

CURRICULUM VITAE
Sarah C. Vigmostad

Contact Information

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Education

2007 Ph.D., Biomedical Engineering
 Thesis Title: *A Sharp Interface Fluid-Structure Interaction Model for Bioprosthetic Heart Valve Dynamics*
 The University of Iowa, Iowa City, IA

2003 M.S., Biomedical Engineering
 Thesis Title: *Hemodynamics and Wall Thickness in Relation to Localized Geometric Changes in the Coronary Arteries*
 The University of Iowa, Iowa City, IA

2001 B.S., Biomedical Engineering
 The University of Iowa, Iowa City, IA

Professional Experience

2008-Present	<u>Assistant Professor</u> ,	Dept of Biomedical Engineering & IIHR The University of Iowa
Jun -Aug, 2008	<u>Adjunct Faculty</u> ,	Dept of Biomedical Engineering, The University of Iowa
Jan -Aug, 2008	<u>Post-Doctoral Researcher</u> ,	Dept of Biomedical Engineering, The University of Iowa

Scientific and Professional Societies:

- Member, Biomedical Engineering Society
- Member, American Society of Mechanical Engineering (*SBC Fluid Dynamics Committee, SBC Education Committee*)
- Member, American Society for Engineering Education
- Member, Intl Society for Applied Cardiovascular Biology (*Ad Hoc Webinar & Podcast Committee*)
- Member, Society of Women Engineers (*Faculty Advisor, University of Iowa SWE Chapter*)

Research Summary:

My research area is **computational biomechanics**. My focus is on developing and applying computational methodologies for the study of disease formation and progression, improving disease treatment options and prosthetic device designs, and identifying biomechanics-related risk factors for diseases. My research efforts focus on developing a user-friendly **multi-scale, fluid-structure interaction computer modeling package** that can be applied to a multitude of biomedical problems. I believe there are many applications for computational work in biomechanics, including the **understanding of disease progression**, the development of **improved treatment modalities**, and as a **tool for physicians** to use in determining therapeutic options. I have employed the computational models developed by my group in the study of bioprosthetic and bicuspid aortic valve dynamics, aortic arch hemodynamics, mitral valve mechanics, micro-scale modeling of RBCs (using NURBS isogeometric modeling to enable multi-scale coupling), and the acoustics and fluid dynamics of voice production. More recently, in an effort to create more user-friendly and widely applicable modeling tools, my group has developed imaging-to-modeling and **movie-to-modeling** capabilities using a level-set based segmentation algorithm and optical flow techniques. This has enabled more straight-forward implementation of patient-specific 3D & 4D data, the first step in developing **virtual surgical tools** for better treatment planning.

Present Research Interests

- Fluid-Structure Interaction Modeling and Applications including blood cell dynamics, valve mechanics, voice Production, and cancer metastasis.
- Multiscale modeling and experiments including with red blood cell/platelet dynamics and cancer cell modeling.
- Imaging to simulation of patient-specific models with coronary artery modeling in 4D, aorta dynamics in dissection and bicuspid valve geometries, and mitral valve virtual surgery.

Teaching Experience

Classes Taught:

- Engineering Fundamentals 1: Statics
- Design of Artificial Organs and Circulatory Devices
- Biomedical Engineering Senior Design
- Biomaterials/biomechanics
- Mechanics of Cells and Cellular Systems
- First Year Seminar: Engineering Human Circulatory Implants (Honors Section)
- Leadership and Resourcefulness

Teaching Workshops (as Organizer or Speaker):

- *Learning through Games* (**Facilitator**), The University of Iowa (Summer 2014).
- *Iowa Governor, Lt Governor Visit U of Iowa* (**Invited by Faculty Senate to Speak**) Showcase of how BME Senior Design & IMIG enable students to be entrepreneurs, and have an impact on University & State of Iowa. Included two BME students in presentation (May, 2014).
- *STEM in TILE Workshop* (**Instructor, Organizer for Two-Day Workshop**), ITS & College of Engineering, The Univ of Iowa, Iowa City, Iowa (November 2013).
- *University of Iowa TILE Workshop* (**Guest Instructor**), Overview of my teaching experiences, advice, and best practices for teaching in TILE class (Nov, 2013)
- *Engineering Lecture & Something More*, (**Invited Speaker**) Overview of my teaching experiences, advice, and best practices for teaching in flipped classroom (Oct, 2013)
- *Flipping the classroom: Why to try it and how to start* (**Instructor, Organizer**), UI College of Dentistry Faculty Workshop (Summer 2013).
- *Flipping the K-12 Classroom*, (**Guest Instructor**), Provost's Office & ITS, Iowa City, Iowa. (August 2013).
- *Flipping the K-12 Classroom* (**Instructor**), MSAE K-12 School (Summer 2013).
- *University of Iowa TILE Workshop* (**Guest Instructor**), Overview of my teaching experiences, advice, and best practices for teaching in TILE class (Mar, 2013)
- *Iowa Governor, Lt Governor First Visit to U of Iowa* (**Invited by Provost's Office to be Instructor**), I lead a *one-hour* demonstration for Governor, Lt. Governor, and 30 student government representatives of inquiry-guided learning using Design of Cardiovascular Implants as topic. (Mar, 2013)

Honors and Awards

- **James L. Murray Award**, given to one UI tenure-track faculty member for demonstrating outstanding rapport with students and creating an exemplary classroom atmosphere, April 2014.
- University of Iowa College of Engineering **Outstanding Teacher Award** Recipient, 2013
- **Women in Innovation Finalist**, Technology Association of Iowa, 2013
- Recognized by graduating seniors for excellence in teaching and dedication to student success, Dec 2012
- Student (VK Chivukula) won BME Best Poster Award at Engineering Open House, 2013
- Student (L. Shrestha) won Third Place: at ASME Summer Bioengineering Conference MS Student Paper Competition, 2011

- First Place, US National Congress on Computational Mechanics Ph.D. Student Competition, Biotechnology Division, 2007
- Hancher-Finkbine Medallion Recipient, 2006
- Third Place: ASME Summer Bioengineering Conference Ph.D. Student Paper Competition, 2006
- First Place: University of Iowa Jakobsen Graduate Forum, Math, Physical Sciences & Engineering, 2004
- First Place: University of Iowa Engineering Research Open House Poster Session, 2006
- First Place: University of Iowa Engineering Research Open House Poster Session, 2003
- Second Place: University of Iowa Jakobsen Graduate Conference, Math, Physical Sciences &
- U.S. National Congress on Computational Mechanics Student Travel Fellowship, 2005
- American Society of Artificial Internal Organs Biomedical Engineering Student Travel Fellowship, 2004

Research Highlights

Publications:

1. V. Chivukula, J. Mousel, J. Lu, and S. **Vigmostad**, "Micro-scale Blood Particulate Dynamics Using a NURBS-Based Isogeometric Analysis," International Journal of Numerical Methods in Biomedical Engineering DOI: 10.1002/cnm.2666, online August 2014.
2. S. Dillard, J. Mousel, L. Shrestha, M.L. Raghavan, **S.C. Vigmostad**, "From medical images to flow computations without user-generated meshes." International Journal of Numerical Methods in Biomedical Engineering. DOI: 10.1002/cnm.2644, online April 2014.
3. S. Dillard, J. Buchholz, **S. Vigmostad**, H. Kim, H.S. Udaykumar, "Techniques to derive geometries for image-based Eulerian computations", Engineering Computations, Vol. 31 Iss: 3, pp.530 – 566, 2014.
4. Klemuk, S., **Vigmostad, S.**, Endapally, K., Wagner, A., Titze, I. "A Multiwell Disc Appliance Used to Deliver Quantifiable Accelerations and Shear Stresses at Sonic Frequencies," Processes," 2(1), pp.71-88, 2014.
5. M.H. Farahani, J. Mousel, F. Alipour, and **S. Vigmostad**, "A Numerical and Experimental Investigation of the Effect of False Vocal Fold Geometry on Glottal Flow," Journal of Biomechanical Engineering, 135(12), pp.121006 (11 pages) 2013.
6. K.B. Chandran and **S.C. Vigmostad**, "Patient Specific Bicuspid Valve Dynamics: An Overview of Methods and Challenges," Journal of Biomechanics, 46(2), pp.208-16, 2013.
7. E. K. Shang, D. P. Nathan, S.R. Sprinkle, **S C Vigmostad**, R.M. Fairman, J.E. Bavaria, R. C Gorman, J. H. Gorman, , Benjamin M Jackson, "Peak Wall Stress Predicts Expansion Rate in Descending Thoracic Aortic Aneurysms," Journal of Vascular Surgery, 95 (2), pp.593-98, 2013.
8. T. AlMamani, **S. C. Vigmostad**, V.K. Chivukula, LA Alzube, O. Smadi: "Red Blood Cell Flow in the Cardiovascular System: A Fluid Dynamics Perspective." Critical Reviews of Biomedical Engineering. 40(5), pp. 427-40, 2012.
9. F. Alipour and **S.C. Vigmostad**, "Measurement of Vocal Folds Elastic Properties for Continuum Modeling," Journal of Voice, 26(2), 2012.
10. T. AlMamani, **S. C. Vigmostad**, L. Alzube, "A Sharp-Interface Fluid-Structure Interaction Algorithm for Modeling Red Blood Cells. Jordan Journal of Mechanical and Industrial Engineering," Vol 6 (2), pp. 193-98, 2012.
11. **S.C. Vigmostad**, H.S. Udaykumar, Fluid Structure Interaction Development, in Image-based computational modeling in the human circulatory and pulmonary systems, Chandran, KB, Reinhardt, JM, and Udaykumar, HS, eds
12. F. Alipour, S. Jaiswal, **S.C. Vigmostad**, "Vocal fold elasticity of pig, sheep and cow larynges", Journal of Voice, Vol 25, 2, pp.130-6, 2011.
13. **S. C. Vigmostad**, H.S. Udaykumar, J. Lu, K.B. Chandran, "Fluid Structure Interaction Methods in Biological Flows with Special Emphasis on Heart Valve Dynamics," Communications in Numerical Methods in Engineering, Vol 26, 3-4, pp435-70, 2010.

14. G. C. Engelmayr, L. Soletti, **S. C. Vigmostad**, S. G. Budilarto, W. Federspiel, K. B. Chandran, D. A. Vorp, and M. S. Sacks. "A Novel Flex-Stretch-Flow Bioreactor for the Study of Engineered Heart Valve Tissue Mechanobiology." *Annals of Biomedical Engineering*, pp. 700-12, 2008.
15. K. B. Chandran, A. Wahle, **S. C. Vigmostad**, M. E. Olszewski, J. D. Rossen, M. Sonka: "Coronary Arteries: Imaging, Reconstruction, and Fluid Dynamic Analysis." *Critical Reviews in Biomedical Engineering*, Vol 1, Begellhouse, New York, pp. 23-103, 2006.
16. Wahle, J. J. Lopez, M. E. Olszewski, **S. C. Vigmostad**, K. B. Chandran, J. D. Rossen, M. Sonka: "Plaque Development, Vessel Curvature, and Wall Shear Stress in Coronary Arteries assessed by X-ray Angiography and Intravascular Ultrasound." *Medical Image Analysis - Functional Imaging and Modeling of the Heart*, 10, pp. 615-31, 2006.
17. S. D. Ramaswamy, **S. C. Vigmostad**, A. Wahle, Y.G. Lai, M. E. Olszewski, K. C. Braddy, T. M. H. Brennan, J. D. Rossen, M. Sonka, and K. B. Chandran: "Comparison of Left Anterior Descending Coronary Artery Hemodynamics before and after Angioplasty." *Journal of Biomechanical Engineering*, 128, pp.40-48, 2006.
18. S. D. Ramaswamy, **S. C. Vigmostad**, A. Wahle, Y-G. Lai, M. E. Olszewski, K. C. Braddy, T. M. H. Brennan, J. D. Rossen, M. Sonka, and K. B. Chandran: "Fluid dynamic analysis in a human left anterior descending coronary artery with arterial motion." *Annals of Biomedical Engineering*, 32(12), pp. 1628-41, December 2004.

Patents:

1. Kim, H, Rim, Y, Choi, A, McPherson, D, **Vigmostad, S.** System and Methods for Selecting, Modeling, and Analyzing Mitral Valve Surgical Techniques U.S. Patent Application 14/318,344, filed June 2014. Patent Pending.
2. Henry, M, **Vigmostad, S.** Diagnostic device for measuring fluid shear stress resistance in cancer cells. Provisional Patent Application In Preparation, September 2014.

Invited Lectures:

1. A Closer Look at Blood Flow: Fluid-Structure Interaction Modeling and Multiscale Hemodynamics (**Invited Speaker**), Penn State University Bioengineering Department, State College, PA (March, 2014).
2. Speaking from the Heart: Examining Physiologic Function using Computational Modeling – From Voice Mechanics to Multiscale Hemodynamics (**Invited Speaker**), University of Pittsburgh Bioengineering Department, Pittsburgh, PA (February, 2014).
3. Fluid-Structure Interaction Modeling of Physiologic Phenomena: Challenges and Current Methodology (**Invited Speaker**), Ohio State University, BME, Columbus, Ohio. (May 2012).
4. Fluid-Structure Interaction Modeling of Physiologic Phenomena: Challenges and Solutions (**Seminar Speaker**), CBE Grad Seminar, Iowa City, Iowa. (November 2010).
5. Fluid Structure Interaction Modeling of Physiologic Phenomena: Challenges and Solutions (**Invited Speaker**), NASA, Houston, Texas. (August 2010).
6. Computational Tools for Design and Optimization of Heart Valves (**Invited Speaker**), Design of Medical Device Conference, Minneapolis, MN (April, 2010).
7. Understanding Voice Production in Healthy and Pathological States Through Computational Modeling: A Discussion of Proposed Research (**Seminar Speaker**), BME Grad Seminar, Iowa City, Iowa. (December 2009).

Conference Presentations:

1. Chivukula, VK, Nauseef, JT, Henry, M, **Vigmostad, SC** (2014), *Investigating the response of cancer cells to fluid shear stress using a micropipette aspiration technique*, World Congress of Biomechanics, Boston, MA.

2. Govindarajan, V, Mousel, J., Burken, J., Shrestha, L, Chandran, KB, **Vigmostad, SC** (2014), *A Parametric Study of the Effects of BAV Morphology on Aortic Hemodynamics and Wall Stress*, **Invited**: World Congress of Biomechanics, Boston, MA.
3. Gade, P., Rim, Y, Choi, A, Magnotta, V, Grosland, N, Kim, H, **Vigmostad, SC**. (2014) *Towards the Development of a Surgical Simulation Tool for Mitral Valve Repair Surgery*, **Invited**: World Congress of Biomechanics, Boston, MA.
4. Chivukula, K. C., Henry, M., Chandran, K. B. and **Vigmostad, S**. *Determining elastic properties of cancer cells using a micropipette aspiration technique*. 2013 BMES Annual Conference, Seattle, WA.
5. Farahani, M., Mousel, J., Alipour, F., **Vigmostad, S**. (2013). *Proceedings of the 10th International Conference on Advances in Quantitative Laryngology, Voice and Speech Research* (vol. 10, pp. 55-56). AQL Press.
6. Farahani, M., Mousel, J., **Vigmostad, S**. (2013). *A Study on the Effect of False Vocal Folds Gap Size on the Self-Sustained Oscillation of True Vocal Folds* (vol. 1B). ASME 2013 Summer Bioengineering Conference.
7. Dillard, S., Mousel, J., Shrestha, L., Raghavan, M. L., **Vigmostad, S**. (2013). *Image Based Flow Computations without User Generated Meshes* (vol. 1A). ASME 2013 Summer Bioengineering Conference.
8. Govindarajan, V., Mousel, J., **Vigmostad, S.**, Udaykumar, H. S., Levack, M. M., Gorman, J., Jackson, B., Gorman, R., Chandran, K. B. (2013). *Patient-Specific Valve Dynamics Using 3D Fluid-Structure Interaction Modeling: Comparison between Bicuspid and Tricuspid Aortic Valves* (vol. 1B). ASME 2013 Summer Bioengineering Conference.
9. Shrestha, L, J Burken, D Calcaterra, **S Vigmostad**: *Hemodynamics in the Aortic Arch and the Relationship to Rupture During Type-A Dissection*. 2012 BMES Annual Conference, Atlanta, GA.
10. D. Calcaterra, M. Bashir, J.W. Turek, J. Burken, **S.C. Vigmostad**, *Follow-up on 74 patients and computational aortic flow model predicting wall stresses in root, ascending aorta, and arch*. Aortic Symposium, May 2012, New York, NY.
11. **S.C. Vigmostad**, J.A. Burken, K.B. Chandran, *Flow Development Past Bicuspid Aortic Valves and the Relationship to Ascending Aortic Pathology*, International Biofluids Symposium, Israel, March, 2012.
12. Shang, E.K., Nathan, D. P., **Vigmostad, S.**, Fairman, R. M., Gorman, R. C., Gorman III, J. H., Chandran, K. B., and Jackson, B. *The impact of wall thickness and saccular geometry on the computational wall stress of descending thoracic aortic aneurysm*. AHA Annual Conference, 2012.
13. V. Govindarajan, H.S. Udaykumar, **S.C. Vigmostad**, M.M. Levack, J.H. Gorman, B.M. Jackson, R.C. Gorman, K.B. Chandran, *Fluid Structural Interaction of A Patient Specific Congenital Bicuspid Aortic Valve*. ASME Summer Bioengineering Conference 2012, June 2012, Fajardo, PR
14. V. Chivukula, J. Lu, **S.C. Vigmostad**, *RBC Modeling Using a NURBS Based Stress Analysis Method*. ASME Summer Bioengineering Conference 2012, June 2012, Fajardo, PR
15. M. Farahani, J. Mousel, F. Alipour, **S.C. Vigmostad**, *Influence of the False Vocal Fold Gap on the Glottal Flow Jet*, ASME Summer Bioengineering Conference , June 2012, Fajardo, PR.
16. L. Shrestha, J. Garvin, R.W. Downe, M. Sonka, A. Wahle, **S.C. Vigmostad**, *CFD Study on the Effects of Branch Sizes in Human Coronary Arteries*, ASME Summer Bioengineering Conference 2011, June, 2011.
17. M. Farahani, F. Alipour, **S.C. Vigmostad**, *Pressure Distribution and Vortex Structures in a Rigid Model of Human Larynx*, AIAA 2011 Hawaii Conferences, June, 2011
18. **S. C. Vigmostad**, H.S. Udaykumar, K.B. Chandran: *Computational Simulations of Bioprosthetic Heart Valves: Challenges and Solutions*. International Biofluids Symposium, CalTech, 2008.
19. **S. C. Vigmostad**, S. Krishnan, H.S. Udaykumar, K.B. Chandran: *Simulations of Bioprosthetic Heart Valve Dynamics Using a Sharp Interface Method*. BMES, 2007.

20. **S. C. Vigmostad**, S. Krishnan, H.S. Udaykumar, K.B. Chandran: Development and Validation of a Strongly Coupled Approach for Heart Valve Simulations. 9th US National Conference on Computational Mechanics, 2007.
21. **S. C. Vigmostad**, B. Jeffrey, S. Krishnan, H.S. Udaykumar, K.B. Chandran: Simulations of Bioprosthetic Heart Halve Dynamics Using a Sharp Interface Method. 2007 Summer Bioengineering Conference, American Society of Mechanical Engineers.
22. **S. C. Vigmostad**, A. Wahle, M. E. Olszewski, K. C. Braddy, T. M. H. Brennan, J. D. Rossen, M. Sonka, K. B. Chandran: Effect of local geometry on the fluid dynamics of coronary artery segments with stent implants. Fifth World Congress of Biomechanics, 2006.
23. **S. C. Vigmostad**, B. Jeffrey, S. Krishnan, H.S. Udaykumar, K.B. Chandran: A Novel, Efficient Fluid-Structure Interaction Algorithm for Dynamic Bioprosthetic Heart Valve Simulations. 2006 Summer Bioengineering Conference, American Society of Mechanical Engineers.
24. **S. C. Vigmostad**, S. Marella, H. S. Udaykumar, K.B. Chandran: A Fluid-Structure Interaction Model for a Bioprosthetic Heart Valve Using a Sharp Interface Fixed Grid Method. American Physical Society, Division of Fluid Dynamics Annual Meeting, 2005.
25. **S. C. Vigmostad**, B. Jeffrey, S. Marella, J. Lu, H.S. Udaykumar, K.B. Chandran: A Sharp Interface Fixed Grid Fluid-Structure Interaction Model for a Bioprosthetic Heart Valve. BMES Annual Fall Meeting, 2005.
26. **S. C. Vigmostad**, S. Marella, H. S. Udaykumar, K.B. Chandran: A Sharp Interface Fluid-Structure Interaction Model for a Hyperelastic Membrane. 8th US National Congress on Computational Mechanics, 2005.
27. **S. C. Vigmostad**, S. Marella, H. S. Udaykumar, K.B. Chandran: A Sharp-Interface Fluid-Structure Interaction Model for a Bioprosthetic Heart Valve. 2005 Summer Bioengineering Conference, American Society of Mechanical Engineers.
28. M. E. Olszewski, A. Wahle, **S. C. Vigmostad**, M. Sonka: Multidimensional Segmentation of Coronary Intravascular Ultrasound Images using Knowledge-Based Methods. Medical Imaging 2005: Image Processing, SPIE Proceedings (2005).
29. J. J. Lopez, A. Wahle, M. E. Olszewski, S. Gualano, S. W. Bokhari, J. G. Bennett, **S. C. Vigmostad**, R. Medina, M. Sonka: Differential Effects of Coronary Stenting on Calcified and Non-Calcified Vessels: Reanalysis of the Mechanism of Lumen Enlargement by Quantitative Analysis of Plaque Redistribution with 3-D IVUS/Angiography Fusion. Society for Cardiovascular Angiography and Interventions, 28th Annual Scientific Sessions, Ponte Vedra FL, Catheterization and Cardiovascular Interventions, Suppl. (2005).
30. Wahle, J. J. Lopez, M. E. Olszewski, **S. C. Vigmostad**, K. B. Chandran, J. D. Rossen, M. Sonka: Analysis of the Interdependencies among Plaque Development, Vessel Curvature, and Wall Shear Stress in Coronary Arteries. FIMH '05, Third International Conference on Functional Imaging and Modeling of the Heart, Frangi AF, Radeva PI, Santos A, Hernandez M (eds), Barcelona, Lecture Notes in Computer Science, Springer (2005).
31. Wahle, J. J. Lopez, M. E. Olszewski, **S. C. Vigmostad**, K. C. Braddy, T. M. H. Brennan, S. W. Bokhari, J. G. Bennett, E. M. Holper, J. D. Rossen, K. B. Chandran, M. Sonka: Relationship between Plaque Development and Local Hemodynamics in Coronary Arteries. Medical Imaging 2005: Physiology, Function, and Structure from Medical Images, SPIE Proceedings.
32. Wahle, J. J. Lopez, M. E. Olszewski, **S. C. Vigmostad**, K. C. Braddy, T. M. H. Brennan, S. W. Bokhari, J. G. Bennett, E. M. Holper, J. D. Rossen, K. B. Chandran, M. Sonka: Inverse Relationship between Local Wall Shear Stress and Plaque Thickness in Coronary Arteries is Retained by Compensatory Enlargement in Early Atherosclerosis. American College of Cardiology, 54th Scientific Sessions, Orlando FL, Journal of the ACC, Suppl. Volume 45, Number 3/A, Page 416A, Abstract 1126-138, February 2005.
33. **S. C. Vigmostad**, S. Marella, S. Krishnan, H. S. Udaykumar, and K. B. Chandran: Simulation of fluid dynamics of bioprosthetic heart valves on fixed Cartesian Meshes. BMES Annual Fall Meeting, 2004.
34. **S. C. Vigmostad**, A. Wahle, M. E. Olszewski, K. C. Braddy, T. M. H. Brennan, J. D. Rossen, M. Sonka, K. B. Chandran: Hemodynamics in Stented Human Coronary Arteries with Implications to Restenosis. BMES Annual Fall Meeting, 2004.

35. Wahle, M. E. Olszewski, **S. C. Vigmostad**, R. Medina, A. U. Coskun, C. L. Feldman, P. H. Stone, K. C. Braddy, T. M. H. Brennan, J. D. Rossen, K. B. Chandran, M. Sonka: Quantitative Analysis of Circumferential Plaque Distribution in Human Coronary Arteries in Relation to Local Vessel Curvature. 2004 IEEE International Symposium on Biomedical Imaging, IEEE Press.

Funding Support Summary

1. "Mitral valve dynamic analysis and potential clinical applications," Sponsored by NIH (Co-PI, R01), \$610,000.00. (August 2011 - July 2015).
2. "Development of Realistic Computational Models of Spaceflight Effects on Human Physiology," Sponsored by Iowa Space Grant Consortium (PI) \$150,000.00. (September 2011 - July 2015).
3. "Prototype diagnostic device for measuring fluid shear stress resistance in cancer cells" Sponsored by Iowa Centers for Enterprise Commercialization Gap Fund (Co-PI) \$75,000.00. (September 2013 - August 2014).
4. "Can Computational Biomechanics Guide Mitral Valve Repair?" Sponsored by VPR, Univ. of Iowa (PI) (IFI Grant), \$25,000.00. (January 2013 - June 2014).
5. "Mechanobiology Laboratory," Sponsored by Carver Charitable Trust, \$550,000.00. Co-PI, (November 2012 - May 2014).
6. "Enhancing Student Learning in Transport Phenomena Related Engineering Courses Through Web-Accessed Computational Thermal-Fluid Modeling Tools," Univ of Iowa Innovations in Teaching Award, (Co-PI), \$25,000.00. (December 2013 - December 2014).
7. "Development of a Mechanobiology Laboratory," Carver Charitable Trust, (Co-PI), \$525,000 (Nov 2012 – Nov 2014).
8. "Online Course Pilot Study," Sponsored by DCE & College of Engineering, \$50,000.00. (Co-PI), (October 2012 – December 2013).
9. "Multiscale Modeling of Thrombus Initiation in Cardiovascular Prostheses," Sponsored by NIH (Co-I, R21), \$418,718.00. (March 1, 2011 - March 1, 2013).
10. "The Role of Hemodynamic Forces in Cancer Cell Metastasis," Sponsored by American Cancer Society Seed Grant (PI), \$30,000.00. (January 1, 2011 - December 31, 2011).
11. Faculty Support Fund Fellowship, Sponsored by Provost's Office, (PI), \$3500, (Summer, 2010).
12. Old Gold Fellowship, Sponsored by Provost's Office, (PI), \$6000, (Summer, 2010).
13. "Laboratory for Multi-Scale Modeling of Biomedical Systems," Sponsored by Carver Charitable Trust (Co-I, Equipment Only Grant), \$250,000. (Nov, 2010 - Nov, 2012).
14. "Understanding Voice Dynamics using Computational Mechanics," Sponsored by VPR, Univ of Iowa (PI, IFI Grant), \$20,000, (Sept 2009 – Aug 2010).

Details of Currently Funded Projects

1. NIH R01: NHLBI – HL109597

9/11 – 8/16

Mitral valve Dynamic Analysis and Potential Clinical Applications

The major goals of this project is to develop dynamic structural and fluid computational analysis to assess the dynamics of mitral valve function from patient-specific geometries obtained with TEE imaging. The dynamics of the mitral valve pre- and post-valve repair will be analyzed through computational simulations to assess the efficacy of repair techniques.

Role: Co-PI of a subcontract from the University of Texas Medical Center

2. Iowa Space Grant Consortium Early Career Award

8/11 – 7/15

Development of Realistic Computational Models of Spaceflight Effects on Human Physiology

This funding has supported the significant advancement of computational tools for incorporating in vivo imaging data into computational simulations. This work focuses on the development of image-based fluid-structure interaction modeling, tools for incorporating in vivo imaging data into computational simulations, specifically focusing on the bladder. In the urinary bladder, urinary retention, urinary tract infections, and other

problems have been frequently reported during spaceflight. Through the computational model under development, we can employ medical image data obtained on the International Space Station, and quantify detailed organ-level dynamics, including bladder wall stresses, pressure in the bladder and velocity of the urine, and other important measures that impact how the bladder functions and whether its performance is optimal for health and is responsive to environmental changes.

Role: Principal Investigator

3. Iowa Centers for Enterprise Commercialization Gap Fund

9/13 – 8/14

Prototype diagnostic device for measuring fluid shear stress resistance in cancer cells

We have recently discovered that cancer cells from many tumor types exhibit resistance to fluid shear stress (FSS) applied in a simple microfluidic assay. The UIRF has filed a patent application on this discovery, on behalf of my collaborator, Dr. Henry (PCT/US2012/030034). There exists the potential that this assay can be used for clinical diagnostic purposes in routine needle biopsy or circulating tumor cell specimens from cancer patients for one or both of the following applications: 1) To enhance the prognostic value of specimens; and 2) To predict which among available therapeutics might be more efficacious in that patient. *The purpose of this funding is to develop a prototype device for semi-automated measurement of FSS resistance in cell suspension preparations from tumor biopsy material.* It is envisioned that once the clinical relevance of FSS resistance has been established and a prototype device for making FSS resistance measurements exists, further commercial development of our discovery can be actively pursued.

Role: Co-PI

4. UI OVPR Internal Funding Initiative Seed Grant

1/13 – 6/14

Can Computational Biomechanics Guide Mitral Valve Repair?

While it is estimated that an experienced surgeon can effectively repair 95-100% of mitral valve (MV) disorders, a recent study found that the average MV repair rate is 41%. Our long-term goal is to enhance patient-specific MV repair rates and outcomes by improving diagnostic capabilities and simulating surgical pathways. Our central hypothesis is that providing surgeons with a priori knowledge of the post-repair dynamics of a diseased MV will lead to improved surgical decision-making and an increased MV repair rate. In this current project, we will further develop and employ computational tools to develop, validate, and test our approach for imaging-to-modeling-to-virtual repair capabilities to improve outcomes and guide surgical decision-making in the treatment of mitral valve disease.

Role: Principal Investigator

5. Carver Charitable Trust

10/12 - 11/14

Mechanobiology lab: teaching, training and research

The goal of this project is to develop a laboratory devoted to the field of experimental mechanobiology – the study of how cells, bodily fluids and tissues respond to mechanical stimuli. The lab will be housed with state of the art biomechanical test apparatus and may be used for both research and laboratory teaching sessions within courses offered by the department of biomedical engineering.

Role: Co-Principal Investigator

Student Mentoring

Post-Doctoral Student Supervision

1. Seth Dillard, Imaging-to-Flow (50%, 2012-14; Now Lecturer and Research Scientist, Univ of Iowa)
2. John Mousel, Fluid-Structure Interaction Optimization (50%, 2013-14; Now Sr Scientist, NUMECA Intl)

PhD Dissertation Supervision

4. Aaron Goddard, Bicuspid Aortic Valve Dynamics (May 2014 – Present)
3. Liza Shrestha, GUI-Based Imaging to Computation (January 2011 - Present)
2. Venkat Keshav Chivukula, RBC & Cancer Cell Modeling (August 2010 - February 2014; now Post-Doc at OHSU, Portland, OR)
1. Mehrdad Farahani, "False Vocal Fold Dynamics" (August 2009 - November 2013; now Post-Doc at UCLA, Los Angeles, CA)

MS Student Supervision

6. Moustafa Ibrahim, Bicuspid Aortic Valve Dynamics (August 2013 – Present)
5. Piyusha Gade, Virtual Surgery for Mitral Valves (January 2013 – August 2014)
4. Jennifer Burken, BAV hemodynamics (August 2010 - May 2012)
3. (Non-thesis) Kalyan Endapally, Microscale Cell Mechanics Modeling (August 2009 - July 2011)
2. (Non-thesis) James Arter, Commercialization in Medical Device Design (May 2010 - May 2011)
1. Liza Shrestha, Branching in Coronary Artery Hemodynamics (August 2008 - December 2010)

Other Student Mentoring & Additional Graduate Thesis Committees

- Iowa Medical Innovations Group Advisor (2009-Present)
- Society of Women Engineers, UI Chapter, Faculty Advisor (2012 – Present)
- PhD Student Dissertation Committees (2008 – Present, **14** students from **four** departments)
- Master's Student Thesis Committees (2008 – Present, **five** students)
- BME Senior Design Mentor (2009-Present; **nine** student groups, **32** students total)
- Engineering Honors Student Mentor (Haniya Khalid, 2012-2013)
- ICRU Mentor for Janani Veluchamy (Summer 2010)
- Iowa Space Grant Consortium Student Mentor (2011-present; **three** students total)

Service Activities

Department

- Member, BME Undergraduate Committee (August 2008-Present)
- Secretary, BME Faculty Meetings (August 2008-2009)

College

- Profiled for [UI Foundation Campaign "Engineering & Something More,"](#) (Spring, 2014)
- Chair of IT Committee (Sept 2012 – May 2013)
- Online/Blended Learning Pilot Project (Aug 2012 – Aug 2013)
- IT Committee (Sept 2010 – Aug 2012)
- Grand Challenge Scholars Committee (Sept 2010 – Dec 2010)

University

- Panelist, Faculty Council Retreat - Faculty at Work: the 21st Century (August 2014)
- Profiled for [Extraordinary Teaching Project](#), Center for Teaching (Fall, 2014)
- Panelist, OVPR Research@Iowa Orientation (Oct, 2012)
- Judge, Jakobsen Graduate Conference (Spring, 2009)
- Faculty Panel Member, UI Graduate College Open House (Oct, 2008)
- Member, University of Iowa Presidential Search Committee (2007)
- Co-Chair, Jakobsen Graduate Conference (2007)

Community, State, National, International

- Profiled for [LabTV](#), (Currently being edited – Recorded Spring, 2014)
- ASME SBC Education Committee, 2013 – Present
- ASME SBC Fluid Dynamics Committee, 2012 – Present
- ISACB Ad Hoc Webinar & Podcast Planning Committee, Spring 2014 – Present
- NCIIA E-Team Award Review Panel, Spring 2014
- NSF Graduate Research Fellowship Panel, Washington, DC, January 2014
- NSF Graduate Research Fellowship Panel, Washington, DC, January 2013
- NSF Panel Review Member, Washington DC, January 2012
- NSF Panel Review Member, Washington DC, January 2011

- VPR Reviewer for IFI funding, 2010, 2012
- NSF Panel Review Member, Washington DC, May 2010
- NSF Panel Review Member, Washington DC, December 2009

Miscellaneous Service Activities

- Speaker, TILE Overview Courses (Spring 2013 – Present – See page 2)
- Instructor/Facilitator/Organizer of Misc Teaching Workshops (Summer 2013 – Present – See page 2)
- Speaker, UI Engineering Orientation (Summer 2014)
- Speaker, Explore Engineering Day (2013)
- Speaker, First Year Seminar for Engineering Students (Fall 2010 - Present)
- Presentation to Engineering Young Advisory Council on Blended Learning and TILE classroom efforts (Fall, 2012)
- Presentation to Engineering Advisory Council on Blended Learning and TILE classroom efforts (Fall, 2012)
- Speaker, Explore Engineering Day (2011)
- Presenter, Go! Girls STEM Day (Oct, 2011)
- Speaker, Orientation (Summer 2010)
- Speaker, Explore Engineering Day (Feb 2010)
- Speaker, Workplace Learning Connection (Oct 2009)
- Presenter, Go! Girls STEM Day (April, 2009)
- Presenter, Iowa Engineering Society's Annual Career Guidance Conference (Feb, 2009)
- Presenter, Biomedical Engineering meeting for High School Juniors from Grantwood AEA (Nov, 2008)
- Speaker, First Year Seminar for Engineering Students (Oct, 2008)