Contributed Session 6: Control and Optimization

On the minimal time null controllability of the heat equation

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We show that the heat equation modeled as $y' = Ay + u$ in $L^1(\Omega)$ is null controllable with control in $L^\infty(0,T;L^p(\Omega))$ with $1 \leq p \leq \infty$. Moreover, the corresponding minimum time function is Hölder continuous.

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Bilinear hierarchical differential games between manufacturer and retailer

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In this work, two-dimensional microeconomic models with three controls are created and investigated. The models describe a manufacturer producing a consumer good and a retailer that buys his product in order to resell it for profit. Two types of differential hierarchical games will be applied in order to model the interactions of manufacturer and retailer. We will consider the difficult case in which the maximum of the objective function can be reached only on the boundary of the admissible set. Our particular interest will be on differential games with restriction on controls (bounded controls).

This investigation will be done in order to determine condition of the interaction of retailer and manufacturer that might provide the stable and maximal effectiveness of the structure over planning periods.

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State estimation for linear impulsive differential systems through polyhedral techniques

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The report is devoted to the state estimation problem in the control theory under uncertainty. Models with set-membership description of uncertainties arise in a wide variety of applications. There are many approaches for solving these important problems. Some of them use the techniques of ellipsoidal or polyhedral (parallelepiped-valued) estimates. The above mentioned approaches deal with classical uncertain control problems where the control functions are Lebesgue measurable. We study the case of differential systems with impulsive controls. Our approach is based on the approximation of the primary impulsive problem by the problems for special discrete time systems. The families of external and internal parallelepiped-valued estimates of reachable sets of the auxiliary systems are introduced. This technique gives the possibility to construct the guaranteed estimates for reachable sets of the primary systems. The results of numerical simulations are presented.

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Observability and Global Controllability of a Class of Output Feedback Systems

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Output feedback stabilization of a class of nonlinear systems is considered. By constructing appropriate Lyapunov functions and utilizing observer backstepping procedure, the observability and global controllability of the systems are proved. The control design is used to a tow dimension system, and simulation results are obtained.

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Controlled Lagrangians and Stabilization of Discrete Mechanical Systems

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Anthony Bloch, Melvin Leok and Jerrold Marsden

In this talk we discuss the controlled Lagrangian approach to feedback stabilization of discrete mechanical systems with symmetry. In the controlled Lagrangian approach, one considers a mechanical

system with an uncontrolled (free) Lagrangian equal to kinetic energy minus potential energy. To stabilize a (relative) equilibrium of interest, the kinetic energy is modified to produce a controlled Lagrangian which describes the dynamics of the controlled closed-loop system. The modifications to the Lagrangian are chosen so that no new terms appear in the equations corresponding to the variables that are not directly controlled. As the closed loop dynamics of a controlled Lagrangian system is itself Lagrangian, it is natural to adopt a variational discretization that exhibits good long-time numerical stability. The discrete controlled dynamics is used to construct a real-time model predictive controller with piecewise constant control inputs.

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