BRIGHAM AND WOMEN'S HOSPITAL

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Department of Medicine
Channing Division of Network Medicine

Channing Network Science Seminar

April 5th (Thursday), 2018, 11am @ 3rd-floor conference room

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A Framework for Structural Input/Output and Control Configuration Selection of Complex Networks

The control network design consists mainly of two steps: input/output (I/O) selection and control configuration (CC) selection. The first one is devoted to the problem of computing how many actuators/sensors are needed and where should be placed in the plant to obtain some desired property. Control configuration is related to the decentralized control problem and is dedicated to the task of selecting which outputs (sensors) should be available for feedback and to which inputs (actuators) in order to achieve a predefined goal. The choice of inputs and outputs affects the performance, complexity and costs of the control system. Due to the combinatorial nature of the selection problem, an efficient and systematic method is required to complement the designer intuition, experience and physical insight. Motivated by the above, this presentation addresses the structure control system design taking explicitly into consideration the possible application to large - scale systems. We provide an efficient framework to solve the following major minimization problems: i) selection of the minimum number of manipulated/measured variables to achieve structural controllability/observability of the system, and ii) selection of the minimum number of measured and manipulated variables, and feedback interconnections between them such that the system has no structural fixed modes. Contrary to what would be expected, we showed that it is possible to obtain the global solution of the aforementioned minimization problems in polynomial complexity in the number of the state variables of the system. To this effect, we propose a methodology that is efficient (polynomial complexity) and unified in the sense that it solves simultaneously the I/O and the CC selection problems. This is done by exploiting the implications of the I/O selection in the solution to the CC problem.

BIO: Sérgio Pequito is an assistant professor at the Department of Industrial and Systems Engineering at the Rensselaer Polytechnic Institute. From 2014 to 2017, he was a postdoctoral researcher in General Robotics, Automation, Sensing & Perception Laboratory (GRASP lab) at University of Pennsylvania. He obtained his Ph.D. in Electrical and Computer Engineering from Carnegie Mellon University and Instituto Superior Técnico, through the CMU-Portugal program, in 2014. Previously, he received his B.Sc. and M.Sc. in Applied Mathematics from the Instituto Superior Técnico in 2007 and 2009, respectively. Pequito's research consists of understanding the global qualitative behavior of large-scale systems from their structural or parametric descriptions and provide a rigorous framework for the design, analysis, optimization and control of large-scale (real-world) systems. Currently, his interests span to neuroscience and biomedicine, where dynamical systems and control theoretic tools can be leveraged to develop new analysis tools for brain dynamics that, ultimately, will lead to new diagnostics and treatments of neural disorders. In addition, these tools can be used towards effective personalized medicine and improve brain-computer and brain-machine-brain interfaces that will improve people's life quality. Pequito was awarded the best student paper finalist in the 48th IEEE Conference on Decision and Control (2009). Also, Pequito received the ECE Outstanding Teaching Assistant Award from the Electrical and Computer Engineering Department at Carnegie Mellon University, and the Carnegie Mellon Graduate Teaching Award (University-wide) honorable mention, both in 2012. Also, Pequito was a 2016 EECI European Ph.D. Award on Control for Complex and Heterogeneous Systems finalist and received the 2016 O. Hugo Schuck Award in the Theory Category.

Hosted by Yang-Yu Liu