WORKSHOP

"New Perspectives in Optimal Control and Games"
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ABSTRACT INVITED SPEAKERS

M. T. BASAR (Univ. of Illinois, Urbana-Champaign)
Stochastic Dynamic Teams and Games with Asymmetric Information

Abstract
In any real application of stochastic decision making, be it in the cooperative team framework or the non- cooperative game setting, asymmetry in the information acquired by different decision makers (synonymously agents or players) naturally arises. Presence of asymmetric information, particularly in dynamic (multi-stage) decision problems, creates challenges in the establishment of existence of optimal solutions (in teams) and non-cooperative equilibria (in games) as well as in their characterization and computation. No unified theory exists (such as dynamic programming or maximum principle) that would be applicable to such problems. In this talk, I will discuss our efforts toward developing such a unified theory with regard to existence of solutions. For stochastic dynamic teams, the framework will encompass problems with non-classical information, such as Witsenhausen's counterexample (and its multi- dimensional extensions) and the Gaussian test channel (and its multi-relay versions with real-time information processing and transmission), among others, for which the existence of team-optimal solutions will be obtained. For stochastic dynamic games with asymmetric information, the existence of Nash equilibria will be established using the newly introduced refinement concept of "common information based Markov perfect equilibrium". The approach for games entails establishing an equivalence between the original game and an appropriately constructed one in a higher dimensional space, with symmetric and perfect information, and with virtual players. For dynamic teams, the approach first lifts the analysis to the space of behavioral strategies, establishing existence in that richer space, and then brings the solution down to the original team problem while respecting the informational relationships. Several examples will be provided to illustrate the solution technique, the underlying caveats, and the conditions involved. Some open problems and future directions for research will be identified.

K. GIGA (Univ of Tokyo)

A Level-set Crystalline Mean Curvature Flow

Abstract:
It is by now standard that a level-set approach provides a global unique generalized solution (up to fattening) for mean curvature flow equations [G]. Even from the early stage of the theory, it is known that the method is very flexible to apply anisotropic curvature flow equations which correspond to anisotropic interfacial energy.
The anisotropy is very important in materials sciences. However, if the anisotropy is very singular for example a crystalline mean curvature flow corresponding to crystalline interfacial energy, even local-in-time existence of a solution was not known except for convex initial data [BCCN]. A level set approach was not available except evolution of curves to which a foundation of the theory was established by M.-H. Giga and Y. Giga more than ten years ago.
In this talk we push forward a level-set approach to surface evolution by crystalline mean curvature. The main difficulty is that crystalline mean curvature is a nonlocal quantity and it may not be a constant on each flat potion of a surface. (In the case of curve evolution it is always a constant over a segment.) We overcome this difficulty by introducing a suitable notion of viscosity solutions so that a comparison principle holds. We further construct a global-in-time solution as a limit of smoother problem. A delicate analysis is necessary to achieve the goal. A similar but a simpler problem was studied in [MGP1], [MGP2]. We elaborate these approaches for our purpose.

[BCCN] G. Bellettini, V. Caselles, A. Chambolle, M. Novaga, Crystalline mean curvature flow of convex sets. *Arch. Ration. Mech. Anal.* 179 (2006), 109-152.
[G] Y. Giga, Surface evolution equations. A level set approach. Monographs in Mathematics, 99. *Birkhauser Verlag, Basel*, 2006. xii+264 pp.
[MGP1] M.-H. Giga, Y. Giga and N. Pozar, Periodic total variation flow of non-divergence type in **R**^*n*. *J. Math. Pures Appl. (9)* 102 (2014), 203-233.
[MGP2] M.-H. Giga, Y. Giga and N. Pozar, Anisotropic total variation flow of non-divergence type on a higher dimensional torus. *Adv. Math. Sci. Appl.* 23 (2013), 235-266.

A. KRENER (Naval School, Monterey)
Speeding Up Model Predictive Control and Model Predictive Regulation

Abstract: Model Predictive Control (MPC) is an increasingly popular way of stabilizing a process to a set point. Recently we have offered a new way of tracking reference signals and/or rejecting disturbances called Model Predictive Regulation (MPR).
MPC is widely used in the chemical processing industries where the dynamics is slow enough so that the time steps can be long enough to solve the nonlinear program in a small fraction of one time step. We will offer several suggestions about how to speed up MPC and MPR so that it can be applied to systems with faster dynamics. Our ultimate goal is to speed up MPC and MPR enough so that they can be used to control constrained, fast and unstable systems such as a high performance airplane or helicopter.

J.M. LASRY (Univ. Paris Dauphine)
TBA

J. SPREKELS (WIAS, Berlin)

Optimal control of phase field systems involving dynamic boundary conditions and singular nonlinearities

Abstract: We study PDE systems of phase field type which are complemented by dynamic boundary conditions involving the Laplace-Beltrami operator. The evolution both in the bulk and on the boundary of the domain are driven by nonlinearities that exhibit a singular behaviour at the boundaries of their domains of existence. For such systems, distributed and boundary control problems are investigated, where we deal with both (differentiable) logarithmic nonlinearities and the (non-differentiable) case of subdifferentials of double obstacle potentials. First-order necessary and second-order sufficient optimality conditions are derived for the differentiable case, and a so-called "deep quench limit" in the differentiable case leads to first-order necessesary conditions in the nonsmooth double obstacle.