

**MADHAVAN L. RAGHAVAN, Ph.D.**

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**EDUCATION**

- July 1998: Doctor of Philosophy in Bioengineering, University of Pittsburgh, Pittsburgh, PA  
Major: Cardiovascular Biomechanics  
Ph.D. Dissertation: Mechanical wall stress in human abdominal aortic aneurysm: towards the development of a biomechanical tool to predict aneurysm rupture
- April 1992: Bachelor of Engineering, Coimbatore Institute of Technology, India.  
Major: Mechanical Engineering  
Senior Project: Finite element transient thermal analysis of an internal combustion engine

**PROFESSIONAL EXPERIENCE**

- July 2012 – present, Professor, Dept. of Biomedical Engineering, University of Iowa, IA
- July 2012 – July 2014: Director of Graduate Studies, Dept. of Biomedical Engineering, University of Iowa, IA
- Aug 2007 – Present: Director, BioMechanics of Soft Tissues (BioMOST) Research Division, Center for Computer-Aided Design, University of Iowa
- Aug 2006–Jun 2012: Associate Professor, Dept. of Biomedical Engineering, University of Iowa, IA
- Aug 2000– Aug 2006: Assistant Professor, Dept. of Biomedical Engineering, University of Iowa, IA
- Mar 2000 – Aug 2000: Research Assistant Professor, Thayer School of Engr, Dartmouth College
- Sep. 1998 – April 2000: Post-doctoral fellow, Thayer School of Engineering and Section of Vascular Surgery, Dartmouth College

**TEACHING EXPERIENCE** (@ University of Iowa)

<ul style="list-style-type: none"><li>• Sp 14, 51:154, Cardiac and vascular Mechanics</li><li>• Sp 14, 51:191, Seminar in Biomedical Engineering</li><li>• Fall 13, 59:007:BBB, Statics</li><li>• Fall 13, 51:191, Seminar in Biomedical Engineering</li><li>• Sp 13, 51:154, Cardiac and vascular Mechanics</li><li>• Sp 13, 51:191, Seminar in Biomedical Engineering</li><li>• Fall 12, 59:007:AAA, Statics</li><li>• Sp 12, 51:154, Cardiac and vascular Mechanics</li><li>• Fall 11, 51:050, Biomaterials/Biomechanics</li><li>• Fall 11, 59:007:AAA, Statics</li><li>• Fall 11, 59:007:CCC, Statics</li><li>• Sp 11, 51:154, Cardiac and vascular Mechanics</li><li>• Sp 11, 51:086, BME Senior Design-II</li><li>• Fall 10, 51:256, Advanced Biological Soft</li></ul>	<ul style="list-style-type: none"><li>• Fall 06, 51:154 Cardiac and Vascular Mechanics</li><li>• Sp 06, 51:083, Biomechanical Design</li><li>• Fall 05, 51:050, Biomechanics</li><li>• Fall 05, 51:154, Cardiac and Vascular mechanics</li><li>• Sp 05, 51:030, BME Fundamentals</li><li>• Sp 05, 51:254, Advanced Vascular Mechanics</li><li>• Sp 05, 51:130, Genetics and Quantitative Physiology</li><li>• Fall 04, 51:050, Biomechanics</li><li>• Fall 04, 51:154, Cardiac and Vascular mechanics</li><li>• Sp 04, 57:010, Dynamics</li><li>• Fall 03, 51:154, Cardiac and Vascular Mechanics, New course developed in Fall 2002</li></ul>
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<p>Tissue Mechanics</p> <ul style="list-style-type: none"> <li>• Fall 10, 51:085, BME Senior Design-I</li> <li>• Sp 10, 51:086, BME Senior Design-II</li> <li>• Winter 09-10, India Winterim: Sustainable technology in healthcare, environment and sanitation</li> <li>• Fall 09, 51:085, Biomedical Engineering Senior Design I</li> <li>• Fall 09, 59:005, Engineering Problem Solving I</li> <li>• Sp 09, 51:154, Cardiac and Vascular mechanics</li> <li>• Sp 09, 51:090, First Year Forum</li> <li>• Fall 08, [on sabbatical]</li> <li>• Sp 08, 51:090, First Year Forum</li> <li>• Sp 08, 51:191, Seminar in Biomedical Engineering</li> <li>• Fall 07, 51:050, Biomechanics</li> <li>• Fall 07, 51:154, Cardiac and Vascular mechanics</li> <li>• Sp 07, 57:019 Mechanics of Deformable Bodies</li> <li>• Sp 07, 51:050 Biomechanics: theory and design</li> </ul>	<ul style="list-style-type: none"> <li>• Fall 03, 51:050, Biomechanics, (taught 1/3rd of this course)</li> <li>• Sp03, 51:091, Professional Seminar</li> <li>• Sp 03, 51:155, Cardiovascular Biomechanics</li> <li>• Sp 03, 57:010, Dynamics</li> <li>• Fall 02, 51:154, Cardiac and Vascular Mechanics, New course developed in Fall 2002</li> <li>• Fall 02, 51:050, Biomechanics, (taught 1/3rd of this course)</li> <li>• Sp02, 51:091, Professional Seminar</li> <li>• Sp 02, 51:155, Cardiovascular Biomechanics</li> <li>• Sp 02, 57:010, Dynamics</li> <li>• Fall 01, 57:007, Statics</li> <li>• Fall 01, 51:050, Biomechanics (taught 1/3rd of this course)</li> <li>• Sp 01, 57:090, BME Fundamentals (taught 2 lectures for this course)</li> <li>• Sp 01, 51:155, Cardiovascular Biomechanics</li> <li>• Sp 01, 57:010, Dynamics</li> <li>• Fall 00, 51:050, Biomechanics (taught 1/4th of this course)</li> </ul>
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### HONORS AND AWARDS

- 2014: Fulbright Distinguished Chair, Fulbright Foundation
- 2014: Distinguished Alumni Award, Swanson School of Engineering, University of Pittsburgh, Pittsburgh, PA
- 2013: Nominated for University of Iowa College of Engineering Faculty Excellence Award for Research
- 2013: Robert and Virginia Wheeler Fellow Award, University of Iowa
- 2008-present: Reviewer (ad-hoc), National Institutes of Health (MABS, BTSS and BRP study sections)
- 2006: Nominated for the 2006 collegiate teaching award
- 2005: Nominated for the 2005 collegiate teaching award
- 2005: “Mentor Recognition Award” by the University of California San Diego in “recognition of commitment and dedication to mentoring students in their preparation for graduate study”
- 2004: American Heart Association Beginning-grant-in-aid award to study aortic aneurysm disease
- 2004: Basic Science Award in Neurovascular Disease and Endovascular Therapeutics from the American Association of Neurological Surgeons and Congress of Neurological Surgeons (AANS/CNS), 2004 Feb
- 2000: Finalist (one of three), International Young Investigator Competition, Association for the Advancement of Medical Instrumentation, June 2000, San Jose, CA.

### PROFESSIONAL SOCIETIES

- Member, Biomedical Engineering Society (BMES), 2001 – present
- Member, American Society for Mechanical Engineers (ASME), 2001 – Present

**JOURNAL PUBLICATIONS** (last 3 years only; from total of 50 peer-reviewed journal articles)

1. Dillard SI, Mousel JA, Shrestha L, Raghavan ML, Vigmostad SC, "From medical images to flow computations without user-generated meshes", *Int J Numer Method Biomed Eng.* 2014 Epub ahead of print, 2014
2. Retarekar R, Ramachandran M, Berkowitz B, Harbaugh RE, Hasan D, Rosenwasser RH, Ogilvy CS, Raghavan ML, "Stratification of a population of intracranial aneurysms using blood flow metrics", *Comput Methods Biomech Biomed Engin.* 2014 Epub ahead of print, 2014
3. Raghavan ML, Sharda GV, Huston J 3rd, Mocco J, Capuano AW, Torner JC, Saha PK, Meissner I, Brown RD Jr; International Study of Unruptured Intracranial Aneurysms Investigators, "Aneurysm shape reconstruction from biplane angiograms in the ISUIA collection", *Transl Stroke Res*, 5(2):252-9, 2014
4. Amelon RE, Cao K, Reinhardt JM, Christensen GE, Raghavan ML, "A measure for characterizing sliding on lung boundaries", *Ann Biomed Eng*, 42(3):642-50, 2014
5. Monteiro JAT, da Silva ES, Raghavan ML, Puech-Leão P, Higuchi ML, Otoch JP, "Histological, histochemical and biomechanical properties of fragments isolated from the anterior wall of abdominal aortic aneurysms", *Journal of Vascular Surgery*, 59(5):1393-1401, 2014
6. (Invited comment) A Hoppe, ML Raghavan, RE Harbaugh, "Comment RE: Computational Fluid Dynamic Analysis of Intracranial Aneurysmal Bleb Formation", *Neurosurgery*, 73 (6):1068-1069, 2013
7. J Lu, S Hu, ML Raghavan, "A Shell-Based Inverse Approach of Stress Analysis in Intracranial Aneurysms", *Annals of Biomedical Engineering*, 41(7):1505-15, 2013
8. Ramachandran, R, Retarekar R, Harbaugh RE, Hasan D, Policeni B, Rosenwasser R, Ogilvy C, and Raghavan ML, "Sensitivity of Quantified Intracranial Aneurysm Geometry to Imaging Modality", *Cardiovascular Engineering and Technology*, 4(1), 75-86, 2013
9. Azevedo EP, Retarekar R, Raghavan ML, and Kumar V, "Mechanical properties of cellulose: chitosan blends for potential use as a coronary artery bypass graft", *Journal of Biomaterials Science, Polymer Edition*, 24(3): 239-252, 2013
10. Cao K, Christensen GE, Ding K, Du K, Raghavan ML, Amelon RE, Baker KM, Hoffman EA, Reinhardt JM, "Tracking regional tissue volume and function change in lung using image registration", *Int J Biomed Imaging.* 2012 Epub (PMID: 23118740)
11. Ramachandran M, Laakso A, Harbaugh RE, Raghavan ML, "On the role of modeling choices in estimation of cerebral aneurysm wall tension", *J Biomech*, 15;45(16):2914-9, 2012
12. (Invited comment) Harbaugh RE, Raghavan ML, Ramachandran M, Rahman M, Hoh BL, "Comments RE: Ruptured status discrimination performance of aspect ratio, height/width, and bottleneck factor is highly dependent on aneurysm sizing methodology", *Neurosurgery.* 2012 Jul;71(1):45-6.
13. Lin KK, Kratzberg JA, Raghavan ML, "Role of aortic stent graft oversizing and barb characteristics on folding", *J Vasc Surg.*, 55(5):1401-9, 2012
14. Laaksamo E, Ramachandran M, Frösen J, Tulamo R, Baumann M, Friedlander RM, Harbaugh RE, Hernesniemi J, Niemelä M, Raghavan ML, Laakso A., "Intracellular signaling pathways and size, shape, and rupture history of human intracranial aneurysms", *Neurosurgery*, Jun;70(6):1565-72, 2012
15. Hasan DM, Nadareyshvili AI, Hoppe AL, Mahaney KB, Kung DK, Raghavan ML., "Cerebral aneurysm sac growth as the etiology of recurrence after successful coil embolization", *Stroke*, Mar;43(3):866-8, 2012

## BOOK CHAPTERS

- Raghavan ML and da Silva, ES, “Mechanical properties of abdominal aortic aneurysms”, In: Biomechanics and Mechanobiology of Aneurysms Edited by Timothy McGloughlin, Springer Science, Ireland, 2011
- Raghavan ML and Vorp DA, “Aneurysms”, In: Image-based Computational Modeling in the Human Circulatory and Pulmonary Systems Edited by K.B. Chandran, H.S. Udaykumar, and J.M. Reinhardt, Springer Science, Norwell, MA, 2010

## INVENTIONS AND PATENTS

- Dickerhoff B, Kumar V, and Farivar RS, Raghavan ML, “Cellulose-based percutaneous Heart valve Prosthesis”. Patent filed; status: pending.

## GRANTS RECEIVED

1. Principal Investigator, “Bridging engineering and medicine in the study of arterial aneurysms”, Fulbright-Brazil Scientific Mobility Distinguished Chair Award, Aug – May 2015, \$35,000
2. Principal Investigator, “Mechanobiology lab: teaching, training and research”, Carver Charitable Trust, Oct 2012 – Dec 2013, \$325,000
3. Principal Investigator, “Iowa Centers for Enterprise GAP commercialization award”, Sep 2012 – June 2013, \$89,913
4. Principal Investigator, NIH/NHLBI, “ARRA supplement: Assessment of intracranial aneurysm shape as an indicator of rupture risk”, July 2009 – Jun 2011, \$232,992
5. Co-Investigator (PI: James Torner, Epidemiology), NIH/NINDS, “CG1: Predictors of Long-Term Outcome of Unruptured Intracranial Aneurysms”, Sep 09-Sep 11, \$220,000
6. Co-investigator (PI: Kumar, Pharmaceuticals), CTSS seed funding to develop tissue engineered vascular grafts, 2009-2010, \$50,000
7. Principal Investigator, NIH/NHLBI, “Assessment of intracranial aneurysm shape as an indicator of rupture risk”, Aug 2007 – Aug 2013, \$2,724,751
8. Principal Investigator, NIH/NHLBI, “Study of design variables of endovascular graft”, Jan 2007 – Dec 2008, \$221,250
9. Co-Investigator (PI: Reinhardt, BME), NIH/NHLBI, “Regional Lung Mechanics by 3D Image Registration”, Jul 2006 – Dec 2011,
10. Co-investigator, Industry, “Testing of ultrasonic heart valves”, Mar 2006 – Aug 2006, \$15,000
11. Principal Investigator, Industry, “Flow loop testing of prosthetic heart valves”, June 2005 – Aug 2005, \$9800 (PI: Chandran)
12. Principal Investigator, Industry, “Venogram contrast injection”, Jan 2005 – July 2005, \$19,404
13. Principal Investigator, Failure strength distribution of abdominal aortic aneurysm, American Heart Association, July 2003 – June 2005, \$121,000,
14. Principal Investigator, Graduate Student Summer Support, Year-end funds from graduate college, May – July 2003, \$5111
15. Principal Investigator, Understanding the mechanisms of aneurysm growth, Collaborative Interdisciplinary Proposal, Office of VPR, University of Iowa, Jan 1, 2003 – Dec 31, 2003, \$24,550, 85002902, 15%
16. Principal Investigator, Cost-sharing towards purchase of a uniaxial extension testing machine for cardiovascular Lab, Discretionary funds from the Office of the Vice President for research, May 24, 2001, \$5,737, 100%
17. Principal Investigator, Cost-sharing towards purchase of a uniaxial extension testing machine for

- cardiovascular Lab, BME Indirect Cost Recovery Fund, April 24, 2001, \$2,431, , 100%
18. Principal Investigator, Autopsy studies on the biomechanical properties of abdominal aortic aneurysm, NSF, Jul 01 – Dec 01, \$7,808.00, 1 51887, 100%
  19. Co-Investigator (PI on subcontract), Role of biomechanics in abdominal aortic aneurysm growth and rupture, NIH, Oct 00-Aug 02, \$54,207.34 (Project PI: Fillinger)
  20. Principal Investigator, Evaluation of a biomechanical approach to predicting the rupture of abdominal aortic aneurysm, Hitchcock Foundation, Jul 99-Jun00, \$12,500

## RESEARCH MENTORSHIP EXPERIENCE

- Post doctoral fellows mentorship
  - Jan 2013 – present, Aditya Badheka, MD, Pediatric Intensive Care Fellow
  - Aug 2012 – present, Govinda Paudel, MD, Pediatric Cardiology Fellow
  - June 2010 – Aug 2011, Alexander Nadareyshvili, Ph.D., Post doctoral fellow
- Ph.D. candidates (research mentor)
  - May 2012 – present, Chaid Schwarz, Stent graft modeling
  - May 2012 – present, Timothy Chung, Aortic aneurysm modeling
  - May 2012 – present, Ben Berkowitz, Cerebral aneurysm modeling
  - Aug 2010 – present, Anna Hoppe, Mechanics of embolization coils
  - May 2014 – present, Nasibeh Hassanlou, Pulmonary flow in Tetralogy of Fallot patients
  - Fall 08 – December 2012, Rohini Retarekar, Cerebral aneurysm hemodynamics; Graduated Spring 2012; Now: R&D Engineer, Microvention, Tustin, CA
  - Fall 08 – July 2012 Ryan Amelon, Pulmonary biomechanics and device design; Graduated Summer 2012; Now: Product Engineer, IDx Inc., Coralville, IA
  - Fall 07 – May 2012, Manasi Ramachandran, Cerebral aneurysm geometric and tissue mechanics modeling; Graduated – May 2012; Now: R&D Engineer, Covidien Inc.
  - Fall 07 – May 2012, Kathleen Lin, Endovascular graft design; Graduated – May 2012; Now: Design engineer, Med Institute, Cook medical Corp.
  - Fall 02 – Fall 08, Jarin Kratzberg, Design of endovascular graft; Graduated May 2008; Now: Senior Engineer, Med Institute, Cook Medical Corp
  - Fall 00 – Sp04, Baoshun Ma, Curvature distribution in cerebral aneurysm; Graduated Dec 2004; Now: Research Scientist, University of Vermont
- M.S. candidates (research mentor)
  - Mentoring 1 MS candidate currently; 10 MS degree holders have been mentored to graduation; current status of graduates include: employed in medical device industry (5), pursuing Ph.D. or M.D. (4), and employed as a physician (1).
- B.S. candidates (research mentor)
  - 25 undergraduate students have spent at least 6 months in my lab

## HIGHLIGHTS OF SERVICE ACTIVITIES (activities of last 2 years listed below)

- Organizer, Cerebral Aneurysm Minisymposium, 2014 World Congress of Biomechanics, Boston, MA
- June 2012 – July 2014: Director of Graduate Studies, Department of Biomedical Engineering
- Chair, University of Iowa Information Technology Committee, 2013-2014
- NIH Reviewer (ad-hoc)
- Member, University of Iowa Information Technology Committee, 2011-present