University of Southern California

USC

Department of Biomedical Engineering Division of Biokinesiology and Physical Therapy

From Legged Dynamics to Motor Control of Human Locomotion

Abstract

This talk explores simple models of legged dynamics and their consequences for human and artificial leg control. We start by modeling human locomotion with a point mass that rebounds on two passive spring legs. Exploring its parameter space, we find the model reproduces the center of mass dynamics of human walking and running, unifying both gaits in one theory. To understand how human legs can behave like springs in locomotion, we expand our mechanical model into a neuromuscular one, and show that a simple muscle reflex, positive force feedback of the extensor muscles, could be enough control to generate and stabilize spring-like behavior of the human leg in stance. Using this and other control principles derived from the passive spring-mass model as our guides, we then build a more detailed muscle-reflex model of human locomotion, which requires neither central rhythm generators nor desired joint trajectories to walk and almost run, and to manage random ground and stairs. Finally, we discuss current efforts to apply this flexible and self-adaptive reflex control to artificial leg control in prosthetics and neurorehabilitation.

Engineering Neuroscience & Health

Seminar Series

Presents:

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Tuesday
September 2, 2008
4:00 p.m.

Refreshments will be served 3– 4 p.m.

Locations:
Seminar is simultaneously presented

UPC: HNB 100 - LIVE
Hedco Neurosciences Building
UPC Campus Map/Directions:
http://www.usc.edu/about/visit/upc/

HSC: 147 - Video Conference
Center for the Health Professional
HSC Campus Map/Directions:
http://www.usc.edu/about/visit/hsc/

Biography

Hartmut Geyer received a Diploma of Physics degree (2001) and a Ph.D. degree (2005) from the University of Jena, Germany. Since 2006, he holds a Marie-Curie International Outgoing Fellowship of the European Union and, within this fellowship program, currently works as a postdoctoral affiliate in the Biomechatronics Group. His research interests are the mechanical and neuromechanical principles of legged locomotion, and their application to the design and control of legged robots and prosthetic limbs. He has worked on the mechanical principles of legged locomotion from walking to the walk-run transition to running. His current research expands on these earlier works. He develops a human locomotion model whose legs are mainly driven by muscle-force reflexes and, together with the researchers of the Biomechatronics Group, works on implementing this model's muscle-reflex dynamics in the control of an active foot prosthesis. http://www.lauflabor.uni-jena.de/

Web Cast
http://capture.usc.edu/college/Catalog/?cid=af180d48-ceff-42b9-a35c-eb199daed320

Information about all seminars can be found at
http://www-clmc.usc.edu/~heiko/ENH