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SPECIAL ISSUE ON MODELING AND CONTROL IN SOCIAL DYNAMICS

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Motivation. There is an increasing interest for social dynamics emerging in a number of different fields. The broad definition of social dynamics is that of a system of active agents (other terms may be autonomous, intelligent, decision-making), which use elaborated interactions rules motivated by social features. One of the key aspects is that of self-organization, i.e. the emergence of complicate and often times very efficient group configuration by sophisticated yet simple individual interaction rules. Examples are found in different disciplines: animal groups in biology (e.g. murmuration of starlings), crowd dynamics (e.g. zipper effect at bottlenecks) and social networks (e.g. centrality of leaders).

Rationale. Even if the specific examples depend strongly on the specific features of interacting agents, general mathematical frameworks may capture the relevant mechanisms of self-organization. Ideally model design, for the purpose of forecasting and control of the group behavior, should be conducted in strict collaboration with experts of the specific fields: economics, sociology, psychology etc. Thus there is a high need of creating fruitful interactions among mathematicians working in the field and experts of other disciplines, who may be interested in the outcomes of advanced modeling and actively participate in suggesting the relevant features to be included in the models.

Specific focus. Within the broad field, we focused specifically on systems reproducing consensus, flocking and alignment phenomena and on their control. Examples of such systems are the Hegselmann-Krause model for opinion formation, and the Helbing-Molnar model for pedestrian dynamics.

Goals. The Special Issue encompasses contributions from leading researchers in the social sciences, engineers, physicists and mathematicians who are working on these problems. The goal is to enhance the communication, exchange of ideas and collaborations between these communities in order to better address social dynamic as a field, which poses many challenges still unsolved.

Contributions. The Special Issue consists of twelve contributions encompassing various mathematical models and applications of social dynamics. In particular the contributions can be grouped in four areas: 1) Social systems, 2) Economic systems, 3) Human crowds and 4) General math models.

The first area includes three papers. The contribution of Bellomo, Colasuonno, Knopoff and Soler discusses a model for evolution of criminality in a territory including three populations: citizens, criminals and detectives. Berestycki, Nadal and Rodriguez model riots via a system of ordinary differential equations and study traveling wave solutions. Finally, Hegselmann and Krause design an extension of the celebrated bounded confidence model to include the influence of radical groups and charismatic leaders.

Also the second area includes three contributions. The paper by Armbruster, Herty, Wang and Zhao deals with production processes and dispatch policies, while the one by Armbruster, Ringhofer and Tatcher proposes an agent-based kinetic model to simulate sales curves. Brugna and Toscani study a kinetic system for financial markets with different trader populations.

Four papers deal with human crowds and analyze models based on experiments. The first one, by Bravo, Caponigro, Leibowitz and Piccoli, proposes a cognitive model for crowd dynamics, which includes psychological insight and optimization criteria. The second one, by J. Fehrenbach, J. Narski, J. Hua, S. Lemercier, A. Jelic, C. Appert-Rolland, S. Donikian, J. Pettre and P. Degond, uses a follow-the-leader model for pedestrians walking-in-line. The third, by De la Croix and Egerstedt, focuses on humans interacting with a swarm of robots, using control Lyapunov functions for feasibility of particular geometric configurations. Finally, Lin and Lucas design a swarm-optimization model for emergency evacuation of airplanes.

General mathematical models were considered in two paper: Bongini, Fornasier, Junge and Scharf construct low-dimensional representations for high-dimensional alignment models; Herty, Pareschi and Steffensen consider control problems for large systems of interacting agents and studied the mean-field limit equations.

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