AKSOE 6 Economic Models and Evolutionary Game Theory I

Time: Tuesday 10:15–12:45 Room: BAR 205

AKSOE 6.1 Tue 10:15 BAR 205

Evolution rate is crucial for the emergence of cooperation — •Angel Sánchez[1,2], Carlos P. Roca[1,3], and José A. Cuesta[1] — [1]GISC/Matemáticas, Universidad Carlos III de Madrid, 28911 Leganés, Madrid, Spain — [2]Instituto de Biocomputación y Física de Sistemas Complejos (BIFI), Universidad de Zaragoza, 50009 Zaragoza, Spain — [3]Centro Nacional de Biotecnología, 28049 Cantoblanco, Madrid, Spain

A fundamental, profound and broad-ranging unsolved question is how cooperation among animals and humans has evolved. Evolutionary game theory is the mathematical framework that has provided the deepest insights into this issue. Simple games such as the Prisoner's Dilemma, the snowdrift game or the stag-hunt game have been the subject of intense experimental and theoretical work along this line. The emergence of cooperation has been shown to be sensitive to whether populations are well-mixed, such as in replicator dynamics evolution, or spatially structured. Co-evolution of agents and networks and finite population effects are also relevant factors. None of these approaches has considered the influence of different evolution rates. Here we show that the pace at which selection acts on the population is crucial for the appearance and stability of cooperation. Even in non-dilemma games such as Harmony, where cooperation is the only possible rational outcome, defectors may be selected for if population renewal is very rapid. Similar results are found for coordination games such as the stag-hunt, where the basins of attraction of cooperation and defection depend on the evolution rate. Our results point out the necessity to include a discussion of the time scale of evolution in any study about cooperation.

AKSOE 6.2 Tue 10:45 BAR 205

Statistical mechanics of random replicators and matrix games — •Tobias Galla — The Abdus Salam International Centre for Theoretical Physics Trieste, Italy

An important objective of game theory consists in the static study of Nash equilibria. Popular cases are situations in which the payoffs take matrix form, the well-known prisoner's dilemma or the rock-scissors-paper game are simple examples.

Replicator equations on the other hand describe the dynamic evolution of self-reproducing interacting species for example in population dynamics and theoretical biology. In the context of evolutionary game theory these equations correspond to matrix games which are played repeatedly by players, who then reproduce according to their success, passing on their strategies to their children.

In this talk we will apply the methods and concepts of statistical mechanics of disordered systems to study large dynamical replicator systems with random couplings. We will give an overview over their basic phenomenological behaviour and will address different ergodic/non-ergodic phase transitions exhibited by such models. The connection between ergodicity in replicator systems, their attractors and the Nash equilibria in the corresponding games will be discussed.

AKSOE 6.3 Tue 11:15 BAR 205

Learning through social interactions — •Viktoriya Semeshenko[1], Mirta B. Gordon[1], and Jean-Pierre Nadal[2] — [1]Laboratoire Leibniz-IMAG, 46 av Felix Viallet, 38031 Grenoble Cedex 1, France — [2]Laboratoire de Physique Statistique, Ecole Normale Superieure, 24 rue Lhomond, 7231 Paris cedex 05, France

We consider a simple market model in which a population of heterogeneous individuals, subject to local positive externalities, must choose repeatedly either to buy or not a unit of a single homogeneous good, at a price posted by a monopolist [1]. If the weight of externalities is strong enough, there are multiple Nash equilibria, revealing coordination problems. We assume that individuals learn to make their choices repeatedly using deterministic and trembling hand decision rules. We study the performances along the learning path and the reached equilibria for different learning schemes [2]. In the presence of multiple equilibria, coordination on the optimal one through learning is shown to be reached only with some of the learning schemes. The result of the learning rules depends crucially on the learning parameters and the agents' initial beliefs. With a trembling hand dynamics the system is shown to converge to a stationary state, in which the decisions fluctuate close to the optimal ones. This equilibrium has the flavor of (but is not identical to)what is known as a 'Quantal Response Equilibrium' in the economic literature.

[1] Gordon M. B., Nadal J.-P., Phan D., Vannimenus J: Seller's dilemma due to social interactions between customers. *Physica A, 356, Issues 2-4:628-640*, (2005).
[2] Camerer C. F. Behavioral Game Theory. *Princeton Press*, (2003).

AKSOE 6.4 Tue 11:45 BAR 205

Faster-is-slower effects in traffic and production systems — •Dirk Helbing — Institute for Transport and Economics, TU Dresden

The faster-is-slower effect has been first discovered for panicking pedestrians, where evacuation times may increase, when a crowd is in a rush. Similar phenomena have now been discovered for other traffic and production systems. We will present various examples, analytical approaches to intermittent pedestrian flows and methods of self-organized flow optimization.The applications reach from intersecting pedestrian and vehicle streams over chip production upto harbor logistics. We will also address the optimization of productions processes and traffic light scheduling in urban traffic networks. The theoretical challenges of these problems and the economic potentials of related results can hardly be overestimated.

References:

[1] D. Helbing, I. Farkas, and T. Vicsek, Simulating dynamical features of escape panic.Nature 407, 487-490 (2000).
[2] D. Helbing, S. Lammer, and J.-P. Lebacque, Self-organized control of irregular or perturbed network traffic, in: C. Deissenberg and R. F. Hartl (eds.) Optimal Control and Dynamic Games (Springer, Dordrecht), pp. 239-274.
[3] D. Helbing, R. Jiang, and M. Treiber, Analytical investigation of oscillations in intersecting flows of pedestrian and vehicle traffic. Physical Review E 72, 046130 (2005).

AKSOE 6.5 Tue 12:15 BAR 205

The remarkable effects of a finite score memory in Minority Games — •Andrea De Martino — CNR-ISC, INFM-SMC, Dipartimento di Fisica, Universita' di Roma "La Sapienza", p.le A. Moro 2, 00185 Roma (Italy)

Introducing a finite score memory in Minority Games leads to substantial changes in both the static and the dynamical picture of the model. As expected, the dependence of the stationary state on the initial conditions is removed (which is desirable). However, the dynamics is characterized by anomalous fluctuation outbutsts and volatility clusering. Memory also turns out to affect the emergence of stylized facts and the static properties of Minority Games in a non-trivial way. These models constitute a serious challenge for statistical physics and their characterization requires a combination of analytical and numerical techniques. We will review their phenomenology and address recent progress made in the direction of a deeper theoretical understanding of the nature of these peculiar dynamical regimes.