SOE 8: Dynamics of Social and Adaptive Networks II

Time: Friday 11:15–12:45 Location: H6

SOE 8.1 Fri 11:15 H6

Spinning faster and faster: acceleration of collective attention
— •Philipp Hövel — University College Cork, Irlenad

Due to the advent of smart phones and other tools of modern communication, news are available in real time and social media reactions spread across the globe in seconds. As a consequence, the public discussion seems to be accelerated and its pace ever increasing. In longitudinal datasets across various domains (online and offline), covering multiple decades, we find significantly increasing gradients and shortened periods in the trajectories of how cultural items receive collective attention. Is this the inevitable conclusion of the way information is disseminated and consumed?

We present a simple mathematical model that is based on Lotka-Volterra dynamics with a memory kernel. The three main mechanisms are imitation/production, saturation/aging and competition. The common resource, for which different topics compete, is the collective attention of the userbase. The numerical time series are able to explain the empirical data remarkably well. Our modeling suggests that the accelerating ups and downs of popular content are driven by increasing production and consumption of content, resulting in a more rapid exhaustion of limited attention resources. In the interplay with competition for novelty, this causes growing turnover rates and individual topics receiving shorter intervals of collective attention.

SOE 8.2 Fri 11:45 H6

Evolutionary Reinforcement Learning Dynamics with Irreducible Environmental Uncertainty
— •Wolfram Barfuss[1,2] and Richard P. Mann[2] — [1]University of Tübingen, Germany — [2]University of Leeds, United Kingdom

In this work we derive and present evolutionary reinforcement learning dynamics in which the agents are irreducibly uncertain about the current state of the environment. We evaluate the dynamics across different classes of partially observable agent-environment systems and find that irreducible environmental uncertainty can lead to better learning outcomes faster, stabilize the learning process and overcome social dilemmas. However, as expected, we do also find that partial observability may cause worse learning outcomes, for example, in the form of a catastrophic limit cycle. Compared to fully observant agents, learning with irreducible environmental uncertainty often requires more exploration and less weight on future rewards to obtain the best learning outcomes. Furthermore, we find a range of dynamical effects induced by partial observability, e.g., a critical slowing down of the learning processes between reward regimes and the separation of the learning dynamics into fast and slow directions. The presented dynamics are a practical tool for researchers in biology, social science and machine learning to systematically investigate the evolutionary effects of environmental uncertainty.

SOE 8.3 Fri 12:15 H6

Desynchronization Transitions in Adaptive Networks
— •Rico Berner[1,2], Simon Vock[3], Serhiy Yanchuk[2], and Eckehard Schöll[1,4,5] — [1]Institut für Theoretische Physik, Technische Universität Berlin, Germany — [2]Institut für Mathematik, Technische Universität Berlin, Germany — [3]Charité-Universitätsmedizin Berlin, Germany — [4]Bernstein Center for Computational Neuroscience Berlin, Humboldt-Universität Berlin, Germany — [5]Potsdam Institute for Climate Impact Research, Potsdam, Germany

Adaptive networks change their connectivity with time, depending on their dynamical state [R. Berner, E. Schöll and S. Yanchuk, SIAM J. Appl. Dyn. Syst. 18, 2227 (2019)]. While synchronization in structurally static networks has been studied extensively, this problem is much more challenging for adaptive networks. In this work, we develop the master stability approach for a large class of adaptive networks [R. Berner, S. Vock, E. Schöll and S. Yanchuk, PRL 126, 028301 (2021)]. This approach allows for reducing the synchronization problem for adaptive networks to a low-dimensional system, by decoupling topological and dynamical properties. We show how the interplay between adaptivity and network structure gives rise to the formation of stability islands. Moreover, we report a desynchronization transition and the emergence of complex partial synchronization patterns induced by an increasing overall coupling strength. We illustrate our findings using adaptive networks of coupled phase oscillators and FitzHugh-Nagumo neurons with synaptic plasticity.