SYSTEMS, CONTROLS, AND ROBOTICS SEMINAR SERIES

Dr. Jason L. Speyer

Roland and Valerie Sugar Distinguished Professor
Mechanical and Aerospace Engineering Department, UCLA
speyer@seas.ucla.edu

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4:00 p.m. / 100 Harrington Education Classroom Center

Stochastic Estimation for Vector Linear Systems with Additive Cauchy Noise

ABSTRACT
The Gaussian paradigm has dominated the foundation of estimation and control algorithms. The assumed Gaussian probability density functions (pdf) have very light tails where almost all of its uncertainty evolves near its mean value. However, in many realistic applications the system can experience large impulsive noises far more often than the Gaussian would admit. By using the heavy-tailed Cauchy pdf, rather than the Gaussian pdf, a new class of estimators is determined. In particular, for the Cauchy vector–state estimation problem, the characteristic function of the unnormalized conditional probability density function (ucpdf) is generated algebraically and recursively through measurement updates and state propagation.   Once the characteristic function of the ucpdf is obtained, the conditional mean and variance are easily computed from its first and second derivatives. Two-state and three-state dynamic system examples demonstrates the vector-state Cauchy estimator's performance and the two-state estimator is compared to a conditional mean Gaussian estimator (Kalman filter) in Cauchy and Gaussian simulations.

BIO
Jason L. Speyer received the B.S. in Aeronautics and Astronautics from MIT and the Ph.D. in applied mathematics from Harvard University. He is the Ronald and Valerie Sugar Distinguished Professor in Engineering within the Mechanical and Aerospace Engineering Department and the Electrical Engineering Department, UCLA. He coauthored with W. H. Chung, *Stochastic Processes, Estimation and Control* (SIAM, 2008), and coauthored with D. H. Jacobson, *Primer on Optimal Control Theory* (SIAM, 2010). He is a life fellow of the IEEE and a fellow of the AIAA and was awarded the AIAA Mechanics and Control of Flight Award, AIAA Dryden Lectureship in Research, Air Force Exceptional Civilian Decoration (1991 and 2001), IEEE Third Millennium Medal, the AIAA Aerospace Guidance, Navigation, and Control Award, and membership in the National Academy of Engineering.

Pizza will be served at 3:45 p.m.