International Workshop on "Recent Topics in Control"

March 7, 2018

Katsura Campus, Kyoto University

Organizer:

Yoshio Ebihara (Kyoto University, Japan)

Sponsored by:

TOYOTA RIKEN Specially Promoted Project

Program

10:00-10:10 Opening Address

Morning Session

Chair: Yoshio Ebihara (Kyoto University, Japan)

10:10-11:00 Subspace Identification in Uncertain Closed Loop via Nuclear Norm Minimization
Toshiharu Sugie (Kyoto University, Japan)

11:00-11:50 From Separation to Lyapunov Functionals
Carsten Scherer (The University of Stuttgart, Germany)

Lunch

12:00-13:20 at Cafeteria

Afternoon Session I

Chair: Graziano Chesi (The University of Hong Kong, Hong Kong)

13:20-14:10 Constructing Externally Positive Systems for General LTI System Analysis
Yoshio Ebihara (Kyoto University, Japan)

14:10-15:00 A Characterization of Algebraic Connectivity of Multi-Agent Systems with Hierarchical Network Structure
Yasumasa Fujisaki (Osaka University, Japan)
in collaboration with Hojin Lee (Osaka University, Japan)

Tea Break

15:00-15:20

Afternoon Session II

Chair: Yasumasa Fujisaki (Osaka University, Japan)

15:20-16:10 Static Output Feedback Control of Switched Systems with Dwell Time Constraints or Arbitrary Switching
Graziano Chesi (The University of Hong Kong, Hong Kong)

16:10-17:00 Hierarchical Optimal Controller Synthesis based on Matrix Subalgebras
Daisuke Tsubakino (Nagoya University, Japan)

Dinner Party

18:00- Restaurant at City Center

Toshiharu Sugie
Kyoto University,
Japan

Title: Subspace Identification in Uncertain Closed Loop via Nuclear Norm Minimization

Abstract: Closed loop identification is known to be difficult due to the correlation between the measurement noise and the input. It becomes, however, more and more important these days. For example, if we look at networked control systems or large scale interconnected systems, it is difficult to identify the whole system simultaneously. Instead we have to identify each subsystem where there exist some feedback by other subsystems. This talk presents a subspace method for closed loop identification, which is aimed to provide low order system models in the presence of colored noises without the knowledge of feedback controllers. First, it compresses the long data by projecting them to an appropriate subspace, then obtains a low order model based on the compressed data by exploiting the nuclear norm minimization. Its effectiveness is demonstrated through numerical simulations.

go back to the program page

Carsten Scherer
The University of Stuttgart, Germany

Title: From Separation to Lyapunov Functionals

Abstract: A classical approach to stability and performance analysis of feedback interconnections is based on graph separation. As a popular incarnation, the main result on integral quadratic constraints (IQCs) renders such separation approaches computational for a linear system in feedback with a general system without a particular description. Despite its long history, the link between general integral quadratic constraints and Lyapunov theory has not been established so far. The purpose of this talk is to link both worlds through an encompassing new result which is based on the notion of finite horizon IQCs with a terminal cost. We reflect on the general merits of such an approach for inferring invariance properties on the basis of absolute stability criteria.

go back to the program page

Yoshio Ebihara
Kyoto University,
Japan

Title: Constructing Externally Positive Systems for General LTI System Analysis

Abstract: Recently the author has shown an analysis technique of general, not necessarily positive, LTI systems via conversion to externally positive systems. More precisely, the author established a construction method of an externally positive system whose impulse response is given by the square of the original LTI system to be analyzed. Then, it has been proved that the H_2 norm computation problem of a general LTI system of order n can be reduced into the L_∞-induced norm computation problem of an externally positive system of order n^2. On the basis of these preceding results, in this study, we show that the order of the externally positive system can be reduced up to $n(n+1)/2$ by using the elimination and duplication matrices that are intensively studied by Jan R. Magnus in the 80's. In addition to the computational complexity reduction in dealing with the H_2 analysis, we show that such construction of externally positive systems with reduced order is quite effective in semidefinite-programming-based peak value analysis of impulse responses of general LTI systems.

go back to the program page

Yasumasa Fujisaki
Osaka University,
Japan

Title: A Characterization of Algebraic Connectivity of Multi-Agent Systems with Hierarchical Network Structure

Abstract: This talk deals with a characterization of a multi-agent system with hierarchical network structure having heterogeneous substructure based on its algebraic connectivity. The multi-agent system is modeled as an interconnected system of several kinds of multi-agent subsystems via a certain structure, where several vertices of each subsystem are connected to the structure, that is, to other subsystems. The algebraic connectivity of this multi-agent system can be characterized by using an appropriate multi-agent system having homogeneous subsystems under a certain condition, which is investigated in this talk. In particular, it is shown that an algebraic condition for adding links (edges) to subsystems which preserve the algebraic connectivity.

go back to the program page

Graziano Chesi

The University of Hong Kong, Hong Kong

Title: Static Output Feedback Control of Switched Systems with Dwell Time Constraints or Arbitrary Switching

Abstract: This talk addresses the problem of determining static output feedback controllers for stabilizing continuous-time switched linear systems with either dwell time constraints or arbitrary switching. This problem is challenging due to nonconvexity of the set of sought controllers and due to nonlinear matrix inequalities (NMIs) that arise whenever typical conditions for stability analysis are exploited. The strategy presented in this talk consists of searching for a family of homogeneous polynomial Lyapunov functions (HPLFs) parameterized by the sought controller that prove stability for the considered set of switching rules. In order to conduct this search, polynomials are introduced for approximating the matrix exponential and for quantifying the feasibility of the Lyapunov inequalities. It is shown that there exists a stabilizing controller if and only if a condition built solving three convex optimization problems with linear matrix inequalities (LMIs) holds for polynomials of degree sufficiently large.

go back to the program page

Daisuke Tsubakino
Nagoya University,
Japan

Title: Hierarchical Optimal Controller Synthesis based on Matrix Subalgebras

Abstract: Large-scale systems usually consist of a number of subsystems over a network. Then, their dynamical behavior is divided into two layers. The lower layer corresponds to the dynamics of each subsystem and interaction between subsystems is considered as the upper layer behavior. When considering a control problem for such a system, it is natural to assign an objective to each layer separately. Namely, the resulting performance criteria also have a multi-layer structure. Then, we can expect that the corresponding optimal control law inherits this structure. In this talk, we first formulate such a problem as a hierarchical optimal control problem for a class of linear systems with quadratic cost functions. Then, a solution to this problem, which exploits an algebraic property of the algebraic Riccati equation, is given. It will be shown that, if the system matrices and the weight matrices in the cost function satisfy an algebraic condition, the positive semi-definite solution to the Riccati equation can be decomposed into layers compatible with those of the system and cost function. An application to satellite formation flying will also be presented.

go back to the program page