Denise R. Cruise

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Research Interests	Biomechanics Controls Neuromechanics	Human-machine coupled systems Biosensors Nonlinear Dynamical Systems

Education

Ph.D., Mechanical Engineering Aug. 2018
Purdue University, *West Lafayette, IN*

- Dissertation Topic: Focus on understanding how humans balance upright, and how that ability affected by a variety of factors, both external (e.g. standing on a balance board) and internal (e.g. aging and specific pathologies)
- Dissertation Title: A Dynamical Systems Analysis of Upright Stance: Exploring the Effect of Unstable Surfaces, Aging, and Pathology
- Advisor: Prof. Arvind Raman (Mechanical Engineering)

M.S.E., Mechanical Engineering Aug. 2014
Purdue University, *West Lafayette, IN*

- Thesis Topic: Device creation to study human posture dynamics
- Thesis Title: Design, Development, and Testing of a Balance Board with Variable Torsional Stiffness and Time Delay
- Advisor: Prof. Arvind Raman (Mechanical Engineering)

B.S.E., Biomedical Engineering May 2011
Purdue University, *West Lafayette, IN*

Research Experience

Graduate Research Assistant, School of Mechanical Engineering Aug. 2014—
Purdue University, *West Lafayette, IN* Aug. 2018

- Advisor: Prof. Arvind Raman (Mechanical Engineering)
- Committee: Prof. Shirley Rietdyk (Health and Kinesiology), Prof. Jeffrey Haddad (Health and Kinesiology), Prof. Howard Zelaznik (Health and Kinesiology), Prof. Eric Nauman (Mechanical Engineering)
- Project Goal: Utilize devices and techniques to analyze balance on an active balance board; develop mathematical models to predict balance changes due to specific deficiencies; develop device to quantitatively analyze balance in real time

Tasks include:

- Testing of subjects (young, old, MS) on active balance board; involved collecting joint angle data, balance board data, and physiological data
- Development of mathematical MATLAB model to represent physiological changes in balance due to diabetic neuropathy that incorporated statics, dynamics, contact mechanics, and physiology

Graduate Research Assistant, School of Mechanical Engineering Aug. 2012—
Purdue University, *West Lafayette, IN* Aug. 2014

- Advisor: Prof. Arvind Raman (Mechanical Engineering)
- Committee: Prof. Shirley Rietdyk (Health and Kinesiology), Prof. Jeffrey Haddad (Health and Kinesiology), Prof. Howard Zelaznik (Health and Kinesiology), Prof. Eric Nauman (Mechanical Engineering), Prof. Justin Seipel (Mechanical Engineering)
- Project Goal: Develop devices and techniques to help detect balance disorders

Tasks include:

- Designed and built one degree-of-freedom balance board: utilized basic design skills including stress and strain analysis and 3D-CAD (ProE) drawings
- Designed and created electromechanical interface of board which utilized position sensors, pressure sensors, pneumatic controllers, and pneumatic cylinders
- Created control scheme for balance board using LABVIEW that incorporated stiffness (linear and nonlinear), damping, and time-delay

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Teaching Experience

Teaching Assistant: ME 270/274 F12, S13, Su13,
Purdue University, *West Lafayette, IN* F14, F17

ME 270 is an ME course titled "Basic Mechanics I" that involves analyzing static systems, and ME 274, "Basic Mechanics II" involves analyzing dynamic systems.
Tasks include:

- Maintained blog that students used to interact with teachers, TAs, and other students; posted problems, solutions, videos, and discussion topics
- Worked in the help room to answer any questions that the students had
- Helped professors grade exams when needed

Teaching Assistant: ME 365 S16
Purdue University, *West Lafayette, IN*

ME 365 is titled "Measurement and Control Systems I", and is the introduction to control systems for students. The course primarily focuses on system identification, measurement techniques, and LabVIEW software to run the NI myRIO system.
Tasks include:

- Responsible for one lab section of students (14): introduced the lab, answered questions during the lab, graded all assignments, and maintained grades
- Worked in the help room to answer any questions the students would have about labs, homework assignments, or myRIO assignments
- Helped instructors grade exams

Journal Publications

Cruise, D.R., Chagdes, J.R., Liddy, J.J., Rietdyk, S., Haddad, J.M., Zelaznik, H.N., and Raman, A. "An active balance board system with real-time control of stiffness and time-delay to assess mechanisms of postural stability." Journal of Biomechanics, submitted January 2016.

Conference Publications

Cruise, D.R., Chagdes, J.R., and Raman, A. "Dynamics of Upright Posture on an Active Balance Board with Tunable Time-Delay and Stiffness." ASME 2016 International Design Engineering Technical Conferences and Computers and Information in Engineering Conference. American Society of Mechanical Engineers, 2016.

Conference Proceedings

Cruise, D.R., Suderman B., Stepan L., Scher, I. "An epidemiological study of mountain biking injuries treated in emergency departments in the United States." 2019 Biennial meeting of the International Society for Snowsport Safety. Squaw Valley, California, April 2019. (Oral)

Cruise, D.R., Chagdes, J.R., and Raman, A. "Dynamics of Upright Posture on an Active Balance Board with Tunable Time-Delay and Stiffness." ASME 2016 International Design Engineering Technical Conferences and Computers and Information in Engineering Conference. Charlotte, NC, August 2016. (Oral)

Cruise, D.R., Rietdyk, S., Haddad, J.M., Zelaznik, H.N., Chagdes, J.R., Liddy, J., Raman, A. "Principal component analysis of human balance on a tunable balance board," *39th Annual Meeting of the American Society of Biomechanics,* Columbus, OH, August 2015. (Poster)

Cruise, D.R., Chagdes, J.R., Liddy, J., Rietdyk, S., Haddad, J.M., Zelaznik, H.N., Raman, A. "Analysis of upright human stability through the use of a novel balance board with variable torsional stiffness and time delay," *International Society of Posture and Gait Research World Congress 2015,* Seville, Spain, June-July 2015. (Oral)

Cruise, D.R., Chagdes, J.R., Raman, A. "Balance board with tunable time delay and torsional stiffness to diagnose and improve balance instabilities," *7th World Congress of Biomechanics Conference,* Boston, MA, July 2014. (Poster)

Cruise, D.R., Chagdes, J.R., Raman, A. "A dynamic balance board to diagnose and improve balance instabilities," *17th U.S. National Congress on Theoretical & Applied Mechanics,* East Lansing, MI, June 2014. (Oral)

Outreach

ME Graduate Women's Group Ambassador F13, S14,
Women in Engineering Program/Official ME Graduate Association F16, S17
Volunteered as the Graduate Women's Group Ambassador for the ME department during the 2013-2014 academic year and again during the 2016-2017 academic year.
Responsibilities include:

- Organize events for female ME graduate students to meet each other and interact
- Organize female professor luncheon for female graduate students to meet female professors and ask them questions

Access Engineering Team Member Su14 & Su15
Women in Engineering Program (WIEP)

Access Engineering is a program run by WIEP that collaborates with local summer program to bring hands-on engineering activities led by female engineering role models.
Tasks Include:

- Travel to various summer camps to present engineering activities to students
- Helped to choose specific activities to complete, helped organize process to present activities, managed other Purdue students who helped with activities

I2D2 Team Leader Aug '13 —
Women in Engineering Program (WIEP) Dec '15
I2D2 is an after-school academic year program for children in kindergarten through 5th grade; it introduces young students to engineering through hands-on engineering activities lead by teams of current Purdue engineering students.
Tasks Include:

- As team leader, I would attend one after-school activity per week. I was responsible for making sure we had enough Purdue students to help run the activities, I helped organize the activities, and once on site, I would introduce the activity to the children.
- I helped teach the Purdue students how to best present the material to the children.
- Once a semester an open house was held that was intended to show the community what i2d2 does—I ran a family activity during this event three years in a row that parents could complete with their children

Work Experience

Biomechanics Associate Sept '18 —
Guidance Engineering, *Seattle, WA* present
Worked as a biomechanist focusing on injury biomechanics & accident reconstruction
Tasks include:

- Managing 13 injury litigation cases which involves reading legal documents, performing inspections, running tests, analyzing test results and injury mechanisms, reviewing medical records and images, and writing reports
- Attended and helped facilitate 2019 International Society for Snowsport Safety Conference

Database Architect July '11 —
Accenture, *Chicago, IL* July '12
Worked as a Database Architect Analyst for Accenture's Internal Department
Tasks include:

- Responsible for moving 900 databases from PolyServe to virtual environment
- Coordinated & led meetings (~20) for the multicultural database owners
- Attended Accenture's Core Analyst School of Leadership

Intern: Bench Testing Engineer May '10 —
MED Institute, *West Lafayette, IN* August '10
Worked as a bench testing engineer in the Product Testing Department
Tasks include:

- Performed quantitative tests on all medical devices that COOK creates
- Followed good manufacturing practices (GMP)
- Learned how to submit FDA approval paperwork

Intern: Chemistry Team Member May '09 —
MED Institute, *West Lafayette, IN* August '09
Worked as an engineer on the chemistry team in the Product Discovery Department
Tasks include:

- Developed a hydrophobic coating for a urethral catheter
- Led the project for 2.5 months: gave updates at meetings, chose direction
- Permitted to try several new ideas—many successful
- Utilized large design matrices to make decisions

Community Activities

Seattle Green Lake Running Group Wednesday Night Run Host
I began attending the Seattle Green Lake Running Group Wednesday Night Run in late August after moving to Seattle. This run meets every week at the Brooks Trailhead Store and runs between three and five miles. Near the end of the year, I was asked to act as a host for the group, which includes explaining routes to the group, making an effort to welcome new members, and being a regular presence at the run.

FIRST Robotics Judge
I have acted as a judge for First Lego League (FLL), First Tech Challenge (FTC), and First Robotics Competition (FRC). FLL is for students in grades 4-8, and involves building a robot with a Lego kit and programming with Lego Mindstorms. FTC is a more open-ended competition for students in grades 7-12. FRC is similar to FTC, but the robots are larger and typically more technical.
Tasks Include:

- I have been a project judge and a robot design judge for FLL. In these positions, I interact with the students, evaluate their performance, and give them feedback.
- For FTC, I was a judge at the Indiana State Competition. I was an overall award judge, so I was able to talk to all of the teams, see their robots, and hear about their design process.

Purdue Orchestra Member
I was a violinist in the Purdue Orchestra from 2008 to 2015. It gave me an opportunity to continue to play my violin, introduced me to many other Purdue student musicians, and allowed me to perform concerts for the community. Through this, I was able to travel to Spain in 2015 and perform several concerts in Madrid and Barcelona.

Lafayette Citizens Band Member
I have been a clarinet player in the Lafayette Citizens Band for the past six summers (2013—2018). This group performs weekly outdoor concerts in the summer for members of the community. It is a great opportunity to perform on an instrument, meet other musicians, and perform for the community.

Professional Organizations	**American Society for Testing and Materials (ASTM)** **American Society of Biomechanics (ASB)** **American Society of Mechanical Engineers (ASME)** **International Society of Posture and Gait Research (ISPGR)** **Tau Beta Pi (Engineering Honor Society)**