

# SHAWN M. O'CONNOR

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## Research Interests

My research uses approaches from biomechanics and mechanical engineering to discover the biomechanical and neurophysiologic principles underlying locomotion and balance. To meet this aim, I develop models of human locomotion and design novel human testing experiments and equipment. My specific goal is to investigate how the nervous system coordinates with natural dynamics of the limbs to pattern and stabilize gait and generate efficient movements and apply this knowledge to technology or health related endeavors.

## Research Experience

**2009- : Postdoctoral Fellow**, Simon Fraser University, Canada

Dept. of Biomedical Physiology and Kinesiology, Locomotion Laboratory, Max Donelan

Cerebrovascular responsiveness after spinal cord injury

Physiological mechanisms of metabolic cost minimization in human locomotion

Comparative neurophysiology and biomechanics of animal locomotion

**2004-2009: Graduate Student Research Assistant**, University of Michigan, USA

Dept. of Mechanical Engineering, Human Biomechanics and Control Laboratory, Art Kuo

Modeling of the pendular and compliant modes of human locomotion

Effects of compliance on energetics of gait in humans and robots

Role of state estimation in generating rhythmic motions

Effects of passive stability on direction dependent control of balance

Visual control of walking balance in impaired and aged populations

**2003-2004: Undergraduate Student Research Assistant**, Georgia Institute of Technology, USA

Dept. of Biomedical Engineering, Laboratory for Neuroengineering, Steve DeWeerth

Simulating two-joint neuromuscular control in motorized platforms

Interfacing with and electroplating multi-electrode arrays for neuron network recording

## Education

**2006-2009: Ph.D. Biomedical Engineering**, University of Michigan, Ann Arbor, MI, USA

Dissertation Title: The Relative Roles of Dynamics and Control in Bipedal Locomotion

**2004-2006: M.S. Biomedical Engineering**, University of Michigan, Ann Arbor, MI, USA

**1999-2004: B.S. Mechanical Engineering, Highest Honors**, Georgia Institute of Technology, Atlanta, GA, USA

## Peer-Reviewed Publications

**O'Connor S.M.**, Kuo A.D. (2009). "Direction-dependent control of balance during walking and standing." *Journal of Neurophysiology*. 102(3): 1411-9.

**O'Connor S.M.**, Xu H.Z., Kuo A.D. (2012) "Energetic cost of walking with increased step variability." *Gait and Posture*. 36(1): 102-107.

**O'Connor S.M.**, Donelan J.M. (2012) "Fast visual prediction and slow optimization of preferred walking speed." *Journal of Neurophysiology*. 107(9): 2549-59.

More\* H.L., **O'Connor\* S.M.**, Brøndum E., Wang T., Bertelsen M.F., Grøndahl C., Kastberg K., Hørlyck A., Funder J., Donelan J.M. (accepted pending minor revisions) "Sensorimotor responsiveness and resolution in the giraffe." *Journal of Experimental Biology* (\*1st two authors contributed equally to this work)

**O'Connor S.M.**, Kram R, Dawson T.J. "Tale of a tail: The red kangaroo's fifth leg" *Science*. (in submission)

**O'Connor S.M.**, Kuo A.D. (in preparation) "Passive elastic walking." *International Journal of Robotics Research*.

**O'Connor S.M.** (in preparation) "Visual control of balance during walking is speed dependent." *Gait and Posture*.

## Peer-Reviewed Conference Proceedings

Ross, J.D., **O'Connor, S.M.**, Blum, R.A., Brown, E.A., DeWeerth, S.P. "Multielectrode impedance tuning: reducing noise and improving stimulation efficacy" *International Conference of the IEEE Engineering in Medicine and Biology Society*, September 2004, San Francisco, CA. Conference Proceedings; Volume 2, 2004 Page(s):4115 - 4117 Vol.6

## Invited Talks

"Physiological mechanisms underlying prediction and optimization of metabolic cost during walking" *Dynamic Walking Conference*, May 2012, Pensacola, FL.

"Simplified models of locomotion: a little does a lot" *IRMACS Modeling Consortium*, Simon Fraser University, March 2012, Burnaby, BC, Canada.

"Limit Cycles: A Tutorial" (Co-presented with Peter Adamczyk), *Dynamic Walking Conference*, June 2009, Burnaby, BC, Canada.

## Media Coverage

Experimental methodology from O'Connor and Donelan (2012) *Journal of Neurophysiology* covered on mathworks.com and in a **MATLAB Digest** article titled "Using MATLAB, Virtual Reality, and a Treadmill to Investigate How Humans Use Visual Input to Control Their Gait"

## Podium Presentations

**O'Connor, S.M.** "Active control of walking balance is speed and direction dependent" *Conference of the Canadian Society of Biomechanics*, June 2012, Vancouver, BC, Canada

More H.L., **O'Connor S.M.**, Donelan, J.M. "Sensorimotor responsiveness and resolution in the giraffe" *Conference of the Canadian Society of Biomechanics*, June 2012, Vancouver, BC, Canada

**O'Connor, S.M.**, Donelan, J.M. "Vision influences the predictive minimization of energetic cost during walking" *Northwest Biomechanics Symposium*, June 2011, Vancouver, BC, Canada

**O'Connor, S.M.**, Kuo, A.D. "Direction dependent visual weighting for walking and standing balance" *Dynamic Walking Conference*, June 2009, Burnaby, BC, Canada.

**O'Connor, S.M.**, Kuo, A.D. "Direction dependent weighting of vision for walking balance" *North American Congress on Biomechanics*, August 2008, Ann Arbor, MI.

**O'Connor, S.M.**, Kuo, A.D. "Predictions of an elastic locomotion model" *Dynamic Walking Conference*, May 2008, Delft, The Netherlands.

**O'Connor, S.M.**, Kuo, A.D. "Visual Perturbation of Walking Balance" *Conference of the American Society of Biomechanics*, August 2007, Palo Alto, CA.

**O'Connor, S.M.**, Kuo, A.D. "Walking, Skipping, and Running Produced From a Single Bipedal Model" *Conference of the American Society of Biomechanics*, August 2007, Palo Alto, CA.

**O'Connor S.M.**, Kuo A.D. "Dynamic bipedal locomotion on compliant legs" *World Congress of Biomechanics*, August 2006, Munich, Germany *Journal of Biomechanics* 2006; Vol. 39 Suppl. 1, page S359

**O'Connor, S.M.**; Kuo, A.D. "Elastic dynamic walking" *Dynamic Walking Conference*, May 2006, Ann Arbor, MI.

**O'Connor, S.**; Kuo, A.D. "Optimization of feedforward and feedback control during walking" *Congress of the International Society of Biomechanics and American Society of Biomechanics*, August 2005, Cleveland, OH.

## Poster Presentations

**O'Connor, S.M.**, Donelan, J.M. "Rapid visual prediction and slow optimization of preferred walking speed." *Society for Neuroscience Annual Meeting*, November 2011, Washington, DC.

**O'Connor, S.M.**, Donelan, J.M. "Vision influences the predictive minimization of energetic cost during walking" *Dynamic Walking Conference*, July 2010, Boston, MA.

Rebula, J.R., **O'Connor, S.M.**, Kuo, A.D. "Vertical stiffness during the double support period of walking" *North American Congress on Biomechanics*, August 2008, Ann Arbor, MI.

**O'Connor, S.M.**, Kuo, A.D. "Selection of Double Support Duration in a Compliant Walking Model" *North American Congress on Biomechanics*, August 2008, Ann Arbor, MI.

**O'Connor, S.M.**, Kuo, A.D. "Feed-forward and feed-back components of rhythmic motor control" *Society for Neuroscience Annual Meeting*, November 2007, San Diego, CA.

## **Honors, Awards, Fellowships**

2010: Company of Biologists Travel Grant: Society for Experimental Biology  
2008: Rackham Graduate Research Grant: University of Michigan  
2007, 2008: Rackham Travel Grant: University of Michigan  
2005: NSF Graduate Research Fellowship: Honorable Mention  
2005: Gerstacker Foundation Fellowship: Biomedical Engineering, Univ. of Michigan  
2004: Eschenbach Memorial Award: Mechanical Engineering, Georgia Tech  
2003: Petit Undergraduate Research Scholarship, Biomedical Engineering, Georgia Tech  
2003: Robert Engineering Award: Outstanding Senior in Engineering, Georgia Tech  
2003: ASME Auxiliary Scholarship: National ASME Merit Scholarship  
2002: Hammock Scholarship: Mechanical Engineering, Georgia Tech  
2000: Outstanding Co-op Scholarship: Motorola, Inc.  
1999-2005: Georgia Tech President's Scholarship  
1999-2005: Georgia Governor's Scholarship  
1999-2004: Georgia Tech Dean's List and Faculty Honors  
1999: National Merit Scholarship

## **Academic Service**

Reviewer for Journal of Biomechanics, Journal of Motor Behavior, Journal of NeuroEngineering and Rehabilitation, Gait & Posture, Experimental Brain Research

## **Teaching Experience**

### **Fall 2008, Winter 2009: Engineering Graduate Student Instructor Mentor**

Center for Research on Learning and Teaching, University of Michigan, (15-25 instructors)

Mentored graduate student instructors and provided feedback for improving teaching by observing instructors in the classroom and organizing mid-term student feedback. Co-developed training sessions for new instructors on handling office hours and seminars on incorporating active learning techniques into lectures.

### **Fall 2007: Biomedical Engineering 458 - Biomedical Instrumentation and Design**

Biomedical Engineering, University of Michigan (19 undergraduate and graduate students)

Graduate Student Instructor for laboratory-based course on the design and construction of bio-sensors (EMG, EKG, Pulse-Ox). Supervised student laboratory work, developed brief lectures on background material, graded lab assignments, and advised students on a final design project. Revised all laboratory guidelines, handouts and lesson plans to enhance student learning and meet ABET accreditation goals.

## **Industry Work Experience**

**2009: Research Engineer**, Intelligent Prosthetic Systems L.L.C. Ann Arbor, MI, USA

Developed passive walking models to determine how leg compliance affects gait timing, stability and energetics for the purposes of tuning compliant ankle prostheses.

**2000-2002: Mechanical Engineering Co-op**, Motorola, Inc., Lawrenceville, GA, USA

Personal Communications Sector: Energy Systems Group

Designed testing equipment and measurement protocols for several cell phone battery models; Led mechanical design of Motorola V70 accessory battery and received design committee approval; Led mechanical re-design of Sapphire battery: final design yielded a yearly cost reduction of \$960,000 to \$1,440,000.

## **Professional Memberships**

Society for Experimental Biology (SEB), Society for Neuroscience (SFN), American Society of Biomechanics (ASB), American Society of Mechanical Engineers (ASME)

## **Research Mentor Experience**

### **Graduate**

2009- : Heather More, Biomedical Physiology & Kinesiology, Simon Fraser University

2009- : Mark Snaterse, Biomedical Physiology & Kinesiology, Simon Fraser University

2010- : Jessica Selinger, Biomedical Physiology & Kinesiology, Simon Fraser University

### **Undergraduate**

2011- : Renato Pagliara, Biomedical Physiology & Kinesiology, Simon Fraser University

2008-2009: Wisit Jirattigalachote, Mechanical Engineering, University of Michigan

2007-2008: Andrew Koltonow, Materials Science, University of Michigan