



Technical Presentation

“Distributed Control of Clustered-Networks of Dynamic Systems”

by

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**Abstract:** Systems that share a communication network are ubiquitous in this day and age. Examples of such systems include sensor networks, swarms of robots and power grids. In this work, we design a distributed control system for networks that have multiple dense clusters with sparse interconnection structure. The sparsity pattern in such networks naturally gives rise to a time-scale separation in its dynamics, whereby nodes inside a cluster synchronize over a fast time-scale while the areas themselves synchronize over a slow time-scale. Our goal is to design state-feedback controllers for each cluster so that all cluster controllers can cooperate to shape the closed-loop response of the network. A key feature in our design is that every cluster controller needs to design only one aggregate control law to satisfy this objective for the slow system. Applying results from singular perturbation theory, we show that when these individual controllers are implemented on the actual network model, the closed-loop response is close to that obtained from the approximate models, provided that the clustering is strong. The design procedure is demonstrated by a simulation example.

**Bio of the presenter:** Dr. Almuatazbella Boker received his B.Eng degree in Mechatronics Engineering from the University of Leeds, UK, in 2002, M.S. degree in Control Systems Engineering from the University of Sheffield, UK, in 2003 and Ph.D. degree in Electrical Engineering from Michigan State University, USA in 2013. Dr. Boker worked as an Assistant Lecturer at the Electrical and Electronics Engineering Department, University of Garyounis, Libya, for the period 2004-2008. He also worked as a Post-Doctoral Research Scholar at the Electrical and Computer Engineering Department, North Carolina State University, USA, for the period 2014-2015. Since January 2016, he has been working as an Assistant Professor of Electrical Engineering, College of Information Technology and Engineering, Marshall University, USA. His research interests include estimation and control of nonlinear systems, large scale systems and networked systems, with applications in cyber physical systems. Dr. Boker received the 2002 Smallpeice Trust Prize, the University of Leeds, for “an outstanding work on mechatronics”, and best poster award, 2012, Graduate Research Symposium, Michigan State University.

**PIZZA LUNCH WILL BE PROVIDED.**