# Biomedical Engineering
# Wallace H. Coulter Foundation Lecture Series

## Revisiting muscle spindle function to understand impaired sensorimotor control

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Lecture: Friday, April 5, 2019
9:00AM-10:00AM
Room EC 1104
10555 West Flagler Street
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FIU Engineering & Computing
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### Biography

Dr. Ting studied mechanical engineering at the University of California at Berkeley (BS) and at Stanford University (MSE, PhD). Her postdoctoral training was in neurophysiology at the University of Paris V and Oregon Health and Sciences University. Her research in neuromechanics focuses on complex, whole body movements such as walking and balance in healthy and neurologically impaired individuals, as well as skilled movements involved in dance and sport. By drawing from neuroscience, biomechanics, rehabilitation, computation, robotics, and physiology her lab has discovered exciting new principles of human movement. Her work has revealed principles of sensorimotor control for gait and balance and how they change in stroke, spinal cord injury, Parkinson's disease, and with rehabilitation and training. Her work forms a foundation that researchers around the world are using to understand normal and impaired movement control in humans and animals as well as to develop better robotic devices that interact with people. Dr. Ting is a Fellow of the American Institute of Medical and Biological Engineers and was awarded the Arthur C. Guyton Award for Excellence in Integrative Physiology by the American Physiological Society.

### Abstract

Proprioceptive sensory organs gives us a sense of our limbs and bodies during movement. They are particularly important in sensorimotor responses to external perturbations to the body, such as a push or bump, whether maintaining the posture of a limb, or during standing balance. Based on our studies of electromyographic (EMG) responses during standing balance perturbations in healthy individuals and animals with large-fiber sensory neuropathy, we began re-considering classic ideas of sensory encoding in muscle spindle sensory organs, a class of proprioceptors in the muscles. In contrast to the classical explanation of muscle spindles as encoding muscle length and velocity, our work shows that muscle spindles encode muscle fiber force and rate change in force (dF/dt, or yank). This updated concept of muscle spindle function resolves many previously unexplained phenomena, such as history-dependent initial bursts, rate relaxation, fractional power scaling with stretch velocity, and other conditions where muscle spindles do not have a one-to-one relationship with muscle length and velocity. Using a multiscale model, we can predict differential change in muscle spindle firing occurring with chemotheraphy-induced neuropathy and the implications for balance and movement. Our ideas inspired a computational model of the pendulum test for spasticity, leading to novel mechanistic insights about mechanisms of spasticity in children with cerebral palsy. Finally, our work has implications for explaining known paradoxes in perception of limb position and impaired balance control in Parkinson's disease.

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