# SOE 14: Social Systems, Opinion and Group Formation

Time: Thursday 11:30–12:30 Location: GÖR 226

SOE 14.1 Thu 11:30 GÖR 226

**Consensus and diversity in multi-state noisy voter models** — •Tobias Galla[1,2] and Francisco Herrerías-Azcué[2] — [1]Instituto de Fisica Interdisciplinar y Sistemas Complejos IFISC (CSIC-UIB), 07122 Palma de Mallorca, Spain — [2]Theoretical Physics, Department of Physics and Astronomy, The University of Manchester, Manchester M13 9PL, UK

We study a variant of the voter model with multiple opinions; individuals can imitate each other and also change their opinion randomly in mutation events. We focus on the case of a population with all-to-all interaction. A noise-driven transition between regimes with multi-modal and unimodal stationary distributions is observed. In the former, the population is mostly in consensus states; in the latter opinions are mixed. We derive an effective death-birth process, describing the dynamics from the perspective of one of the opinions, and use it to analytically compute marginals of the stationary distribution. These calculations are exact for models with homogeneous imitation and mutation rates, and an approximation if rates are heterogeneous. Our approach can be used to characterize the noise-driven transition and to obtain mean switching times between consensus states. We also discuss the influence of zealots on the transition between unimodal and multi-modal stationary distributions.

Reference: Francisco Herrerías-Azcué, Tobias Galla, Phys. Rev. E 100, 022304 (2019)

SOE 14.2 Thu 11:45 GÖR 226

**A pair-based approach for modelling epidemics on networks** — Rory Humphries, Kieran Mulchrone, and •Philipp Hövel — School of Mathematical Sciences, University College Cork, Ireland

We present a pair-based description to study the spreading of epidemics. For the contagion process, we consider a class of SIS, SIR and SIRS models, which are realized as a temporal network. The shift in perspective from individual-based to pair-based quantities enables exact modelling of Markovian epidemic processes on temporal tree graphs. On arbitrary graphs, the proposed pair-based model provides a substantial increase in accuracy at a low computational and conceptual cost compared to the individual-based model. Using the pair-based model, we derive useful analytical expressions, such as the epidemic threshold for testing the global susceptibility to epidemic outbreaks. This allows to determine the likelihood of paths that a disease may take and to identify areas that will be most affected.

SOE 14.3 Thu 12:00 GÖR 226

**A network-based microfoundation of Granovetter's threshold model for social tipping** — •Marc Wiedermann[1], E. Keith Smith[2], Jobst Heitzig[1], and Jonathan F. Donges[1,3] — [1]Potsdam Institute for Climate Impact Research, Potsdam, Germany — [2]GESIS – Leibniz Institute for the Social Sciences, Cologne, Germany — [3]Stockholm Resilience Centre, Stockholm, Sweden

Social tipping, where minorities trigger larger populations to engage in collective action, has been suggested as one key aspect in addressing contemporary global challenges, such as climate change and biodiversity loss. Here, we refine Granovetter's widely acknowledged theoretical threshold model of collective behavior as a numerical modelling tool for understanding social tipping processes and resolve issues that so far have hindered such applications. Based on real-world observations and social movement theory, we group the population into certain or potential actors, such that – in contrast to its original formulation – the model predicts non-trivial final shares of acting individuals. Then, we use a network cascade model to explain and analytically derive that previously hypothesized broad threshold distributions emerge if individuals become active via social interaction. Thus, through intuitive parameters and low dimensionality our refined model is adaptable to explain the likelihood of engaging in collective behavior where social tipping like processes emerge as saddle-node bifurcations and hysteresis.

SOE 14.4 Thu 12:15 GÖR 226

**Social features in ICT data** — •Gábor Tamás[1], Yohsuke Murase[2], Hang-Hyun Jo[3,4,5], János Kertész[5,6], Kimmo Kaski[5], and János Török[1,7] — [1]Dept. of Theoretical Physics, BME, Budapest H-1111, Hungary — [2]R-CCS, Kobe, Hyogo 650-0047, Japan — [3]APCTP, Pohang 37673, Republic of Korea — [4]Dept. of Physics, POSTECH, Pohang 37673, Republic of Korea — [5]Dept. of Computer Science, Aalto University, Espoo FI-00076, Finland — [6]DNDS, CEU, Budapest H-1051, Hungary — [7]MTA-BME Morphodynamics Research Group, Budapest H-1111, Hungary

In human societies homophily, the tendency of similar individuals getting associated and bonded with each other is known to be a prime tie formation factor between a pair of individuals. This is manifested in the egocentric networks of humans, which are characterized by different communities related to our activities. The social features of the acquaintances in these groups are similar to some extent.

To quantify the above effect, we have measured the average group overlap with the ego on two different social network sites (iWiW and Pokec). We found that the feature overlap counterintuitively increases with the egocentric group size.

We use a model [1] that describes social tie formation based on focal and cyclic closure, and we show that the above effect is related to the social effort needed to keep up a big community.

[1] Murase, Y., Jo, H. H., Török, J., Kertész, J., & Kaski, K. (2019). Structural transition in social networks: The role of homophily. Scientific reports, 9(1), 4310.