The University Of Sheffield.

Automatic Control and Systems Engineering

The Department of Automatic Control & Systems Engineering is pleased to announce the following seminar:

A structural approach to dynamical networks

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Wednesday, 27 April 2016 at 15:00
LT01, Sir Henry Stephenson Building

Abstract

Dynamical networks are systems whose behaviour results from the interaction of several dynamic subsystems. Interactions occur according to a given topology, which can be visually represented as a graph. Structural investigation aims at assessing general properties based on the system structure (essential, qualitative information about the system), without any quantitative knowledge of the system parameters (or even of numerical bounds).
The main purpose is to establish how local interactions can affect the global behaviour of the dynamical network. In particular, systems whose structure is defined by the associated graph, or hyper-graph, will be considered. This class of systems includes both natural systems, for instance biochemical systems, food webs and social networks, and artificial systems, such as production and distribution systems, telecommunication systems, computer networks and vehicle platoons.

The so-called "BDC-decomposition" will be presented as a local and global tool for the structural analysis of dynamical networks, with a special focus on biochemical systems. Based on this decomposition, criteria can be obtained to structurally assess the stability of the system and the sign of steady-state input-output influences. Also, a structural classification of the transitions to instability (either oscillatory or multistationary) that can occur in systems having a sign-definite Jacobian, or consisting of the sign-definite interaction of stable monotone subsystems, will be illustrated.

In a dynamical network, local interactions can also be designed to obtain the desired global behaviour. Network-decentralised control strategies will be considered, in which several control agents act locally and make their decisions based on local information only. Precisely, each control agent is associated with an arc and has knowledge exclusively about variables related to the nodes that it directly affects. Some theoretical results on network-decentralised stabilisability for linear systems and for nonlinear compartmental systems will be presented, showing that network-decentralised stabilisability is equivalent to stabilisability under suitable conditions. Finally, the asymptotic optimality properties of network-decentralised controllers will be presented.

Biography

Giulia Giordano received her B.Sc. and M.Sc. degrees in Electrical Engineering, in 2010 and 2012 respectively, and her Ph.D. with a focus on Systems and Control Theory in 2016, from the University of Udine, Italy. Starting from June 2016, she will join the LCCC Linnaeus Center at Lund University, Sweden. She had been visiting the Control and Dynamical Systems group at the California Institute of Technology, Pasadena (CA), USA, from June to August 2012 and the Institute of Systems Theory and Automatic Control at the University of Stuttgart, Germany, from March to May 2015. Her main research interests include the analysis of biological systems and the control of network systems.

Light refreshments will be served in the foyer of the Sir Henry Stephenson Building following the seminar