

Talk 304

Development of a Mechanistic Model of Multisensory Integration and Human Postural Control

(NINDS R01-NS046065 FY 02)

John Jeka

University of Maryland

Tim Kiemel

University of Maryland

Postural sway is considered to have two fundamental stochastic components, a slow nonoscillatory component and a faster damped oscillatory component. The slow component has been shown to account for the majority of sway variance during quiet stance. Postural control is generally viewed as a feedback loop in which sway is detected by sensory systems and appropriate motor commands are generated to stabilize the body's orientation. Whereas the mechanistic source for the damped-oscillatory sway component is most likely feedback control of an inverted pendulum, the underlying basis for the slow component is less clear. We investigated whether the slow process was inside or outside the feedback loop by providing standing subjects with sum-of-sines visual motion. Linear stochastic models were fit to the experimental sway trajectories to determine the stochastic structure of sway as well as the transfer function from visual motion to sway. The results supported a fifth-order stochastic model, consisting of a slow process and two damped-oscillatory components. Importantly, the slow process was determined to be inside the feedback loop. This supports the hypothesis that the slow component is due to errors in state estimation because state estimation is inside the feedback loop rather than a moving reference point or an exploratory process outside the feedback loop.

Project (or PI) Website

[Http://www.hhp.umd.edu/KNES/faculty/jjeka/](http://www.hhp.umd.edu/KNES/faculty/jjeka/)

Publications

1. Kiemel T, Oie K, Jeka JJ (2006) The slow dynamics of postural sway are in the feedback loop. *Journal of Neurophysiology*, 95, 1410-1418.
2. Carver S, Kiemel T, Jeka JJ (in press) Modeling the dynamics of sensory reweighting: Rates depend upon weights. *Biological Cybernetics*.
3. Jeka JJ, Saffer M, Allison L, Zhang Y, Carver S, Kiemel T (in press) Sensory reweighting with translational visual stimuli in young and healthy elderly adults:

The role of state dependent noise. *Experimental Brain Research*.

4. Creath R, Kiemel T, Horak F, Peterka R, Jeka JJ (2005) A unified view of quiet and perturbed stance: Simultaneous co-existing ankle and hip strategies. *Neuroscience Letters*, 377(2), 75-80.