



CLAREMONT CENTER
for MATHEMATICAL SCIENCES

CCMS COLLOQUIUM

UNIVERSAL LAWS AND ARCHITECTURES

by

John Doyle

Caltech

Abstract: This talk will focus on progress towards a more unified theory for complex networks involving several elements: hard limits on achievable robust performance, the organizing principles that succeed or fail in achieving them (architecture), the resulting high variability data and robust yet fragile behavior observed in real systems and case studies, and the processes by which systems evolve. Insights can be drawn from three converging research themes. First, detailed description of components and a growing attention to systems in biology and neuroscience, the organizational principles of organisms and evolution are becoming increasingly apparent. Second, while the components differ, advanced technology's complexity is now approaching biology's and there are striking convergences at the level of organization and architecture, and the role of layering, protocols, and feedback control in structuring complex multiscale modularity. Third, new mathematical frameworks for the study of complex networks suggests that this apparent network-level evolutionary convergence within/between biology/technology is not accidental, but follows necessarily from their universal system requirements to be efficient, evolvable, and robust to perturbations in their environment and component parts. Case studies in classical problems in complexity will be drawn from statistical mechanics, turbulence, cell biology, human physiology and medicine, neuroscience, wildfire, earthquakes, economics, the Internet, and smartgrid.

About the speaker: John Doyle is the John G Braun Professor of Control and Dynamical Systems, Electrical Engineering, and BioEngineering at Caltech. He has a BS and MS in EE, MIT (1977), and a PhD, Math, UC Berkeley (1984). Current research interests are in theoretical foundations for complex networks in engineering and biology, focusing on architecture, and for multiscale physics. Early work was in the mathematics of robust control, including extensions to nonlinear and networked systems. Related software projects include the Robust Control Toolbox (muTools), SOSTOOLS, SBML (Systems Biology Markup Language), and FAST (Fast AQM, Scalable TCP). Prize papers include IEEE Baker, IEEE Automatic Control Transactions Axelby (twice), and best conference papers in ACM Sigcomm and AACC American Control Conference. Individual awards include AACC Eckman, and IEEE Control Systems Field and Centennial Outstanding Young Engineer Awards. He has held national and world records and championships in various sports. He is best known for having excellent co-authors, students, friends, and colleagues.

Wednesday, November 2, 2011, at 4:15pm

Millikan Auditorium, Pomona College

Refreshments at 3:45 p.m. in Millikan Auditorium & wine and cheese after the talk in Harry's Room (Millikan 209)

*The dinner will be hosted by Prof. Stephan Garcia.
Please contact Prof. Garcia if you are interested in attending the dinner*