Boundary feedback control in coupled PDE control systems

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Abstract

This talk will focus on boundary and point control problems associated with coupled PDE dynamics. Of particular interest are systems that are governed by interaction between hyperbolic and parabolic dynamics. Structural acoustic interaction, fluid structure interaction and magnetorestrictive interaction are just few examples.

While boundary or point control problems are reasonably well understood in the context of single dynamics: be it hyperbolic or paraboic, the interaction between the two different dynamical behaviors brings forward new phenomena. The role of the interface and the mechanissm of propagation of hyperbolicity and parabolicity through the associated boundary conditions plays a 'dominant role. In this talk we shall present several abstract theories that have been recently developed in the context of controllability and stabilization of these coupled structures.

By way of illustration, fluid structure interaction which couples Navier Stokes and dynamic system of elasticity will be discussed. The coupling in the structure takes place on the interface between the fluid and solid and is prescribed via matching conditions imposed on Cauchy Polya stress tensors and velocities. Bolza boundary-interface control problem associated with this model will be considered. The result obtained provides feedback representation of the optimal control derived from an appropriate (singular!) Riccati Equation. The optimal rates of singularity (blow up exhibited at the origin $t = 0$ and at the terminal time $t = T$) of the feedback gain and of the transition operators will be given. The blow up phenomenon is due to the fact that Bolza problem is considered with controls supported only on the interface between the fluid and the solid.