AGSOE 12: Economic Models and Evolutionary Game Theory IV

Time: Wednesday 14:00–16:00 Location: BAR 205

AGSOE 12.1 Wed 14:00 BAR 205

Evolutionary Dynamics with High Mutation Rates — •Arne Traulsen — Max-Planck-Institute for Evolutionary Biology, 24306 Plön, Germany

Evolutionary game theory describes systems in which successful strategies spread in a population. It is usually argued that it equally applies to genetical reproduction and to social imitation. However, while biological mutation rates are small, social mutation or exploration rates may be high. This can have a decisive impact on the evolution of cooperation and punishment [1]. Under weak selection, all strategies have similar abundance and one may argue that increasing the mutation rates does not change the strategy abundance. However, it can be shown that even for weak selection, different conditions for the abundance of strategies are obtained in $n \times n$ games for high and low mutation rates [2]. Only for 2×2 games, the condition under which one strategy is more abundant than the other does not depend on the mutation rate at all [3].

[1] A. Traulsen, C. Hauert, H. de Silva, M.A. Nowak, and K. Sigmund, PNAS, in press
[2] T. Antal, A. Traulsen, H. Ohtsuki, C. Tarnita, and M.A. Nowak, arXiv:0811.2009
[3] T. Antal, M.A. Nowak, and A. Traulsen, JTB, in press, arXiv:0809.2804

AGSOE 12.2 Wed 14:30 BAR 205

What is the effect of networks on cooperation? Lack of universality in evolutionary game theory on graphs. — Carlos P. Roca[1,2], Sergi Lozano[1], José A. Cuesta[2], Alex Arenas[3,4], and •Angel Sánchez[3,4,5] — [1]SOMS, ETH Zürich, Switzerland — [2]GISC, U. Carlos III, Madrid, Spain — [3]U. Rovira i Virgili, Tarragona, Spain — [4]BIFI, Zaragoza, Spain — [5]ICMAT, CSIC-UAM-UC3M-UCM, Madrid, Spain

In the past few years much work has been devoted to the study of the emergence of cooperation by considering evolutionary games among individuals whose interactions are governed by a network. This line of research has produced interesting and inspiring results; however, a complete picture of the observed phenomenology and the mechanisms behind it is lacking. In this talk, we provide evidence that such a complete picture can not be found because evolutionary game theory on graphs is highly non-universal. Extensive simulations allow us to conclude that the enhancement or inhibition of cooperation strongly depends on the type of network, the type of evolutionary dynamics and the social dilemma under study. Furthermore, the phenomenology observed in real social networks may be considerably different from the results of this kind of models. In particular, the existence of a mesoscopic level of organization can not be neglected. Our main conclusion is that modeling the emergence of cooperation in a sensible way requires looking at a wide range of social dilemmas and not at a particular one, and that this research should always have in mind a specific context for application because of the lack of universality.

AGSOE 12.3 Wed 15:00 BAR 205

Self-organization of scale free topologies in an adaptive network model of cooperation — •Gerd Zschaler and Thilo Gross — Max-Planck-Institut für Physik komplexer Systeme, Dresden, Germany

We study a model of cooperation on an adaptive network, where both the evolution of strategies and the dynamics of the network topology depend on the individuals' fitness. In our model, individuals adopting either strategy of cooperation or defection are represented by the nodes in a network and participate in a snowdrift game with each of their neighbors. We consider two mechanisms of the system's evolution: A player may adopt the strategy of a more successful neighbor (that receives a higher payoff) with a given probability. Additionally, a successful player can reshape its environment by cutting a link to a neighbor with lower payoff and rewiring to another randomly selected node.

Employing full simulations of the network and analytical approximation through moment-closure techniques, we show that sufficiently strong payoff-dependence in the linking dynamics leads to a higher fraction of cooperators in the stationary regime. As selective rewiring implies a "rich-stays-rich" mechanism in our model, the creation of high-degree nodes is observed. This results in the appearance of a power-law tail in the degree distribution.

AGSOE 12.4 Wed 15:30 BAR 205

Cycles of cooperation and defection in imperfect learning — •Tobias Galla — Theoretical Physics, School of Physics and Astronomy, The University of Manchester, Manchester M139PL, UK

In this talk we discuss the dynamics of agents learning to play a two-player game while subject to memory-loss. If players make an infinite number of observations (actions of their opponent) between adaptation events, the dynamics is deterministic and described by so-called Sato-Crutchfield equations, a modification of the standard replicator dynamics. In case of a finite number N of observations between two adaptation events, the learning dynamics becomes stochastic as the opponent's mixed strategy profile can no longer be sampled accurately.

We discuss the effects of the batch size N and the memory-loss rate for the specific example of the iterated prisoner's dilemma. The deterministic learning dynamics at non-zero memory-loss does here in general not converge to the Nash equilibrium describing full defection, but instead limit cycles or reactive fixed points can be found. The dynamics at finite batch sizes is seen to exhibit sustained stochastic oscillations between co-operation and defection, and the spectrum of these oscillations is obtained analytically within an expansion in the inverse batch size.