

# Rafeed A. Chaudhury

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## Education

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### Ph.D. in Biomedical Engineering

Arizona State University, Tempe, AZ

Dec. 2015

GPA: 3.91/4.0

Co-Advisors: David H. Frakes, Ph.D.<sup>†</sup> and Ronald J. Adrian, Ph.D.<sup>‡</sup>

<sup>†</sup>School of Biological and Health Systems Engineering (SBHSE)

<sup>†</sup>School of Electrical, Computer, and Energy Engineering (ECEE)

<sup>‡</sup>School for Engineering of Matter, Transport and Energy (SEMTE)

Dissertation Title: "Improved Techniques for Cardiovascular Flow Experiments"

### M.S. in Biomedical Engineering

Arizona State University, Tempe, AZ

Dec. 2015

GPA: 3.91/4.0

### B.S. in Biomedical Engineering with Research Option (Pre-Med, High Honor)

Georgia Institute of Technology, Atlanta, GA

May 2010

GPA: 3.44/4.0

## Research Interests

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Wearable computers and mobile sensors, novel sensor and actuator technologies, cardiovascular engineering, image and signal processing, machine learning, artificial intelligence, human computer interaction, pre-surgical planning of cardiovascular diseases, medical device design, particle image velocimetry.

## Work Experience

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### Bioengineer / Project Manager, ATAP

Google via Adecco, Mountain View, CA

May 2016 – Present

- Leading research and development, device testing, biometric signal acquisition, processing, and analysis
- Leading sensor selection and feature extraction from biometric signals (ECG, PPG, EDA, SPO2, etc.)
- Led design of human subjects research studies and data analysis (100+ users, IRB Approved)
- Inventing next generation prototypes using new sensor/actuator technologies (IDF filed)
- Integrating all internal and external cross-functional teams (software, product design, industrial design, program management, manufacturing operations) for successful development of user study prototypes
- Evaluating and characterizing new technologies through hands-on prototyping
- Planning and executing validation of prototyped hardware designs
- Identified and purchased laboratory instrumentation and equipment to stock new lab to streamline prototyping, data acquisition, and device testing process in house
- Proactively took on Project Manager responsibilities after departure of Project Manager from core team
- Spearheaded HW, FW, and SW development of 30+ user study devices from conception to manufacture
- Led software development of cloud dashboard, Android debug app, and client-facing Android app and integrated all aspects with hardware prototypes for user studies
- Successfully managed over 5 critical path external vendor projects (\$1M+)

## Research Experience

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### Graduate Research Associate

Aug. 2010 – Dec. 2015

Arizona State University, Tempe, AZ

**Collaborators:** Barrow Neurological Institute (BNI), Mayo Clinic,

Phoenix Children's Hospital (PCH), Children's Hospital of Philadelphia (CHOP),

Lawrence Livermore National Laboratory (LLNL), Duke University

- Flow Loop and Pump System Design for *In Vitro* Aortic Flow Experiments
  - Designed and built pulsatile piston pump system and flow loop for aortic flow experiments
  - Developed image processing based piston motion tracking software to validate piston motion
  - Programmed LABVIEW to control flow pump system and trigger PIV laser system
  - Assembled laser optics system for PIV experimentation and camera calibration
  - Manufactured optically clear 3D urethane phantom models
  - Obtained and compared velocity field measurements between MRI, Ultrasound, and PIV
- Quantification of Start-up Flows
  - Investigated laminar start-up flows in experimental piston pump systems
  - Verified analytical solution of constant volume flux start-up flows experimentally with PIV
  - Established entrance length and development time of starting laminar flow driven by a constant volume flux (spatio-temporal threshold)
  - Analyzed and compared CFD simulations with PIV and analytical solutions of laminar start-up flows to starting flows driven by a constant pressure gradient
  - Proved analytical solution for constant volume flux in infinitely long pipes is valid for finite length tubes at locations beyond the entrance flow development length
- Downstream Flow and Velocity Waveform Prediction
  - Developed a workflow to predict the output waveform to an arbitrary input in a piston-based pulsatile flow pump system using linear and time invariant (LTI) system theory
  - Developed a workflow to determine the required piston input to achieve desired arbitrary flow and velocity waveforms at downstream locations in piston-based pump systems using LTI theory
  - Acted as a consultant to CHOP to predict downstream flow waveforms for *in vitro* Fontan/TCPC flow experiments
- Pre-Surgical Planning for Coarctation of Aorta
  - Performed PIV experiments on 3D printed geometries generated from the same input meshes used in fluid dynamics simulations to directly compare experiment and theory
  - Performed catheter-based pressure measurements on physical models through pressure taps to validate pressure drops obtained through CFD
  - Investigated and analyzed hemodynamics in patient-specific 3D congenital heart defect models through CFD simulations and PIV experiments

### Undergraduate Research Assistant

Jan. 2009 – May 2010

Georgia Institute of Technology, Atlanta, GA

**Advisor:** Rudolph L. Gleason, Ph.D., Department Biomedical Engineering & Department of Mechanical Engineering, Gleason Lab for Vascular Biomechanics, Mechanobiology, & Tissue Engineering

- Manufactured blood vessel constructs from collagen and rat aortic smooth muscle cells
- Performed histology, axial loading tests, pulse-diameter tests on constructs
- Modified and enhanced protocol for tissue culturing to yield more tissue growth

- Trained two undergraduate researchers in tissue culturing and manufacturing of constructs

**Clinical Research Practicum Student**

*Jan. 2009 – May 2009*

*Grady Memorial Hospital, Atlanta, GA*

**Advisor:** David Wright, M.D., Department of Emergency Medicine, Emory University School of Medicine, Department of Biomedical Engineering, Georgia Institute of Technology

- Collected clinical research data and conducted patient interviews
- Screened and enrolled patients for clinical research trials
- Shadowed physicians and residents in Emergency Department
- Designed and wrote NIH Clinical Research Trial Grant Proposal

**Undergraduate Research Assistant**

*Aug. 2007 – Jan. 2008*

*Georgia Institute of Technology, Atlanta, GA*

**Advisor:** Michelle LaPlaca, Ph.D., Department of Biomedical Engineering, NeuroLab

- Sectioned 3-D cultures using cryostat for immunocytochemistry
- Performed microscopic image analysis & electrophysiological data analysis

**Teaching and Research Mentoring Experience**

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**Teaching Practicum Instructor**

*Spring 2015*

*Arizona State University, Tempe, AZ*

BME 300: Bioengineering Product Design

- Lectured on various topics including 3D prototyping with SolidWorks, performing computational fluid dynamics simulations with ANSYS Fluent, flow data visualization and analysis with Tecplot
- Held weekly office hours, developed, assigned, and graded assignments, including the end of semester final project for 170+ students

**Research Student Mentor**

*Arizona State University, Tempe, AZ*

- Guided and led graduate and undergraduate student research projects through weekly meetings, equipment setup, data collection and analysis, and mentoring

• Master's students

- Christopher Miranda *Spring 2015 – Summer 2015*
  - "3D Particle Tracking for *In Vitro* Flow Experiments"

• Fulton Undergraduate Research Initiative (FURI) students

- Girish Pathangey (Senior Capstone and Honors Thesis) *Summer 2011 – Spring 2015*
  - "Integrated LabVIEW Pump and Camera Automation"
  - "Position Based Modality for Transforming Aortic Waveforms in an Aortic Pump"

- Kevin Winarta (Senior Capstone) *Fall 2013 – Spring 2015*

- Flow Experiments for Coarctation of Aorta
- "Calibration and Verification of a Pulsatile Piston-Pump for Aortic Flow Simulation in a Particle Image Velocimetry System"

- Matthew Mortensen (Honors Thesis) *Spring 2015 – Fall 2015*

• Undergraduate students

- Roman A. Beltran *Summer 2015 – Fall 2015*

- Ariana Richert *Summer 2015 – Fall 2015*

- Christopher Matheny (Senior Capstone) *Fall 2014 – Spring 2015*

- CFD Simulation of Coarctation of Aorta
- Jakob Wells Fall 2013
  - Continuous Flow Pump for Pulsatile Aortic Flow Simulation
- Nicholas Pracht (Georgia Tech Student) Summer 2013
  - PIV experimentation on aortic flows
  - "Impact Force Testing on NFL Thigh Pads"
- Victor Atlasman Fall 2011 – Spring 2013
  - "Design of a Pulsatile Flow Pump System for Aortic Flow"
- Monique White Spring 2013

### Team Leader

Fall 2009

Georgia Institute of Technology, Atlanta, GA

GT 1000: First Year Seminar

- Served as a Teaching Assistant to guide and mentor new students' transition to Georgia Tech
- Developed and facilitated class activities and discussions

## Publications

1. Gounley J., Draeger E. W., Ooppelstrup T., Krauss W. D., Gunnels J. A., **Chaudhury R. A.**, Nair, P., Frakes D. H., Leopold J. A. & Randles A. *Computing the ankle-brachial index with parallel computational fluid dynamics*. Under Review. 2017.
2. Gounley J., **Chaudhury R. A.**, Nair, P., Pathangey G., Winarta K., Ryan, J., Draeger E. W., Frakes D. H. & Randles A. *Validation of Large Fluid Dynamic Simulations of Complex Geometries with 3D Printing in 2017 SIAM Conference on Computational Science and Engineering (Atlanta, 2017)*.
3. **Chaudhury, R. A.**, Frakes, D. H. & Adrian, R. J. *Matching Downstream Velocity and Flow Waveforms for In Vitro Cardiovascular Flow Experiments*. Submitted. 2017.
4. Gounley J., **Chaudhury R. A.**, Frakes D. H. & Randles A. *Risk Factor Study for Patients with Coarctation of the Aorta*. In Preparation (experiments complete). 2016.
5. Gounley J., **Chaudhury R. A.**, Pathangey G., Winarta K., Frakes D. H. & Randles A. *Modeling the Pressure Gradient in Patient-Specific Aortal Geometries*. in *8th International Bio-fluid Symposium* (Pasadena, Feb. 2016).
6. Gounley J., **Chaudhury R. A.**, Vardhan M., Driscoll M., Pathangey G., Winarta K., Ryan J., Frakes D. H., Randles A. *Does the degree of coarctation of the aorta influence wall shear stress focal heterogeneity?* in *38th Annual International Conference of the IEEE Engineering in Medicine and Biology Society* (Orlando, Aug. 2016).
7. **Chaudhury, R. A.** et al. A High Performance Pulsatile Pump for Aortic Flow Experiments in 3-Dimensional Models. *Cardiovascular Engineering and Technology* 7, 148–158 (2016).
8. **Chaudhury, R. A.**, Herrmann, M., Frakes, D. H. & Adrian, R. J. Length and Time for Development of Laminar Flow in Tubes Following a Step Increase of Volume Flux. *Experiments in Fluids* 56, 22–10 (2015).
9. **Chaudhury, R. A.**, Ryan, J., Frakes, D. H. & Adrian, R. J. *Prediction of Downstream Velocity Waveforms for In Vitro Flow Experiments* in *Summer Biomechanics, Bioengineering, and Biotransport Conference* (Snowbird, 2015).
10. **Chaudhury, R. A.**, Herrmann, M., Frakes, D. H. & Adrian, R. J. *Impact of Development Time on Boundary Conditions for Constant Volume Flux Start-up Flow in Arterial Flow Piston Pumps* in *7th World Congress of Biomechanics* (Boston, 2014).

11. **Chaudhury, R. A.**, Atlasman, V., Pathangey, G., Adrian, R. J. & Frakes, D. H. *Design of a New Pulsatile Flow Pump System for Aortic Flow Simulation* in *BMES Annual Meeting* (Atlanta, 2012).
12. **Chaudhury, R. A.** Manufacturing and Mechanical Testing of Biochemically Stimulated Tissue- Engineered Blood Vessel Constructs. Available online: <http://hdl.handle.net/1853/33481>. Undergraduate Research Option Thesis (Department of Biomedical Engineering, Georgia Institute of Technology, Atlanta, 2010).

## Workshops Attended / Professional Development Activities

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Symposium on Innovation in the Health Sector, ASU (April 2015)  
 ASU Preparing Future Faculty (Fall 2014 – Spring 2015)  
 Startup School by Y Combinator (October 2013)  
 ASU Leadership in the Lab for Dean’s Fellows (September 2013)  
 Startup School by Y Combinator (October 2012)  
 National Instruments Technical Symposium in Phoenix, AZ (November 2011)

## Service

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Professional Service.....

<b>National Student Treasurer</b>	<i>Fall 2012 – Fall 2014</i>
<i>Alpha Eta Mu Beta (AEMB) Biomedical Engineering Honor Society</i>	
<b>National Award Evaluator</b>	<i>Fall 2013</i>
<i>Alpha Eta Mu Beta (AEMB) Biomedical Engineering Honor Society</i>	
<b>Journal Reviewer</b>	<i>2013</i>
<i>Journal of Magnetic Resonance Imaging (JMRI)</i>	
<b>Journal Reviewer</b>	<i>2017</i>
<i>Cardiovascular Engineering and Technology (CVET)</i>	

Institutional Service.....

<b>Senior Capstone Judge</b>	<i>Fall 2014 – Fall 2015</i>
<i>School of Biological and Health Systems Engineering</i>	
- Served as graduate student judge for Senior Capstone projects in biomedical engineering	
<b>Chapter Co-President</b>	<i>Spring 2013 – Spring 2014</i>
<i>Alpha Eta Mu Beta (AEMB) Biomedical Engineering Honor Society</i>	
- Presided over members and organized monthly meetings and events	
<b>Chapter Treasurer</b>	<i>Fall 2012 – Spring 2013</i>
<i>Alpha Eta Mu Beta (AEMB) Biomedical Engineering Honor Society</i>	
- Managed organization funds, planned fundraisers, and organized induction ceremony	
<b>Student Representative</b>	<i>Fall 2013</i>
<i>School of Biological and Health Systems Engineering</i>	
- Assisted the school in new Graduate Student Orientation	
<b>Doctoral Student Host</b>	<i>Spring 2011 – 2015</i>
<i>School of Biological and Health Systems Engineering</i>	
- Assisted with the school’s PhD Recruitment Open House	

**JumpStart Research Grants Reviewer** Fall 2011 – Fall 2015  
*Graduate and Professional Student Association*

**Graduate Research Support Program & Travel Grants Reviewer** Fall 2011 – Fall 2015  
*Graduate and Professional Student Association*

**Student Ambassador** 2009 – 2010  
*Georgia Tech Biomedical Engineering Department*

**Chapter President** 2008 – 2010  
*Georgia Tech Biomedical Engineering Society (GT BMES)*

- Served as President for two years; presided over 110-150 members and 10 officers
- Organized bi-weekly seminars and department-wide events
- Represented and presented GT BMES at 2009 BMES Annual Meeting in Pittsburgh, PA
- Presented GT BMES at Georgia Tech Freshman FASET Orientations (2009-2010)

**Secretary & Public Relations Chair** 2007 – 2008  
*Georgia Tech Biomedical Engineering Society (GT BMES)*

- Managed membership and transcribed meeting minutes
- Recruited new members; increased membership by over 40% in a year

**Member & Treasurer** 2007 – 2010  
*Georgia Tech Biomedical Engineering Department Student Advisory Board*

- Elected Treasurer (2009 – 2010) – Managed departmental funds allocated for Advisory Board
- Nominated by faculty to represent interests of BME student body as a faculty-student liaison
- Improved BME curriculum by recommending changes and suggesting courses to department

**Student Representative** 2007 – 2010  
*Georgia Institute of Technology Alcohol Task Force*

- Worked closely with Dean of Students and other leaders at Georgia Tech to reduce and prevent alcohol related incidents involving students and other school affiliated personnel

**Hall Council Voting Representative** 2006 – 2007  
*Georgia Tech Residence Hall Association*

K-12 Outreach and Community Service.....

**Student Host** Summer 2014  
*School of Biological and Health Systems Engineering (SBHSE)*

- Assisted the school SEE ASU SBHSE Day as a host for 32 high school students to explain current Biomedical Engineering research and career paths

**Volunteer** Summer 2013, 2014  
*Arizona Habitat for Humanity*

- Built homes for the state's underprivileged population

## **Related Professional Experience**

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**Georgia Institute of Technology** Atlanta, GA  
*Peer Leader, Community Assistant, Resident Advisor* Fall 2007 – Spring 2010

**Supervisor:** Dan Morrison, Georgia Tech Department of Housing  
*Community Assistant / Resident Advisor* Summer 2008 – Spring 2010

- Managed a university residence hall floor of 52 ethnically diverse undergraduate students
- Created, planned, and implemented educational, social, and recreational programs
- Enforced the rules and regulations of the residence halls
- Assisted in interviewing RA's and Hall Director applicants

*Peer Leader*

*Fall 2007 – Spring 2008*

- Served as mentor and advisor for 38 first year Honors Program students in a dorm setting
- Created, planned, and implemented educational, social, and recreational programs
- Enforced the rules and regulations of the residence halls

## **Fellowships & Awards**

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2015 ASU School of Biological and Health Systems Engineering Travel Award (\$500)  
 2014 – 2015 ARCS Scholar, Achievement Rewards for College Scientists (\$7,000)  
 2014 Alpha Eta Mu Beta Travel Award (\$750)  
 2014 ASU School of Biological and Health Systems Engineering Travel Award (\$500)  
 2014 ASU Graduate Education Travel Award (\$350)  
 2014 ASU Graduate and Professional Student Association Travel Grant (\$950)  
 2013 Alpha Eta Mu Beta Travel Award (\$500)  
 2012 ASU School of Biological and Health Systems Engineering Travel Award (\$500)  
 2012 ASU Graduate and Professional Student Association Travel Grant (\$950)  
 2012 Biomedical Engineering Society Student Travel Award (\$610)  
 2012 Alpha Eta Mu Beta Student Travel Award (\$500)  
 2010 Arizona State University Dean's Engineering Fellowship (Value: \$60,000 per year)  
 2010 Wallace H. Coulter Dept. of Biomedical Engineering Outstanding Senior Leadership Award  
 2006 – 2010 Georgia Institute of Technology Dean's List Award  
 2009 Angela Gill Stewardship – GT BMES Travel Award (\$1,000)  
 2009 Georgia Institute of Technology President's Undergraduate Research Award

## **Professional Memberships**

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Alpha Eta Mu Beta (AEMB) Biomedical Engineering Honor Society (since 2011)  
 Biomedical Engineering Society (BMES) (since 2006)  
 Eta Kappa Nu (HKN-IEEE) Electrical Engineering Honor Society (since 2011)  
 Institute of Electrical and Electronics Engineers (since 2011)  
 Tau Beta Pi (since 2011)  
 National Society of Collegiate Scholars (since 2006)

## Technical Skills

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### Programming

- MATLAB & SIMULINK
- ARDUINO C
- OBJECTIVE-C / RUBY / RAILS
- PYTHON
- HTML / CSS / JAVASCRIPT
- LABVIEW
- L<sup>A</sup>T<sub>E</sub>X
- Source Control (GIT)
- JIRA, Gerrit, Cider (Google)

### Experimental / Hardware

- Motion Tracking
- Laser and Optics Systems
- Particle Image Velocimetry (LaVision)
- National Instruments DAQ
- Flow Loops
- AD Instruments PowerLab
- Other Laboratory Equipment
- Embedded Systems
- Instron
- Confocal, Florescence, BF Microscopy
- Embedded Systems
- Arduino, nRF52x
- Biosignal Analysis
- Medical Imaging
- Prototype Bring-up
- Hardware Validation
- Device Integration

### Software Applications

- ANSYS Fluent / ICEM
- Tecplot
- Paraview
- LaVision DaVis
- LabChart
- SolidWorks
- Geomagic
- Mimics
- Adobe Creative Cloud (Photoshop, Illustrator)

### Instrumentation

- 3D Printing
- Rapid Prototyping
- Magnetic Resonance Imaging
- Ultrasound Imaging
- Cluster Computing

### Other Skills

- Technical Writing
- IRB & FDA Regulatory

## Language Proficiency

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- Fluent in English and Bengali
- Proficient in Spanish

## Personal Interests & Hobbies

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- Marathon running - Finished the 2016 Arizona Rock 'n' Roll and 2017 Nashville Rock 'n' Roll marathons
- Ballroom dancing
- SLR Photography