.R., Utz, M., and Bart-Smith, H., 2009 "Fracture Characterization of Nanoscale Metal Films on Elastomer Substrates."

Bliss, T.K., Iwasaki, T., and Bart-Smith, H., 2009 "Central Pattern Generator Control of Active Tensegrity Structures."

Biagi, R., Deshpande, V., and Bart-Smith, H., 2008 "Measurement and Analysis of the Mechanical Response of Corrugated Core Sandwich Panels and Columns."

<b>CONFERENCE PAPERS</b>
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Jones, T.C., Watson, J.J., Mikulas, M., and Bart-Smith, H. 2008 "Design and Analysis of Tension-Aligned Large Aperture Sensorcraft," AIAA-2008-1775, presented at 49th AIAA/ASME/ASCE/AHS/ASC Structures, Structural Dynamics, and Materials Conference. Schaumburg, Illinois, April 7-10 2008.

Seker, E., Huang, L., Begley, M.R., Bart-Smith, H., Kelly, R., Zangari, G., Reed, M.L., and Utz, M., "Compressive Stress Accumulation in Composite Nanoporous Gold and Silicone Bilayer Membranes: Underlying Mechanisms and Remedies" Materials Research Society Symposium Proceedings, Boston, MA, Nov 26-30, 2007.

Moored, K.W., Taylor, S.A., Bliss, T.K. and Bart-Smith, H., "Optimization of a Tensegrity Wing for Biomimetic Applications," 45<sup>th</sup> IEEE Conference on Decision and Control, San Diego, CA, USA, Dec. 13-15, 2006.

Seker, E., Zhu, J., Bart-Smith, H., Begley, M.R., Kelly, R., Reed, M.L., and Zangari, G., "Thermo-mechanical and Size-dependent Behavior of Freestanding Au-Ag and Nanoporous-Au Beams," Materials Research Society Symposium Proceedings, Boston, MA, Nov 27-Dec 1, 2006.

Hill, J., Bart-Smith, H., Barbier, C., and Humphrey, J.A.C., "Investigation of a Bioinspired Whisker-Like Fluid Motion Sensor," ASME Symposium Proceedings, ASME IMECE Congress and RD&D Expo, Chicago, IL, USA Nov. 5-10, 2006.

Bliss, T., Bart-Smith, H., and Iwasaki, T., "Development of a Morphing Structure with the Incorporation of Central Pattern Generators," Vol 6173, 13th SPIE Annual International Symposium on Smart Structures and Materials, San Diego, CA, USA, Feb. 26-March 2, 2006.

Moored, K.W. and Bart-Smith, H., "The Analysis of Tensegrity Structures for the Design of a Morphing Wing," 13th SPIE Annual International Symposium on Smart Structures and Materials, San Diego, CA, USA, Feb. 26-March 2, 2006.

Scott, O.N., Bart-Smith, H., Begley, M.R., and Jones, M.H., "Elastomer Membrane Actuators Utilizing Ultra-thin Metal Electrodes," 13th SPIE Annual International Symposium on Smart Structures and Materials, San Diego, CA, USA, Feb. 26-March 2, 2006.

Moored, K.W. and Bart-Smith, H., "The Analysis of Tensegrity Structures for the Design of a Morphing Wing," ASME Symposium Proceedings, ASME IMECE Congress and RD&D Expo, Orlando, FL, USA Nov. 15-21, 2005.

Moored, K.W. and Bart-Smith, H., "The Analysis of Tensegrity Structures for the Design of a Morphing Wing," 12th SPIE Annual International Symposium on Smart Structures and Materials, San Diego, CA, USA, March 6-10, 2005.

- Begley, M.R., Scott, O., Jones, M., Bart-Smith, H. and Reed, M., "Electrostrictive Elastomer Membranes for Sensing and Actuation," ASME Symposium Proceedings, ASME IMECE Congress and RD&D Expo, Anaheim, CA, USA Nov. 15-21, 2004.
- Bart-Smith, H. and Risseeuw, P.E., "High Authority Morphing Structures," ASME Symposium Proceedings, ASME IMECE Congress and RD&D Expo, Washington, D.C., USA Nov. 13-19, 2003.
- Kraines, A., Klanian, K.L., Peirce, L., Waters, E., Gluchowski, K., Janezic, K., Labrie, J., Cunningham, J., Bart-Smith, H. and Richards, L.G., 2003 "The Virginia Middle School Engineering Education Initiative: Using a Senior Design course to Develop Engineering Teaching Kits." *Proceedings of the 33<sup>rd</sup> ASEE/IEEE Frontiers in Education Conference.*
- Richards, L.G., Bart-Smith, H., Laufer, G., Humphrey, J.A.C., Bell, R., Tai, R., "Designing Engineering Teaching Kits (ETKs) for Middle School Students," ASEE Annual Conference & Exposition: Staying in Tune with Engineering Education; Nashville, TN; USA; 22-25 June 2003.
- Bart-Smith, H., Bastawros, A-F., Mumm, D.R., Evans, A.G., Sypeck, D.J., and Wadley, H.N.G., 1998 "Compressive Deformation and Yielding Mechanisms in Cellular Al Solids Determined Using X-ray Tomography and Surface Strain Mapping," Materials Research Society Symposium Proceedings, Vol. 521, Porous and Cellular Materials for Structural Applications, pp. 71-81. [Invited]

<b>TEACHING EXPERIENCE</b>
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University of Virginia—Department of Mechanical and Aerospace Engineering

- **MAE 200L Mechanics Familiarity Lab:** a second-year undergraduate lab to introduce students to basic materials, instruments, tools. *(Fall 2006)*
- **MAE 231 Mechanics of Materials:** this second year course serves as the introduction to fundamental mechanics concepts for undergraduates in Mechanical, Aerospace and Civil Engineering, and covers stress, strain, energy concepts, etc. *(Spring 2003, Spring 2004, Spring 2005, Spring 2006, Spring 2008, Spring 2009)*
- **MAE 331 Aerospace Structures:** third year course that introduces students to advanced topics in strength of materials and stress analysis, with specific reference to the types of structures found in aerospace applications. *(Spring 2007, Fall 2008)*
- **MAE 491:** a senior design course that teaches undergraduate students the design process by actually engaging in design activity that results in useful and novel products. Specifically, students were tasked with designing instructional materials for introducing engineering concepts and the engineering design process to middle school students. Co-taught. *(Fall 2002, Fall 2003)*
- **MAE 492:** a senior design course that is a continuation of MAE 491. Co-taught *(Spring 2003, Spring 2004)*
- **AM/APMA/CE/MAE 602 Continuum Mechanics:** a first-year graduate course that introduces students to the concept of continuum mechanics. *(Fall 2004)*

Harvard University

- **ES120 Mechanics of Materials:** teaching assistant responsible to weekly recitation and design and demonstration of laboratory activities. (1996-1999)

## PROFESSIONAL SERVICE ACTIVITIES

Member of organizing committee for National Academy of Engineering 2010 Indo-American Frontiers of Engineering Symposium.  
Panel reviewer for the National Academies: AFOSR Mechanics Proposal Review Panel  
Panel reviewer for: NSF Course, Curriculum, and Laboratory Improvement (CCLI) Program and Department-Level Reform Program.  
Reviewer for: *ASME International Mechanical Engineering Congress and Exposition*, *ASME Journal of Applied Mechanics*, *Journal of Materials Research*, *International Journal of Solids and Structures*, *Scripta Materialia*  
Selected to participate in the National Academy of Engineering's Tenth Annual Symposium on Frontiers of Engineering  
Organizer of Materials Symposium on Nanoporous Materials for ASME IMEC Congress and RD&D Expo, Seattle, WA, USA 2007  
Organizer of Materials Symposium on Novel and Adaptive Materials and Structures for ASME IMEC Congress and RD&D Expo, Chicago, IL, USA 2006  
Organizer of Materials Symposium on Novel and Adaptive Multifunctional Materials Structures for ASME IMEC Congress and RD&D Expo, Orlando, FL, USA 2005  
Co-organizer of Aerospace Symposium on Multifunctional Materials for ASME IMEC Congress and RD&D Expo, Orlando, FL, USA 2005  
Member of Program Committee for Active Materials: Behavior and Mechanics, SPIE 13<sup>th</sup> International Symposium on Smart Structures and Materials

## UNIVERSITY SERVICE ACTIVITIES

### Service to the University:

#### University Level:

Research Ethics Review Committee Member (2008-2009)  
Member of Faculty Forum for Scientific Research (2007-present)  
Packard Fellowship Committee Member (2006-present)  
Teaching Resource Center University Teaching Fellowship Committee Member (2007-present)  
Marshall for Graduation Day (2003-2005)

#### School Level:

Member of the working group on Surface and Interfaces—part of the Institute for Nanoscale and Quantum Engineering, Science and Technology (*NanoQuest*)  
Judge for the Undergraduate Research and Design Symposium (2004)  
Committee Member, Common Reading Experience (2003-present)  
Participated in SEAS Open House (2003-present)  
Marshall for SEAS Graduation Day  
Rolls Royce Faculty Search Committee Member

#### Department Level:

MAE Undergraduate Advisor (2006-present)  
MAE Undergraduate Curriculum Committee (2003-present)  
MAE Solid Mechanics Committee Chair (2007)  
MAE Solid Mechanics Committee (2004-present)  
MAE Bio/Nano-mechanics Research Initiatives Committee (2002-present)  
MAE Seminar Organizing Committee (2006-2007)  
MAE ABET Committee (2009)

Hilary Bart-Smith  
2009

## RESEARCH INTERESTS

- High authority morphing structures—statically and kinematically determinate structures/tensegrity structures
- Ultra light multifunctional materials (e.g. stochastic foams, lattice structures)
- Bio-inspired engineering design—biomechanics of batoid rays, artificial muscle actuators, underwater sensors, synthetic central pattern generators
- Electroactive and electrostrictive polymers
- Nanoporous thin films—nanoporous shape memory alloy films
- Deployable space structures

## GRADUATE AND UNDERGRADUATE ADVISEES

### Ph.D. Students:

Orion Scott (8/2003-2008), Ph.D. MAE  
Keith Moored (6/2004-present), Ph.D. MAE, expected 2009  
Russell Biagi (8/2003-present), Ph.D. MAE, expected 2009  
Thomas Jones (6/2004-present), Ph.D. MAE, expected 2009  
Thomas Bliss (8/2005-present), Ph.D. MAE, expected 2010  
Trevor Kemp (1/2009-present), Ph.D. MAE, expected 2013

### M.S. Students:

Stuart Taylor, MS MAE, March 2006  
Russell Biagi, MS MAE, March 2006  
Jonathan Hill, MS MAE, Oct 2007  
Thomas Jones, MS MAE, Sept 2005  
Adam Malcolm, MS MAE, Jan 2006  
Parixit Mehrotra ME MAE, Dec 2008  
Nathan Houle MS MAE, expected 2010

### Undergraduate Students (Financial support provided for all students during summer session.)

Amanda Kraines ME (2002-2003)  
Philipp Risseuw ME (2002-2003)  
Thomas Bliss ME (2003-2005)  
Kevin McArdle ME (2004-2005)  
Erik Haglund ME (2004)  
Connor Dolan ME (2004)  
Amanda Blumenthal ME (2004)  
Trevor Kemp ME (2004-2006)  
John Page ME (2005-2006)  
John Wade ME (2005-2006)  
Brian Caldwell (2005-2006)  
Jana Hester (2005-2007)  
Andrew Lestor CHE (2005-2006)  
Brandon Jones ECE (2005-2006)  
Will Goodrum MAE (2006)  
Thomas Meriwether ME (2006)  
Will Smith MAE (2006-2008)  
Patrick Ho MAE (2006-2008)  
Wooi (Wayne) Yang Chang MAE (2006-2008)  
Christopher Umphres MAE (2007-2008)  
James McBride MAE (present)  
Jeff Werly (2008-present)  
Jessica Bashkoff MAE (present)  
Jason Kaplan MAE (present)

## Bio-inspired Engineering Research Laboratory/ Multifunctional Materials and Structures Laboratory

**Director:** Hilary Bart-Smith, Associate Professor, Mechanical and Aerospace Engineering Dept., University of Virginia

**Collaborators:** T. Iwasaki (MAE, UVA), Matthew Begley (Mechanical and Aerospace Engineering, UVA), Michael Reed (Electrical and Computer Engineering, UVA), and Haydn Wadley (Materials Science Engineering, UVA), Lex Smits (Mechanical and Aerospace Engineering, Princeton), Vikram Deshpande (Mechanical Engineering, UCSB/Dept. of Engineering, Cambridge University), Frank Fish (Biology, West Chester University), Daniel Mumm (Chemical Engineering and Material Science, UC Irvine)

**Funding Agencies:** National Science Foundation, Packard Foundation, Office of Naval Research, National Institute of Aerospace. Since joining UVA, Bart-Smith has generated over \$9.9M of research funding.

**Current Students/Staff:** 6 graduate students, 2 research associates, and 5 undergraduates work in this lab.

**Research Focus Areas:** Research is focused on three main areas—*(i)* lightweight metallic structures (lattice truss structures, nanoporous films, hierarchical structures), *(ii)* statically determinate and tensegrity morphing structures, and *(iii)* polymer electro-mechanical systems (PEMS).

Professor Bart-Smith's research group is studying the **mechanics of lightweight lattice truss structures for their use as load-bearing structures and impact amelioration systems as well as their possible morphing and thermal management capabilities.**

Secondly, Bart-Smith and her colleagues are using the principles of static determinacy and tensegrity—with their superior mechanical properties such as stiffness and strength—to **develop a three-dimensional morphing foil with the propulsive and control capabilities of a manta ray.** Through collaborations scientists and engineers at the National Institute of Aerospace, NASA Langley and a grant through the Rising Stars Fellowship program, Bart-Smith is also involved in the area of **deployable space structures.** This work is also being expanded to look at the problem of morphing wings in aircraft and micro air vehicles.

Finally, she is **studying the mechanics of electro-active polymers to explore their possible use as artificial muscles within a device with biomimetic properties** (those that mimic a biochemical process). These material systems are also being adapted for underwater flow sensing technology.

**Teaching Focus Areas:** Continuum Mechanics, Elasticity, Statics, Strength of Materials