Dwight Look College of ENGINEERING
TEXAS A&M UNIVERSITY

SEMINAR

SYSTEMS, CONTROLS AND ROBOTICS SEMINAR SERIES

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Friday, September 12, 2014
4:00 p.m. / 108 Jack E. Brown Chemical Engineering Bldg

Dynamics and Control of Large-scale Networks

ABSTRACT

In the first part of the talk, we examine fundamental limitations arising from the use of local feedback in networks subject to stochastic disturbances. For vehicular formation control problems in topology of regular lattices we show that it is impossible to have coherent large formations, that behave like rigid lattices, in one and two spatial dimensions. Yet we prove that this is achievable in 3D. The observed phenomenon is a consequence of the fact that, in 1D and 2D, local feedback laws are ineffective in guarding against disturbances with large spatial wavelength. We provide connections with several other problems including distributed averaging algorithms, global mean first passage time of random walks, effective resistance in electrical networks, and statistical mechanics of harmonic solids.

In the second part of the talk, we demonstrate how tools and ideas from control theory, optimization, and compressive sensing can be combined to identify network topologies that strike desired tradeoff between the performance and sparsity. Our approach consists of two steps. First, we identify sparsity patterns of the feedback gains by incorporating sparsity-promoting penalty functions into the optimal control problem, where the added terms penalize the number of communication links in the distributed controller. Second, we optimize feedback gains subject to structural constraints determined by the identified sparsity patterns. In the first step, the sparsity structure of feedback gains is identified using the alternating direction method of multipliers, an algorithm well-suited to large optimization problems. Several examples are provided to demonstrate the effectiveness of the developed approach.

BIO

Mihailo Jovanovic (www.umn.edu/~mihailo) is an Associate Professor of Electrical and Computer Engineering at the University of Minnesota, Minneapolis, where he also serves as the Director of Graduate Studies in the interdisciplinary PhD program in Control Science and Dynamical Systems. He has held visiting positions with Stanford University and the Institute for Mathematics and its Applications. His research focuses on sparsity-promoting optimal control, fundamental performance limitations in the design of large dynamic networks, and dynamics and control of fluid flows. He is a senior member of IEEE, and a member of APS and SIAM. He currently serves as an Associate Editor of the SIAM Journal on Control and Optimization and has served as an Associate Editor of the IEEE Control Systems Society Conference Editorial Board from July 2006 until December 2010. He received a CAREER Award from the National Science Foundation in 2007, an Early Career Award from the University of Minnesota Initiative for Renewable Energy and the Environment in 2010, a Resident Fellowship within the Institute on the Environment at the University of Minnesota in 2012, the George S. Axelby Outstanding Paper Award from the IEEE Control Systems Society in 2013, and the University of Minnesota Informatics Institute Transdisciplinary Research Fellowship in 2014.

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