Chemical and Biological Engineering Seminar Announcement

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“Energy Efficiency and Sustainability: New Vistas for Systems and Control Research”

Monday, April 3, 2017
12:00PM
SciTech Room 136
Energy efficiency and sustainability are major factors towards mitigating the depletion of fossil fuel reserves and the environmental impact of their consumption. Tight integration is a key enabler towards achieving these goals, both in existing chemical plants, but also in emerging technologies for power generation and for production of fuels and chemicals from renewable resources. The first part of the talk will focus on the control of integrated large-scale plants, a classic open problem in control. A natural paradigm for addressing this problem is the one of distributed control, in which coordinated controllers tackle operational objectives of different sections of the plant. A key underlying problem is the optimal decomposition of the integrated system into the distributed control architecture. A new approach to this problem inspired from network science will be described. It relies on identifying “communities” of system variables whose members interact strongly among them, yet are weakly coupled to the rest of the network members. A modularity measure defined on suitable graphs is used to quantify strength of interactions; maximization of modularity leads to optimal decompositions. Such decompositions are shown to lead to significant reduction in the computational cost of distributed optimization-based control while retaining satisfactory performance compared to centralized control. The second part of the talk will focus on the emerging theme of distributed production of power, fuels and chemicals, using renewable resources. The motivation lies in the promise of developing efficient, sustainable and robust infrastructures utilizing local resources. The challenges span science, technology and public policy considerations. Recent results along with exciting opportunities for systems research will be highlighted, on two broad fronts: micro-grids and bio-refineries.