

Engineering Neuroscience & Health

Department of Biomedical Engineering

Division of Biokinesiology and Physical Therapy



Presents:

Dr. Michael Sherback

Swiss Federal Institute of Technology

Sherback@idsc.mavt.ethz.ch

Monday

October 12, 2009

4:00 p.m.

Refreshments will be served 3–4 pm

“Prompt yet slower corrections are an optimal adaptation to increased noise in the elderly”

We characterized the effect of aging on dynamic sensorimotor control in a visuomotor Gaussian perturbation rejection task. We showed that impairment in the presented task manifests as increased disorder and slowing, but show that slowing only exists as a change in response dynamics after the onset of response. The post-onset slowing is shown to be consistent with optimal response to increased sensorimotor noise. Our combined phenomenological and computational results challenge the idea that slowing of the CNS is a cause of impairment; in our task, it is consistent with a Bayesian optimal adaptation to disorder in the sensorimotor system. Our results complement recent work in brain imaging of aged subjects in choice-reaction tasks, though our experimental paradigm elicits continuous dynamic response rather than specifying a discrete target-oriented motion.

Twelve healthy elderly and twelve young adults used a manipulandum to attempt to keep a displayed cursor at a fixed desired location on a line despite a random perturbation sequence acting on the displayed cursor. The cursor dynamics integrated the sum of the subjects' motions and the perturbation – a simple, easily learned task that elicits rich dynamical response data. Direct inspection of the data reveals increased disorder in elderly response, visible as a reduction in the efficiency of their corrective motions. However, a phenomenological cross correlation analysis relating the perturbation and subject response shows that, surprisingly, the elderly had no significant increase in response latency (267 vs 263ms, young vs. elderly, with median intrasubject SD of 36 and 44 ms) but showed a significant slowing of post-onset response. Mathematical modeling revealed that nine elderly and all young subjects behaved in ways consistent with a published optimal control based model. Importantly, (i) those inferred models confirm the experimental response latency results from the cross correlation analysis (the optimal approach yielded 260 vs. 247ms, young vs. elderly, with median intrasubject SD of 14 and 20 ms) even though they were not tuned to do so; (ii) re-tuning our “young” optimal models to increased sensorimotor noise replicated the slower post-onset response seen in the elderly; and (iii) the optimal control paradigm as well as a more general subspace based system identification method indicate that the relative contribution of higher order dynamics is reduced, again consistent with an optimal adaptation hypothesis. We quantify this reduced complexity using Hankel Singular Values, which are the standard measure of model complexity in control engineering, but novel in the sensorimotor literature.

Locations:

Seminar is simultaneously presented

UPC: HNB 100 – LIVE
Hedco Neurosciences Building

UPC Campus Map/Directions:
<http://www.usc.edu/about/visit/upc/>

HSC: CHP 147 — Video Conference
Center for the Health Professional

HSC Campus Map/Directions:
<http://www.usc.edu/about/visit/hsc/>

Organized by Professor Francisco Valero-Cuevas <http://bme.usc.edu/valero/>

Web Cast

<http://capture.usc.edu/college/Catalog/pages/catalog.aspx?catalogId=946350f1-ca84-40e7-b867-e16adba01e4e>

Information about all seminars can be found at
<http://bme.usc.edu/valero/ENH/ENH-Schedule.html>

ENH SEMINAR SERIES