# SOE 21: Social Systems II

Time: Thursday 17:00–18:30 Location: GÖR 226

SOE 21.1 Thu 17:00 GÖR 226

**Explosive dynamics of social networks** — •Nora Molkenthin[1,2] and Marc Timme[1,2] — [1]Network Dynamics, Max Planck Institute for Dynamics and Self-Organization (MPIDS), 37077 Göttingen, Germany — [2]Institute for Nonlinear Dynamics, Faculty of Physics, University of Göttingen, 37077 Göttingen, Germany

Explosive transitions in and on complex networks have recently attracted attention for percolation and synchronization processes. Here we introduce a novel one-parameter family of random network ensembles that exhibit an explosive transition of the degree distribution. The model can be applied to the dynamics of social network interactions, where the parameter measures the degree of decision power in pairwise interactions between individuals. The revealed mechanism underlying the transition may help to understand the key structural difference between large online communities and personal face-to-face friendships.

SOE 21.2 Thu 17:15 GÖR 226

**Dynamic Content-Communities on Social Networks** — •Philipp Lorenz[1], Frederik Wolf[1], Jonas Braun[2], Philipp Hövel[1], Colin Bauer[3], Julien Siebert[3], and Vitaly Belik[4] — [1]TU Berlin, Hardenbergstraße 36, 10623 Berlin — [2]HU Berlin — [3]Zalando SE — [4]FU Berlin

One of the best studied property of real world networks is their community structure, which represents their composition of dense subnetworks. They can be overlapping [1], hierarchical [2] and temporal [3]. In human social networks all of these properties come into play [4] and can be found on different levels.

On Internet platforms content is posted and within that, trends can be captured as communities of linked topics. They behave highly dynamical, they are born, merge, split or grow and shrink, so capturing them required new methods for temporal community analysis.

Such clusters of topics can move and spread rapidly on social networks. Since these movements depend strongly on the underlying topology, we created multilayer networks, which link contents to users and uncover their relations and interplay.

[1] Palla, G. et al., Nature 435, 7043 (2005) [2] Peixoto, T. P., Phys. Rev.X 4, 011047 (2014) [3] Palla, G. et al., Nature 446, 664 (2007) [4] Sekara, V. et al., PNAS 113, 36, (2016)

SOE 21.3 Thu 17:30 GÖR 226

**Lévy deviations from proportional effect in online attention** — •Jose M. Miotto[1] and Eduardo G. Altmann[2] — [1]Max-Planck-Institut für Physik komplexer Systeme, Dresden, Germany — [2]School of Mathematics and Statistics, University of Sydney, Sydney, Australia

The competition for the attention of users is a central element of the Internet. Crucial issues are the origin and predictability of big hits, the few items that capture a big portion of the total attention. We address these issues analysing 10 million time series of videos' views from YouTube. We find that the average gain of views is linearly proportional to the number of views a video already has, in agreement with usual rich-get-richer mechanisms and Gibrat's law, but this fails to explain the prevalence of big hits. The reason is that the fluctuations around the average views are themselves heavy tailed. Based on these empirical observations, we propose a stochastic differential equation with Lévy noise as a model of the dynamics of videos. We show how this model is substantially better in estimating the probability of an ordinary item becoming a big hit, which is considerably underestimated in the traditional proportional-growth models.

SOE 21.4 Thu 17:45 GÖR 226

**Elo vs. Fifa ranking: how to best estimate the strength of soccer teams?** — Patrick Bücker, Oliver Rubner, and •Andreas Heuer — Institut für Physikalische Chemie, WWU Münster, 48149 Münster

In chess it is common to attribute an Elo value to each player as a measure of his/her quality. From the difference of the Elo values of two players the probabilities of the possible outcomes of a chess match can be predicted.

Recently, the Elo approach has been generalized to soccer for club teams as well as for national teams [1]. On the national level the Elo ranking system opposes the better known Fifa ranking system.

Based on the known probabilistic properties of soccer matches [2] we have analysed the strengths and weaknesses of the Elo approach. It turns out that in particular for the relevant case of time-dependent variations of the team strengths the Elo approach performs very well and allows a reliable prediction of the outcome of soccer matches. Furthermore, possible improvements are suggested and a comparison with the Fifa ranking is discussed.

[1] http://www.eloratings.net
[2] A. Heuer, O. Rubner, PLoS ONE 9, e104647 (2014)

SOE 21.5 Thu 18:00 GÖR 226

**Order statistics of horce racing and the randomly broken stick** — •Julius Bonart — Financial Computing & Analytics, Department of Computer Science, University College London, WC1E 6BT

We find a remarkable agreement between the statistics of a randomly divided interval and the observed statistical patterns and distributions found in horse racing betting markets. We compare the distribution of implied winning odds, the average true winning probabilities, the implied odds conditional on a win, and the average implied odds of the winning horse with the corresponding quantities from the "randomly broken stick problem". We observe that the market is at least to some degree informationally efficient. From the mapping between exponential random variables and the statistics of the random division we conclude that horses' true winning abilities are exponentially distributed.

SOE 21.6 Thu 18:15 GÖR 226

**Innovation- and information production rate for sentences of particular length** — •Bo Liu[1], Stefan Thurner[1,2,3,4], Rudolf Hanel[1], and Bernat Corominas-Murtra[1] — [1]Section for Science of Complex Systems, Medical University of Vienna, Spitalgasse 23, A-1090, Austria — [2]Santa Fe Institute, 1399 Hyde Park Road, Santa Fe, NM 87501, USA — [3]International Institute for Applied Systems Analysis, Schlossplatz 1, A-2361 Laxenburg, Austria — [4]Complexity Science Hub Vienna, Josefstädter Straße 39, A-1080, Austria

Innovations are part of our lives and are the engines that boost our society. The understanding of the underlying dynamics is therefore essential. Language has been considered as a relatively simple toy model to study innovation dynamics. Information in language is encoded in units of different sizes: letters, words, sentences and paragraph. While at the level of letters, many results on information production rate exist, on the level of sentences much less is known. A simple measure of "innovation rate" in language is the so-called Heaps' exponent. We investigate subtexts which are composed of sentences with a particular length (number of words). A non-monotonic behavior of the Heaps' exponent vs. sentence lengths is found, with a maximum value at around sentence length 7. Similar behavior appears in the Zipf exponent and the cross entropy, which measures the information production rate. We analyze texts of the Corpus of Historical American English (CoHA) from 1800 to 2000 and find that the discovered pattern is slightly becoming stronger across history.