

# Curriculum Vitae

## David M. Wootton, PhD

### Professor

Department of Mechanical Engineering,  
The Cooper Union for the Advancement of Science and Art

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### Education

PhD, Mechanical Engineering, 1998	Georgia Institute of Technology, Atlanta, GA
MS, Mechanical Engineering, 1990	Massachusetts Inst. of Technology, Cambridge, MA
BS, Mechanical Engineering, 1987	Cornell University, Ithaca, NY

### Professional Experience

Cooper Union for the Advancement of Science and Art, New York, NY	
Professor of Mechanical Engineering	Sept 2015 - present
Associate Professor of Mechanical Engineering (tenured Dec. 2011),	Sept 2006 – Aug 2014
Director, Kanbar Center for Biomedical Engineering	Jan 2007 – Present
C. V. Starr Distinguished Research Professor	Jan 2016 – Aug 2018
Aix-Marseille University, Marseille, France, Visiting Scholar	Sept 2017 – July 2018
Drexel University, Philadelphia, PA, Assistant Professor,	Sept 2000 – Aug 2006
Johns Hopkins University, Baltimore, MD, Postdoctoral Fellow,	Oct 1998 – Sept 2000
General Motors Corporation, Warren, MI	
Project Engineer, Safety and Crashworthiness Systems	Sept 1990- Mar 1994
Harris Miller Miller and Hanson Inc, Burlington, MA	
Environmental noise and vibrations consultant	Feb 1987 – Aug 1987

### Research Interests

- Upper airway fluid and solid mechanics in Obstructive Sleep Apnea Syndrome
- Mechanochemical and dynamic models of thrombosis and thrombolysis
- Novel biosensor designs for blood hemostatic research, diagnosis, and monitoring
- The role of fluid mechanics and biological processes in cell transport
- Novel computer-aided design and manufacturing methods for tissue engineering
- Biomechanics of pathophysiology and treatment of Thoracic Insufficiency Syndrome

### Research Facilities

- Computational Fluid Dynamics Lab including three twelve-processor workstations and industry standard computational fluid mechanics software.
- Experimental/Teaching Cell and Tissue Engineering Lab facility.
- In vitro models of blood, blood analog, and airway flow.

### Honors and Awards

- National Science Foundation Graduate Fellow, M. I. T., 1987-1988
- President's Fellowship, Georgia Tech, 1994–1998
- Whitaker Foundation Trainee, Georgia Tech, 1994-1998
- Best Mechanical Engineering Ph. D. Qualifying Exam, Georgia Tech, Spring 1995

- BellSouth Scholar, A. R. C. S. Atlanta, 1996–1998
- Distinguished Postdoctoral Fellowship, Johns Hopkins, 1998 – 2000
- Undergraduate Teaching Award, Dept. of Mechanical Engineering and Mechanics, Drexel University, 2002-2003
- C. V. Starr Distinguished Research Professorship, Cooper Union, January 2016 – August 2018
- Fulbright France US Research Scholar, Laboratory of Applied Biomechanics, IFSTTAR, Aix-Marseille University, Marseille, France, January-July 2018

## **Professional Service**

### **Professional Societies**

Member, Biomedical Engineering Society

Member, American Society of Mechanical Engineers - Biofluid Mechanics Technical Committee

Associate Member, American Thoracic Society (ATS)

### **Conference Organization**

Session Organizer and Chair, Thrombosis and Cellular Fluid Mechanics, BED6B, IMECE 2002.

Session Organizer and Chair, Cardiovascular Fluid Mechanics Bypass and Access Grafts, BED2B, IMECE 2003.

Program Committee and Session Chair, NorthEast Bioengineering Conference, Springfield, MA, April 17-18, 2004.

Session Organizer and Chair, Thrombosis and Rheology, BMES 2005 Annual Fall Meeting, Baltimore, MD, Sept 29 – Oct 1, 2005.

Judge, Undergraduate and MS Student paper competitions, ASME IMECE Bioengineering Division, 2001 – 2005.

### **Peer Review**

Annals of Biomedical Engineering

Biorheology

Circulation

Encyclopedia of Medical Devices and Instrumentation (Wiley)

Endothelium

Journal of Biomechanical Engineering

Journal of Biomechanics

Medical Engineering and Physics

Medical Research Council (Britain)

National Institutes of Health (ad hoc proposal reviewer)

National Science Foundation (Bioengineering Program)

Prentice-Hall (Fluid Mechanics in the Human Circulation, a new textbook)

Sleep

Nature

### **Cooper Union**

Director, Maurice Kanbar Center for Biomedical Engineering, 2007 – 2016. Associate Director, 2016 – present. The lab supports courses and student research projects in bioengineering.

Middle States Commission of Higher Education Accreditation Self-Study Working Group IV (Faculty, Educational Offerings, and General Education), 2006 – 2007

Mechanical Engineering Transition Working Group, 2007- present

Interdisciplinary Engineering Oversight Committee, 2008-present

### **Drexel University**

Dean's Advisory Committee, 2003

Undergraduate Affairs Committee, 2000 –2002

MEM Department Head Search Committee, 2000-2001

## **Community Outreach**

Holland and Knight Building Bridges, Atlanta, GA. 1997-1998. Introducing law and engineering to young students through participation in a mock trial.

Drexel COE Summer Mentorship, July 2002. Two week summer research experience for high school junior. Mentoring high school sophomore honors student interested in medicine and engineering.

Research Experiences for Teachers (RET), Drexel University, 2003.

Exercise Equipment for [B'N FIT](#), Cooper Union and the Children's Hospital at Montefiore, 2008 – present. Freshmen design students (EID101) have designed a series of low-cost exercise systems for overweight teens in the [B'N FIT](#) program; each with some unique incentive. Systems include exercise bikes that drive adventure chase and competitive race video games, a stepper that controls current to an entertainment device, and an 8-pad foot operated device for playing synthesized drums or music. Students have talked about engineering and design to children in the clinic.

Summer Engineering Program, Cooper Union, 2008. Ran a full day workshop introducing tissue engineering, gels, and tissue engineering manufacturing, geared for high school and junior high school students.

## Teaching Experience

### Course Design

Biofluid Mechanics (Graduate/Undergraduate), Drexel University, 2001-2006. (MEM 444)  
Crash Data Filtering (Short Course), General Motors Corporation, Fall 1993.  
CFD modules for undergraduate and graduate fluid mechanics courses.  
Injury Biomechanics and Safety Design, Cooper Union EID124.

### Course Coordinator

Engineering Design and Problem Solving, Cooper Union, EID101, 2014-2015.

### Courses Taught

Heat Transfer, Cooper Union, ME142, Spring 2015  
Mechanical Vibrations, Cooper Union, ME101, Spring 2012, 2013  
Engineering Mechanics, Cooper Union, ESC100, Fall 2106  
Engineering Experimentation, Cooper Union, ME160, Spring 2013-2017  
Advanced Fluid Mechanics, Cooper Union, ME/EID/ChE 440, Fall 2012-2016  
Introduction to Tissue Engineering, Cooper Union, EID323/ME323, Spring 2007  
Mechanics of Materials, Cooper Union, ESC101M, Spring 2008 - 2017  
Fluid Mechanics, Cooper Union, ESC140M, Fall 2006 - 2016  
Engineering Design and Problem Solving, Cooper Union, EID101, Fall 2006 – 2015  
Biotransport Phenomena, Cooper Union, EID121, Spring 2009, Fall 2011  
Injury Biomechanics and Safety Design, Cooper Union EID124, Spring 2008, 2011, 2016  
Foundations of Fluid Mechanics (Grad), Drexel University, MEM 621, 2000-2005  
Boundary Layers, Laminar and Turbulent (Grad), Drexel University, MEM 622, 2001-2006  
Heat Transfer (Undergrad), Drexel University, MEM 345, 2006  
Dynamics (Undergrad), Drexel University, MEM 238, 2005 - 2006  
Fluid Dynamics I (Undergrad), Drexel University, MEM 320, 2002  
Dynamics Laboratory, Cornell University.  
Intermediate Dynamics, Massachusetts Institute of Technology.  
Fluid Mechanics III, Georgia Institute of Technology.  
Thermodynamics I, Georgia Institute of Technology.  
Cardiovascular Physiology Simulation Lab, Johns Hopkins University School of Medicine.

## Students Supervised

### PhD

Coadvisor for Sangho Kim (MEM)	PhD 2002	Assistant Professor, U. of Singapore
Chun Xu (MEM)	PhD 2006	Postdoc, U. of Pennsylvania
Chang-Beom Kim (MEM)	PhD 2006	Researcher, Korea University

### Postdoctoral Fellows

Haiyan Luo	2012 – present
Alireza Yazdani	2012 - 2013

### Masters

Chun Xu (MEM)	MS 2003
Brad Xanthopolous	(Independent study)

Priya Vaidyanathan (Biomed)	MS 2004
Sanghun Sin (Biomed)	MS 2004
Matthew Appel (MEM)	MS 2006
Sharon Markowitz (ME)	MS 2008
Hyun Soo Ko (ME)	MS 2009
Stephen Persak (ME)	MS 2010
Jonathan Serman (ME)	MS 2011
Neal Kinariwala (ME)	Withdrew for med school
Yeji Kim (ME)	Withdrew for med school
Joshua Warren (ME)	MS 2014
Olga Shishkov (ME)	MS 2015
Neil Muir (ME)	MS 2017
Eric Ramos (ME)	MS 2017
Anthony Simonetti (ME)	MS 2017
Donggyoon Hong (ME)	MS 2018

#### **Undergraduate Project Advisees (selected)**

Brian Schmidt (MEM)	BS 2003
Kirk Edwards (MEM)	BS 2003
Vince Yanni (MEM)	BS 2004
Bryan Bowker (MEM)	BS 2005
John (Jack) Kuhar (MEM)	BS 2006
Kim Argen (IDE)	BS 2007
Lenore Berhak (IDE)	BS 2007
Paula Ancelson (IDE)	BS 2007
Suzanne Friedman (IDE)	BS 2007
Dan Rene (IDE)	BS 2007
Javier Delgado (IDE)	BS 2007
Christian Sevilla (IDE)	BS 2008
Brian Tovar (ME)	BS 2008
Christopher Phaneuf (ME)	BS 2008
May Chang (ME)	BS 2008
Christopher Miu (ME)	BS 2009
Neal Kinariwala (IDE)	BS 2009
Jonathan Serman (ME)	BS 2009
Filip Cosmanescu (IDE)	BS 2009
Gavriel Feuer (IDE)	BS 2010
Lulu Feldhamer (ME)	BS 2010
Andrea Zaferiou (ME)	BS 2010
Sherry Liang (ME)	BS 2010
Helen Minsky (ME)	BS 2011
Jillian Schinsky (ME)	BS 2011
Sean Davis (ME)	BS 2012
Shawn Devitt (ME)	BS 2012
Sophie Rand (IDE)	BS 2012
Donggyoon Hong (ME)	BS 2012

Julian Alvarez (ME)	BS 2014
Ewan Kay (ME)	BS 2014
Andrew Knuepple (ME)	BS 2014
Kenneth Lehr (ME)	BS 2014
Grant Aarons (ME)	BS 2014
Hannah Talisse (ME)	BS 2015
Alex Novoselov (ME)	BS 2015
Tom Chan (ME)	BS 2016
Austin Chang (ME)	BS 2016
Arvinth Sethuraman (BSE)	BS 2017
Dilara Seyman (ME)	BS 2019

## Publications and Presentations

### Journal Articles

1. Wootton DM, Ku DN, “Fluid Mechanics of Vascular Systems, Diseases, and Thrombosis,” *Annual Review of Biomedical Engineering*, V. 1, pp. 299-329, 1999. [\[abstract\]](#) (333 citations ... counts by Google Scholar, 10/5/2013)
2. Jerius H, Karolyi DR, Mondy JS, Beall A, Wootton D, Ku D, Cable S, Brophy CM, “Endothelial-dependent vasodilation is associated with increases in the phosphorylation of a small heat shock protein (HSP20)”, *Journal of Vascular Surgery*, V. 29, pp. 678-84, 1999. (34 citations)
3. Wootton DM, Markou CP, Hanson SR, Ku DN, “A Mechanistic Model of Acute Platelet Accumulation in Thrombogenic Stenoses,” *Annals of Biomedical Engineering*, V. 29, pp. 321-329, 2001. [\[abstract\]](#) (79 citations)
4. Wootton DM, Popel AS, Alevriadou BR, “An Experimental and Theoretical Study on the Dissolution of Mural Fibrin Clots by Tissue-Type Plasminogen Activator,” *Biotechnology and Bioengineering*, V. 77, #4, pp. 405-419, 2002. [\[abstract\]](#) (15 citations)
5. Xu C, Wootton DM, “Platelet Near-Wall Excess in Porcine Whole Blood in Artery-Sized Tubes Under Steady and Pulsatile Flow Conditions”, *Biorheology*, V. 41, pp 113-125, 2004. [\[abstract\]](#) (15 citations)
6. Arens R, Sin S, McDonough JM, Palmer J, Dominguez T, Meyer H, Wootton DM, Pack AI, “Changes in Upper Airway Size during Tidal Breathing in Children with Obstructive Sleep Apnea Syndrome,” *Am. Journal of Respiratory and Critical Care*, V. 171, #11, pp. 1292-1297. 2005. [\[abstract\]](#) (54 citations)
7. Xu C, Sin S, McDonough M, Udupa JK, Arens R, Guez A, Wootton DM, “Computational Fluid Dynamics Modeling of the Upper Airway of Children with Obstructive Sleep Apnea Syndrome in Steady Flow,” *Journal of Biomechanics*, V. 39, #11, pp. 2043-2054, 2006. [\[abstract\]](#) (71 citations)
8. Mondrinos M, Dembzymsky R, Lu L, Byrapogu, VKC, Wootton DM, Lelkes PI, Zhou GJ, “A Porogen-based Solid Freeform Fabrication of Polycaprolactone-Calcium Phosphate Scaffolds for Tissue Engineering,” *Biomaterials*, V. 27, #25, pp. 4399-4408, 2006. [\[abstract\]](#) (94 citations)
9. Ergezen E, Appel M, Shah P, Kresh JY, Lec RM, Wootton DM, “Real-Time Monitoring of Adhesion and Aggregation of Platelets using Thickness Shear Mode (TSM) Sensor,” *Biosensors and Bioelectronics*, V. 23, #4, pp. 575-82, 2007. [\[abstract\]](#) (7 citations)
10. Zhou J, Lu L, Byrapogu K, Wootton DM, Lelkes PI, Fair R, “Electrowetting-based multi-microfluidics array printing of high resolution tissue construct with embedded cells and growth factors,” *Virtual and Physical Prototyping*, V. 2, #4, pp. 217-223, 2007. (14 citations) [\[abstract\]](#)
11. Marcus C, Smith RJH, Mankarious L, Arens R, Mitchell G, Elluru RG, Forte V, Goudy S, Jabs EW, Katz E, Paydarfar D, Reeves RH, Richtsmeier JT, Ruiz RL, Thach BT, Tunkel DE, Whitsett JA, Wootton D, Blaisdell CJ, “Developmental Aspects of the Upper Airway, Report from an NHLBI Workshop March 5-6, 2009.” *Proceedings of the American Thoracic Society*, V. 6, #6, pp. 513-520, 2009. (9 citations) [\[abstract\]](#)
12. Xu C, Brennick MJ, Dougherty L, Wootton DM, “Modeling of Upper Airway Collapse by Regional Tissue Properties in a Finite Element Model,” *Medical Engineering and Physics*, V. 31, #10, pp. 1343-1348, 2009. (8 citations) [\[abstract\]](#)



13. Lu, Lin, Zhang, Qingwei, Wootton, David, Lelkes, Peter, and Zhou, Jack, “A novel sucrose porogen-based solid freeform fabrication system for bone scaffold manufacturing,” *Rapid Prototyping Journal*, V. 16, #5, pp. 365-376, 2010. [\[abstract\]](#)
14. Arens R, Sin S, Willen S, Bent J, Parikh SR, Freeman K, Wootton DM, McDonough JM, Shifteh K. “Rhino-sinus involvement in children with obstructive sleep apnea syndrome,” *Pediatric Pulmonology*. 2010 Oct;45(10):993-8. [\[abstract\]](#)
15. Arens R, Sin S, Nandalike K, Rieder J, Khan U, Freeman K, Wylie-Rosett J, Lipton M, Wootton DM, McDonough JM, Shifteh K. “Upper Airway Structure and Body Fat Composition in Obese Children With Obstructive Sleep Apnea Syndrome,” *American Journal of Respiratory and Critical Care*, 2011 Mar 15;183(6):782-7. (24 citations) [\[abstract\]](#)
16. Persak SC, Sin S, McDonough JM, Arens R, Wootton DM. “Noninvasive estimation of pharyngeal airway resistance and compliance in children based on volume-gated dynamic MRI and Computational Fluid Dynamics,” *Journal of Applied Physiology*. 2011 Dec;111(6):1819-27. (7 citations) [\[abstract\]](#)
17. Lu L, Zhang Q, Wootton D, Chiou R, Li D, Lu B, Lelkes P, Zhou J. “Biocompatibility and biodegradation studies of PCL/ $\beta$ -TCP bone tissue scaffold fabricated by structural porogen method,” *Journal of Materials Science: Materials in Medicine*, 2012 Sep;23(9):2217-26. [\[abstract\]](#).
18. Lu L, Zhang Q, Wootton DM, Chiou R, Li D, Lu B, Lelkes PI, Zhou J. “Mechanical Study on Polycaprolactone-Hydroxyapatite Porous Scaffolds by Porogen-Based Solid Freeform Fabrication Method,” *Journal of Applied Biomaterials and Functional Materials*., 2014 Dec 30;12(3):145-54. [\[abstract\]](#)
19. Allori AC, Davidson EH, Reformat DD, Sailon AM, **Freeman J, Vaughan A**, Wootton D, Clark E, Ricci JL, Warren SM., “Design and Validation of a Dynamic Cell-Culture System for Bone-Biology Research and Exogenous Tissue-Engineering Applications,” *Journal of Tissue Engineering and Regenerative Medicine*, 2013 Sep 11. doi: 10.1002/term.1810. [\[abstract\]](#). (Dr. Wootton supervised two undergraduate Cooper Union students on this project: James Monroe and Adam Vaughn.)
20. Wootton DM, Alevriadou BR. “The shear stress of busting blood clots,” *New England Journal of Medicine*. 2012 Oct 4;367(14):1361-3. [\[link\]](#)
21. Wootton DM, Luo H, Persak SC, Sin S, McDonough JM, Isasi CR, Arens R, “Computational Fluid Dynamics Endpoints to Characterize Obstructive Sleep Apnea Syndrome in Children.” *Journal of Applied Physiology* (1985). 2014 Jan 1; 116(1):104-112. [\[abstract\]](#)
22. Yu M., George C, Cao Y, Wootton DM, Zhou J, “Microstructure, corrosion, and mechanical properties of compression-molded zinc-nanodiamond composites.” *Journal of Materials Science*. 2014 May; 49(10):. 3629-3641. [\[abstract\]](#)
23. Luo H, Sin S, McDonough JM, Isasi CR, Arens R, Wootton DM, “Computational Fluid Dynamics Assessment of Adenotonsillectomy Outcome in Obese Children with Obstructive Sleep Apnea Syndrome.” *Journal of Biomechanics*. 2014 July, 47(10): 2498–2503. [\[abstract\]](#)
24. Sin S, Wootton DM, McDonough JM, Nandalike K, Arens R, “Anterior nasal resistance in obese children with obstructive sleep apnea syndrome (OSAS).” *Laryngoscope* 2014 Nov, 124(11):2640-4. [\[abstract\]](#)

25. Wootton DM, Sin S, Luo H, Yazdani A, McDonough JM, Wagshul ME, Isasi CR, Arens R, “Computational Fluid Dynamics Upper Airway Effective Compliance, Critical Closing Pressure, and Obstructive Sleep Apnea Severity in Obese Adolescent Girls,” *Journal of Applied Physiology*, 121(4): 925–931, 2016. [\[abstract\]](#)
26. Subramaniam DR, Arens R, Wagshul ME, Sin S, Wootton DM, Gutmark EJ. “Biomechanics of the soft-palate in sleep apnea patients with polycystic ovarian syndrome,” *Journal of Biomechanics*, 2018 Jul 25;76:8-15. [\[abstract\]](#)
27. Naughton JP, Lee AY, Ramos E, Wootton D, Stupak HD, “Effect of Nasal Valve Shape on Downstream Volume, Airflow, and Pressure Drop: Importance of the Nasal Valve Revisited,” *Annals of Otolaryngology, Rhinology & Laryngology*, Accepted July 8, 2018.

### **Book Chapters**

Bergman HL, Chesler N, Ku DN, Wootton DM, "Hemodynamics and Atherosclerosis," Ch. 9 of *Cerebrovascular Ultrasound*, Hennerici MC, Meairs S, editors, Cambridge University Press, 2001.

### **Conference Articles, Posters, and Presentations**

1. Wootton DM, Hanson SR, Markou CP, Ku DN, “Mass Transfer Modeling of Arterial Thrombosis in Ex Vivo Thrombosis Models,” *Annals of Biomedical Engineering*, V. 25 (S1), p. S-2, 1997.
2. Wootton DM, Markou CP, Hanson SR, Ku DN, “Mechanistic Model of Arterial Thrombosis in Collagen-Coated Stenoses,” *Advances in Bioengineering*, V. 39, pp. 115-6, ASME-BED, 1998.
3. Wootton DM, Popel AS, Alevriadou BR, “A Model of Lysis of Mural Platelet-Fibrin Thrombi,” BMES-EMBS First Joint Meeting, Oct 13 -15,1999, Atlanta, GA, Abstract 8.8.1.5, p. A133.
4. Wootton DM, Markou CP, Hanson SR, Ku DN, “Effect of Activation Kinetics on Platelet Accumulation in a Thrombogenic Stenosis,” BMES Fall Annual Meeting, Oct 4-7, 2001, Durham, NC, Abstract 5.9.6.
5. Lamkin-Kennard K, Buerk DG, Barbee K, Wootton D, Jaron D, “Modeling Effects of Nitric Oxide on Oxygen Consumption in the Microcirculation,” *Proceedings of the IEEE 28<sup>th</sup> Annual Northeast Bioengineering Conference*, Apr 20-21, 2002, Philadelphia, PA, pp 31-32.
6. Xu C, Wootton DM, “A model of platelet concentration sampling in arterial flow,” Paper # 981, Second joint meeting of EMBS and BMES, October 23-26, 2002, Houston, TX.
7. Wootton DM, “A Continuum Model of Thrombus Growth and Flow Impingement,” Paper # IMECE2002-32786, ASME IMECE, November 17-22, 2002, New Orleans, LA.
8. Wootton DM, Guez A, Vaidyanathan P, Avinash D, Stablum JR, McDonough JM, Udupa JK, Arens R, “Model of Upper Airway Flow Restriction in Children with Obstructive Sleep Apnea,” Paper #8.3.3.2, *Proceedings of the IEEE 29<sup>th</sup> Annual Northeast Bioengineering Conference*, Newark, NJ, March 22-23, 2003.
9. Wootton DM, Guez A, Vaidyanathan P, McDonough JM, Udupa JK, Arens R, “Image-based Modeling of Upper Airway Resistance in Children with Obstructive Sleep Apnea Syndrome”, *Associated Professional Sleep Societies 17th Annual Meeting*, Chicago IL, June 3-8, 2003. Abstract published in *Sleep* 26(suppl): A233

10. Wootton DM, Guez A, Vaidyanathan P, McDonough JM, Udupa JK, Arens R, "Image-based Modeling of Upper Airway Flow in Children with Obstructive Sleep Apnea", Paper #0779,, 2003 Summer Bioengineering Meeting (ASME/BMES), Key Biscayne, June 23 – 29, 2003.
11. Schmidt BR, Kim CB, Mohamed F, Nunes LW, Ahmed Z, Wootton DM, "Image-based Modeling of Arteriovenous Hemodialysis Access Graft Flow", Paper #IMECE2003-42952, ASME IMECE, November 15-21, 2003, Washington, DC.
12. Burns MP, Jones CI, Wootton DM, Alevriadou RB, "Design of a Flow System for Exposure of Cultured Vascular Endothelial Cells to Ischemia/Reperfusion," FASEB Experimental Biology 2004, Washington, DC, April 17-21, 2004
13. Kim CB, Kresh JY, Wootton DM, "A Novel Translating-Stage Assay to Study Platelet Concentration, Transport, and Adhesion Kinetics," paper 125226, BMES 2004 Annual Fall Meeting, Philadelphia, PA, October 2004.
14. Xu C, Guez A, McDonough JM, Arens R, Wootton DM, "Finite Element Model Of Air Flow In A Stenotic Channel With Large Wall Deformation And Collapse," paper 125164, BMES 2004 Annual Fall Meeting, Philadelphia, PA, October 2004.
15. Vaidyanathan P, Guez A, Udupa JK, Arens R, Wootton DM, "Automated System for Image-Based Upper Airway Flow Modeling," paper 125218, BMES 2004 Annual Fall Meeting, Philadelphia, PA, October 2004.
16. Sin S, Wootton DM, Guez A, Pierson R, Schwab R, McDonough JM, Arens R, "Computational Modeling of Upper Airway Flow using MR Image of Adult with Obstructive Sleep Apnea," paper 125278, BMES 2004 Annual Fall Meeting, Philadelphia, PA, October 2004.
17. Mondrinos M, Lu L, Dembzyński R, Wootton DM, Lelkes PI, Zhou GJ, "Solid Free Form Fabrication System for Manufacturing of Scaffold Porogens," paper 123437, BMES 2004 Annual Fall Meeting, Philadelphia, PA, October 2004.
18. Xu C, Brennick M, Wootton DM, "Image-based three-dimensional finite element modeling approach for upper airway mechanics," 27th Annual International Conference of the IEEE Engineering in Medicine and Biology Society (EMBS), Sept.1-4, Shanghai, China, 2005.
19. Xu C, Brennick M, Wootton DM, "Pharyngeal Airway Collapse Modeling by Magnetic Resonance Imaging with Computational Mechanics," BMES 2005 Annual Fall Meeting, Baltimore, MD, September 2005.
20. Wootton DM, Xu C, Sin S, McDonough J, Guez A, Arens R, "Computational Fluid Dynamics Model of Airway Shape Effects in Children with Obstructive Sleep Apnea," BMES 2005 Annual Fall Meeting, Baltimore, MD, September 2005.
21. Kim CB, Kresh JY, Wootton DM, "A Novel Translating-Stage Assay to Study Platelet Concentration, Transport, and Adhesion Kinetics", BMES 2005 Annual Fall Meeting, Baltimore, MD, September 2005.
22. Lu L, Dembzyński R, Mondrinos M, Wootton DM, Lelkes PI, Zhou GJ, "Manufacturing System Development for Fabrication of Bone Scaffold," Paper # IMECE2005-80937, ASME International Mechanical Engineering Conference and Exposition, Orlando, FL, November 2005 (peer-reviewed conference paper).
23. Wootton DM, Xu C, Sin S, McDonough JM, Guez A, Arens R, "Modeling the role of Anatomical Restriction of the Upper Airway in Flow Limitation in Children with OSAS," American Thoracic Society ATS 2006, May 23, San Diego, CA.

24. Kim CB, Kresh JY, Wootton DM, "Simultaneous Measurement of Platelet Adhesion, Margination, Shear Stress, and Non-Newtonian Profile," BMES 2006 Annual Fall Meeting, Chicago, IL, October 2006.
25. Wootton DM, "Dynamic Lumped Parameter Model Of Airway Collapse," American Thoracic Society, ATS 2007, May 21.
26. Wootton DM, "Tissue Engineering Education at the Cooper Union," NSF CMMI Grantees Conference, Knoxville, TN, January 2008.
27. Zhang Q, Devlin S, Wasko K, Kleinbart R, Wootton D, Lelkes P, Zhou J, "GOALI/Collaborative Research: Design and Manufacturing of Bioactive Surgical Fixation Devices Using Injection Molding of Gradient Cellular Structures," NSF Engineering Research and Innovation Conference, June 22-25, 2009, Honolulu, Hawaii.
28. Geisler C, Lelkes P, Wootton D, Fair R, Zhou J, "Material Selection for Electrowetting Micro Array Printing System for Bioactive Tissue Construct Manufacturing," NSF Engineering Research and Innovation Conference, June 22-25, 2009, Honolulu, Hawaii.
29. Hyun-Soo Ko, David M. Wootton. "Three-dimensional Finite Element Model of Upper Airway Flow Limitation." Biomedical Engineering Society Annual Conference, Pittsburgh, PA, Oct 8, 2010.
30. Steven C. Persak, Sanghun Sin, Raanan Arens, and David M. Wootton. "Computational fluid dynamics modeling of upper airway during tidal breathing using volume-gated MRI in OSAS and control subjects." 36<sup>th</sup> Annual Northeast Bioengineering Conference (NEBEC 2010), New York, NY, March 28, 2010.
31. DM. Wootton, SH. Sin, S. Persak, K. Nandalike, JM McDonough, R. Arens. "Nasal Resistance in Obese Children with and without OSAS." Abstract #6254. American Thoracic Society 2010 ATS International Conference, New Orleans, LA, May 16, 2010.
32. S Persak, S. Sin, R Arens, DM Wootton. "Computational Fluid Dynamics Models of the Upper Airway in Obese Children with and without OSAS." Abstract #7164. American Thoracic Society 2010 ATS International Conference, New Orleans, LA, May 17, 2010.
33. David M. Wootton, Steven C. Persak, Sanghun Sin, and Raanan Arens. "Application of Computation Fluid Dynamics (CFD) to Study Mechanical Properties of Obstructive Sleep Apnea in Children." 12th International Symposium on Sleep and Breathing, Barcelona, Spain, April 7, 2011.
34. S Persak, S. Sin, R Arens, and DM Wootton. "Computational Fluid Dynamics Modeling of Upper Airway During Tidal Breathing Using Volume-Gated MRI in OSAS and Control Subjects." ASME 2011 Summer Bioengineering Conference, Farmington, PA, June 23, 2011.
35. Zaferiou A, McNitt-Gray J, Wootton D, "Quantifying forefoot geometry and pressure distribution during pointe shoe use," International Association for Dance Medicine and Science 21st Annual Meeting, Washington, DC, October 15, 2011.
36. Wootton, David; Persak, Steven; Haiyan, Luo; McDonough, Joseph; Sin, Sanghun; Wagshul, Mark; Arens, Raanan;, "Computational Modeling of the Upper Airway of Children Based on Dynamic MR Imaging," Paper ThA12.3. IEEE Engineering in Medicine and Biology Conference, 34th Annual International IEEE EMBS Conference, August 28 - September 1, 2012, San Diego, CA.
37. DM Wootton, H Luo, S Sin, R Arens, "Using Computational Fluid Dynamics to Analyze Treatment Outcome of Adenotonsillectomy in Obese Adolescents with Obstructive Sleep

- Apnea,” American Thoracic Society Annual Meeting ATS 2013, May 21, 2013, Philadelphia, PA; Am J Respir Crit Care Med 187;2013:A5201.
38. R. Arens, K. Shifteh, M.M. Lipton, D.M. Wootton, S. Sin, “Longitudinal Effects Of Weight Change On Upper Airway Structure In Obese Children,” American Thoracic Society Annual Meeting ATS 2013, May 22, 2013, Philadelphia, PA; Am J Respir Crit Care Med 187;2013:A5461.
  39. DM Wootton, H Luo, A Yazdani, S Sin, M Wagshul, R Arens, “Computational Fluid Dynamics Modeling Of Effective Upper Airway Compliance In Subjects With Polycystic Ovarian Syndrome And Obstructive Sleep Apnea,” American Thoracic Society Annual Meeting ATS 2013, May 22, 2013, Philadelphia, PA; Am J Respir Crit Care Med 187;2013:A5696.
  40. H. Luo, S. Sin, J. M. McDonough, C. R. Isasi , R. Arens, D. M. Wootton, “Computation Fluid Dynamics Model Endpoints Correlate to Clinical Improvement in Obstructive Sleep Apnea Syndrome Severity following Adenotonsillectomy Surgery,” Poster 3948 World Congress of Biomechanics, July 8, 2014, Boston, MA.
  41. David M. Wootton, Haiyan Luo, Alireza Yazdani, Raanan Arens, Mark Wagshul, Sanghun Sin, Carmen R. Isasi, “Upper Airway Effective Compliance Determined by Image-Based Computational Fluid Dynamics Correlates with Critical Closing Pressure and Apnea-Hypopnea Index in Obese Adolescent Girls,” Poster ID 5716, 2016 ATS International Conference, San Francisco, CA, May 15, 2016.
  42. David M. Wootton, Michel Behr, “Finite element model of work of breathing in six year old children,” Abstract # 1914, World Congress of Biomechanics, Dublin, Ireland, July 9, 2018.

### **Invited Seminars and Workshops, Panels**

- University of Maryland, Baltimore County, Mechanical Engineering Seminar, Nov 2, 2001.
- Biofluid Mechanics Education Panel, R Banerjee moderator, Session TBMT-4, ASME ICEME 2002, Nov 20, New Orleans, LA.
- New Jersey Institute of Technology, Applied Math Colloquium, Feb 7, 2003.
- International Workshop on Pulmonary Functional Imaging, University of Pennsylvania, Nov 12-14, 2004.
- “Respiratory Biomechanics,” guest lecture for Natural Science I: The Human Body - The Ultimate Machine, Prof. Peter Walker, NYU, Feb 15, 2007.
- “Image-based airway fluid and solid mechanics models of pediatric obstructive sleep apnea,” in PG23 – New insights into the pathophysiology and consequences of Obstructive Sleep Apnea, Postgraduate course, American Thoracic Society, San Francisco, CA, May 19, 2007.
- “Obstructive Sleep Apnea Projects at Cooper Union,” Cooper Union Board of Trustees Meeting, with David Orbach, and George Delegrammatikas, December 9, 2008.
- NHLBI Workshop, Developmental Aspects of the Upper Airway, March 5-6, 2009
- “Image-based modeling of the upper airway in Obstructive Sleep Apnea Syndrome,” Courant Institute of Mathematical Sciences Biomath/COB Colloquium, NYU, Sept 27, 2011.
- SCONA 2018: Society for CFD of the Nose and Airway, first annual conference, London, England, April 22, 2018:
- 2.4 CFD results for airflow in the normal airway
  - 3.8 The upper airway - pathology and surgery

## Grant Funding

### Current Grants

Arens, R (PI), Wootton, DM (MPI), Udupa, J (MPI), “A Computational Biomechanical Airway Model for Obese Children at Risk for OSAS,” National Institutes of Health NHLBI, 1R01HL130468, Aug. 2016 – June 2021. \$450,000 direct, \$652,500 total to Cooper Union.

### Completed Grants

Wootton, DM (PI), Ahmed, Z. “Model of Dialysis Access Flow and Thrombosis.” Drexel University Synergy Grant, \$20,000, June 2002 – June 2003.

Wootton, DM (PI). “Platelet-vWF transient binding in shear flow: assay and mechanical model.” American Heart Association, Pennsylvania-Delaware Local Affiliate, \$100,000 total, July 2003 – Jun 2005 (extended to Jan 2006).

Zhou, GJ (PI), Lelkes, PI, Wootton, DM, “Biomimetic Structured Porogen Freeform Fabrication System for Tissue Engineering.” National Science Foundation, \$388,704 total, April 2003 – March 2006.

Zhou GJ (PI), Fair R, Lelkes PI, Wootton DM, “Collaborative Research: Electrowetting Micro Array Printing System for Bioactive Tissue Construct Manufacturing.” National Science Foundation, Grant CMMI- 0654244, \$33,654 (to Cooper Union). April 2007 – March 2010.

Papazoglou E, Wootton D, Lowman A, Lelkes PI, McEachron D, “Smart Biomaterials for Tissue and Regenerative Engineering,” National Science Foundation, \$20,500 (subcontract to Cooper Union), July 2009 – June 2011.

Wootton, DM (PI), Delegrammatikas G. “MRI-R2: Acquisition of Endoscopic Particle Image Velocimetry System and Multiprocessor Computer for Fluid Mechanics Research,” National Science Foundation, Grant 959915, \$152,857 total, February 2010 – December 2012.

Zhou GJ, Yao DG, Lelkes PI, Wootton DM, “GOALI/Collaborative Research: Design and Manufacturing of Bioactive Surgical Fixation Devices Using Injection Molding of Gradient Cellular Structures.” National Science Foundation, Grant CMMI-0800743, \$49,925 (to Cooper Union). May 2008 – April 2013.

Arens R (PI), Wootton DM, “Pathophysiology of OSAS in Obese Children 8 – 17 Years Old,” National Institutes of Health, \$360,500 (subcontract to Cooper Union), April 2008 – March 2013.

Arens, R (PI), Udupa JY (PI), Wootton DM (PI), “A Structural & Functional Study of the Upper Airway in Adolescent Girls with PCOS,” National Institutes of Health, Grant 1 R01 HL105212-01, \$891,684 (total to Cooper Union), Sept 2010 –Aug 2015.

Wootton DM. C.V. Starr Research Professorship. January 2016 – August 2018. \$60,000 total.

## Patents, Technology Transfer, and Entrepreneurial Activities

### US Patents

Ku DN, Greer-Braddon L, Wootton DM, "Poly (Vinyl Alcohol) Cryogel", [US Patent #5981826](#), issued Nov 9, 1999.

Lec RM, Kresh JY, Wootton DM, "Acoustic Blood Analyzer for Assessing Blood Properties", [US Patent # 7,857,761](#), issued Dec 28, 2010.

### Novel Electromechanical Hemostatic Biosensors

In collaboration with Ryszard Lec (Drexel Biomedical Engineering) and Yasha Kresh (Drexel University College of Medicine), Dr. Wootton has developed new sensors to detect hemostatic function based on the propagation and attenuation of shear acoustic waves into cells and proteins that attach to bioactive sensor coatings.

The first-generation sensor is designed as a blood clotting timer, capable of enhancing the function of disposable blood clotting assays for home testing and point-of-care testing. Blood clotting timers are crucial for maintaining the health of patients with artificial heart valves and blood pumps (estimated at 50,000 to 100,000 patients annually), and with improvements in cost and accuracy will enable treatment of a larger class of patients at risk from atrial fibrillation and deep vein thrombosis. An option to license the technology from Drexel University has been granted to SonoMedix, a startup funded by BioAdvance greenhouse funding.

### Cryogel Biomaterials for Surgical Applications – Georgia Tech/GTRA/Salumedica

Dr. Wootton is a coinventor of a novel cryogel biomaterial manufacturing process, with Dr. David Ku and Linda Greer Braddon at Georgia Institute of Technology. The invention led to a patent (owned by Georgia Tech), technology seed funding through the Georgia Tech Research Alliance (GTRA), and the formation of a spin-off company, Salumedica, to develop the material for clinical use. Salumedica has an FDA-approved nerve cuff in clinical use, and is completing clinical trials for its second product, an orthopedic implant.

### *Personal*

*Dr. Wootton is married to Gina Snyder, a nonprofit community development corporation director and attorney; they have two young sons. He is a classically trained violinist who enjoys playing chamber music, as well as folk and bluegrass fiddle, and worked in violin repair and restoration for Reuning and Son Violins from 1980 to 1987. Dr. Wootton is a regular attendee at Chestnut Hill Monthly Meeting of the Society of Friends and volunteer with Germantown Avenue Crisis Ministry. He is committed to bicycle commuting and interested in folding bicycle design.*