Exponent
Failure Analysis Associates®

Exponent
23445 N. 19th Avenue
Phoenix, AZ 85027

telephone 623-582-6949
facsimile 623-581-8814
www.exponent.com

Torrence D. J. Welch, Ph.D.
Senior Associate

Professional Profile

Dr. Torrence D.J. Welch is a Senior Associate in Exponent's Biomechanics practice. Dr. Welch's areas of expertise include the biomechanics of human injury, accident reconstruction, occupant kinematics in automobile and UTV collisions, occupant restraints, slip-and-fall events, occupational injury, reactive and postural muscle activity, and postural control and stability.

Dr. Welch has nearly 15 years of biomechanics research experience, studying human movement on multiple levels:

- Injury: the forces present on the body during automotive collisions
- Mechanics: the effects of forces on the bony and soft tissues underlying human movement
- Coordination: the activation of muscles in functional groups called muscle synergies
- Control: the neural mechanisms used to control standing balance and to learn new balance tasks
- Performance: the effects of supplements on sport and exercise performance

He also has experience in human motion and gait analysis, electromyography (EMG), the analysis of kinematic and kinetic data, the computer modeling of biomechanical systems, the mechanical testing of biological soft tissue, the ultrasonic and biochemical characterization of biological soft tissue, biomedical ultrasound imaging, and statistical and wavelet analysis.

Prior to joining Exponent, Dr. Welch was a Research Assistant in the Wallace H. Coulter Department of Biomedical Engineering at Georgia Institute of Technology and Emory University, working in the Neuromechanics Laboratory of the Laboratory for Neuroengineering.

Academic Credentials and Professional Honors

Ph.D., Biomedical Engineering, Georgia Institute of Technology and Emory University, 2008
M.S.E., Biomedical Engineering, Tulane University, 2003
B.S.E., Biomedical Engineering, Tulane University (*summa cum laude*), 2003

Georgia Institute of Technology Tower Award; National Institutes of Health Minority Supplement Award; National Science Foundation FACES Fellow; National Society of Black Engineers Academic Excellence Award; Tulane Dean's Honor Scholarship; National Achievement Scholar; Rensselaer Medal; Tau Beta Pi; Alpha Eta Mu Beta

Licenses and Certifications

Traffic Accident Reconstruction, Northwestern University Center for Public Safety, 2008

Publications

Welch TDJ, Bridges AW, Gates DH, Heller MF, Stillman D, Raasch CC, Carhart MR. An evaluation of the BioRID II and Hybrid III during low- and moderate-speed rear impact. SAE International Journal of Passenger Cars – Mechanical Systems 2010; 3:704–733.

Welch TDJ, Bridges AW, Gates DH, Heller MF, Stillman D, Raasch CC, Carhart MR. An evaluation of the BioRID II and Hybrid III during low- and moderate-speed rear impact. SAE Technical Paper 2010-01-1031.

Gates D, Bridges A, Welch TDJ, Lam T, Scher I, Yamaguchi G. Lumbar loads in low to moderate speed rear impacts. SAE Technical Paper 2010-01-0141.

Ting LH, van Antwerp KW, Scrivens JE, McKay JL, Welch TDJ, Bingham JT, DeWeerth SP. Neuromechanical tuning of nonlinear postural control dynamics. Chaos 2009; 19:026111.

Welch TDJ, Ting LH. A feedback model explains the differential scaling of human postural responses to perturbation acceleration and velocity. Journal of Neurophysiology 2009; 101:3294–3309.

Welch TDJ. A feedback model for the evaluation of the adaptive changes to temporal muscle activation patterns following postural disturbance. Doctoral Dissertation, Georgia Institute of Technology and Emory University, 2008.

Welch TDJ, Ting LH. A feedback model predicts muscle activity during human postural responses to support surface translations. Journal of Neurophysiology 2008; 99:1032–1038.

Welch TDJ. Correlation of the acoustic, mechanical, and biochemical properties in human articular cartilage: Implications in the evaluation and diagnosis of osteoarthritis. Masters Thesis, Tulane University, 2003.

Presentations

Welch TDJ, Bridges AW, Gates DH, Heller MF, Stillman D, Raasch CC, Carhart MR. An evaluation of the BioRID II and Hybrid III during low- and moderate-speed rear impact. SAE World Congress, Detroit, MI, 2010.

Gates D, Bridges A, Welch TDJ, Lam T, Scher I, Yamaguchi G. Lumbar loads in low to moderate speed rear impacts. SAE World Congress, Detroit, MI, 2010.

Ting LH, Chvatal SA, Welch TDJ. To step or not to step: Common mechanisms underlying postural response strategies. International Society for Posture and Gait Research Satellite Symposium, Pavia, Italy, 2009.

Welch TDJ, Ting LH. Adaptive modification of feedback gains revealed through a model of human postural control. Neural Control of Movement Meeting, Naples, FL, 2008.

Welch TDJ, Ting LH. Mechanisms characterizing adaptation of human postural responses to reversing perturbations. Neural Control of Movement Meeting, Seville, Spain, 2007.

Welch TDJ, Ting LH. Adaptation of muscle activity can be represented as gain changes in a feedback model of human postural control. Society for Neuroscience Conference, Atlanta, GA, 2006.

Welch TDJ, Ting LH. The initial burst of the human automatic postural response scales with the perturbation acceleration and velocity during quiet stance. Society for Neuroscience Conference, Washington, DC, 2005.

Torres-Oviedo G, Lockhart DB, Welch TDJ, Ting LH. Dimensional reduction of spatial and temporal patterns of muscle activity for postural control. Progress in Motor Control V, State College, PA, 2005.

Maas H, Prilutsky BI, Welch T, Gregor RJ. Reinnervation of the gastrocnemius muscle in the cat: immediate and long-term effects in interjoint coordination. Society for Neuroscience Conference, San Diego, CA, 2004.

Overstreet J, Herb RA, Ludwig S, Welch T. Clenbuterol treatment impairs maximal exercise performance in adult mice. Southwest American College of Sports Medicine Conference, Las Vegas, NV, 1997.

Prior Experience

Research Assistant, Neuromechanics Laboratory, Georgia Institute of Technology, 2004–2008
Research Assistant, Center for Human Movement Control, Georgia Institute of Technology, 2004
Research Assistant, Tulane Cartilage Laboratory, Tulane University, 2001–2003
Research Intern, Medical Ultrasound Laboratory, University of Rochester, 2001
Research Intern, Microtechnology Medicine and Biology Laboratory, University of Wisconsin – Madison, 2000
Research Apprentice, Exercise Physiology Laboratory, Northern Arizona University, 1997

Professional Affiliations

Tau Beta Pi—ΤΒΠ (Louisiana Beta Chapter President, 2000–2002)
Society of Automotive Engineers—SAE
American Society of Biomechanics—ASB
Neural Control of Movement Society—NCM
Society for Neuroscience—SfN
National Society of Black Engineers—NSBE