

SOE 7: Poster

Time: Monday 17:00–20:00

Location: Poster E

SOE 7.1 Mon 17:00 Poster E

The 'Babylonian' Accounts of Society — ●STEPHEN I. TERNYIK — POB.201, D-82043 Munich

Since Sumerian and Babylonian times, the socio-physics of our accounting system is based on land as private property. All cyclical economic crises are caused by the exhausting increase of rent over growth ($r > g$). Nobel laureate R. Stone (1984) already pointed to the scientific problem, that the future accounts of society must statistically balance the economy, ecology and demographics. When rent outperforms growth, banking excesses in credit money do reinforce this depressive instability, thus curbing the incentive for productivity (liquidity flows into assets). The coming acceleration of exponential finance will add to this tendency. Future automation and clean energy can be of human benefit, if we can adjust the accounting systems of our society to the emerging economic reality. Otherwise, we will face a total collapse of the whole body economic. It is like the analogy of a traffic accident that paralyzes all traffic. Spaceship earth can be kept relatively stable, if we will adapt our accounting techniques to dynamic efficiency.

SOE 7.2 Mon 17:00 Poster E

The Geometry of Moore-Penrose Generalized Matrix Inverses — ●MARTIN ERIK HORN — Berlin School of Economics and Law/HWR Berlin, FB 1 – Department of Business and Economics, FE Quantitative Methods

More and more introductory business mathematics textbooks present Moore-Penrose generalized matrix inverses as elementary part of the foundations of mathematical economics. This is a didactical problem as most textbooks introduce these inverses by purely algebraic reasoning based on the four Moore-Penrose conditions.

To give a complete picture of these mathematical structures it is helpful to introduce and to describe Moore-Penrose generalized matrix inverses also by using geometric representations based on the ideas of Grassmann's theory of extensions. This didactical path will enable learners to understand that a Moore-Penrose inverse only is the scalar part of a more natural geometric matrix inverse which usually possesses higher-dimensional terms, too

SOE 7.3 Mon 17:00 Poster E

Large-deviation properties of oscillator models of energy grids — ●YANNICK FELD and ALEXANDER K. HARTMANN — Institute of Physics, University of Oldenburg, Germany

The exit from nuclear and fossil-fuel energy is resulting in the need for extensive installation of renewable energy generators. Therefore maintaining a stable energy grid becomes more challenging. To find very stable and very unstable grid topologies we apply Markov Chain Monte Carlo simulations of random networks. With large-deviation techniques, specifically by using an artificial finite-temperature (Boltzmann) ensemble, one can access a broad range of the network probability distribution up to very small probability densities (e.g. 10^{-50}) [1]. In the past large-deviation properties of static power grids were investigated [2]. Here we apply the same approach to a dynamic model of power grids, specifically a Kuramoto-like model [3].

[1] A.K. Hartmann, Eur. Phys. J. B **84**, 627-634 (2011)[2] T. Dewenter and A.K. Hartmann, New J. Phys. **17** 015005 (2015)[3] G. Filatrella, A.H. Nielsen, and N.F. Pedersen, Eur. Phys. J. B **61** 485-491 (2008)

SOE 7.4 Mon 17:00 Poster E

Lane Change Prediction in an Urban Area — ●KAROLINE GRIESBACH and KARL HEINZ HOFFMANN — Institute of Physics Technische Universität Chemnitz, D-09107 Chemnitz, +49 371 531 35456

The prediction of the lane change and its integration in advanced driving assistance systems can reduce traffic accidents. A machine learning algorithm for lane change prediction will be discussed. The algorithm was implemented with different input variables which belong to driver attributes and vehicle attributes. The input data was provided by a naturalistic driving study and divided into a training set and a validation set. The results show that the distinction between lane change and no lane change patterns is possible.

SOE 7.5 Mon 17:00 Poster E

Glassy States of Aging Social Networks — ●FOROUGH

HASSANIBESHILI^{1,3}, LEILA HEDAYATIFAR¹, HADISEH SAFDARI¹, GHOLAMREZA JAFARI¹, and MARCEL AUSLOOS² — ¹Shahid Beheshti University, Tehran, Iran — ²Group of Researchers for Applications of Physics in Economy and Sociology (GRAPES), Belgium — ³Potsdam Institute for Climate Impact Research, Germany

Tension reduction is a predominant principle that contributes to the formation of human interactions. This principle acts as a self-organizing process; it indicates that social communications are established based on the tendency towards balanced states. Interesting questions that follow concern what parameters have a pivotal role in the social network dynamics. An appropriate answer seems to lie in the history of relationships. In order to investigate some history (memory) effect on social networks, we introduce a temporal kernel function into the Heider conventional balance theory, allowing for the quality of past relations to contribute to the evolution of the system. We have found out that memory sometimes withstands the quick evolution of the network and eventually preserves the system in unstable but long-lived states namely, glassy states. Under such circumstances, for various time intervals, the system has no tendency to evolve towards global or local minima. In contrast to jammed states (local minimum states), in which systems only experience negative energies, glassy states can occur in positive energy states, thereby imposing instability to and keeping stress in the system.

SOE 7.6 Mon 17:00 Poster E

Are democracies stable? A case study on rise and fall of extremists in Europe — ●KAI SEEGER, FAKHTEH GHANBARNEJAD, and PHILIPP HÖVEL — Institut für Theoretische Physik, TU Berlin

A German proverb says *competition stimulates business*. This seems to hold true for many examples from politics to economics. Recent outcomes of elections in France, Germany and Austria have shown an increase of power of formerly small right wing parties after the established parties seemed to stop provoking each other and thus lost many votes. Similar examples can be found in marketing of companies, artists creating a fan base and more. In this work we investigate the dynamic of opinions in a population in connection with control measures of different parties with focus on addressing, challenging and attacking the other parties by applying techniques from data mining and analysis of collected digital data. Then we develop a novel approach to model this phenomenon. Finally we compare the real outcome with simulated data and discuss the successful stable strategies for future scenarios.

SOE 7.7 Mon 17:00 Poster E

Statistical patterns of Lithuanian parliamentary elections — ●ALEKSEJUS KONONOVICIUS — Vilnius University, Institute of Theoretical Physics and Astronomy, Vilnius, Lithuania

In this contribution we analyze statistical patterns of Lithuanian parliamentary elections. Namely, we consider parties' vote share at polling stations level. Using Bayesian approach we show that the empirical distributions are rather well fitted by the Weibull and Beta distributions, while normal distribution, often used in the literature, works less well. We provide some arguments on why this happens and why normal distribution seems to provide appropriate fit for data considered in the other works. We propose a simple agent-based model, which serves as an argument on why the Beta distribution seems to be the best candidate to fit empirical vote share distributions. The contribution will cover material from [1,2].

[1] A. Kononovicius, Complexity 2017, 7354642 (2017), doi: 10.1155/2017/7354642.

[2] A. Kononovicius, arXiv:1709.07655 [physics.soc-ph].

SOE 7.8 Mon 17:00 Poster E

Multi-Objective Goal Programming Formulation of the Markowitz Portfolio including Diversification with respect to Tail Risks — ●DANIEL CHRISTOPHER MERTEN — Jacobs University, Bremen, Deutschland

The paper aims at adding a tail risk diversification approach to the Markowitz problem, where the tail dependencies are computed using a mixture copula that contains Gaussian and Gumbel contributions whose parameters are estimated based on a maximum likelihood method. In addition, the empirical statistical distributions of

the respective assets are reproduced by deploying an extensive set of marginal distributions such as generalized hyperbolic and generalized lambda distributions, while the latter turns out to be the more appropriate option in terms of computational efficiency. Finally, the performance of such an extended Markowitz portfolio is compared to a naive diversification benchmark portfolio.

SOE 7.9 Mon 17:00 Poster E

Fire-walling banks and assets: A network based approach — SASIDEVAN VIJAYAKUMAR¹ and NILS BERTSCHINGER² — ¹Cochin University of Science and Technology, Cochin, India. — ²Frankfurt Institute for Advanced Studies, Frankfurt am Main

Foreseeing and preventing cascading failures in a financial network is a primary concern in the present era of ever increasing complexity and connectivity in finance. Apart from direct contagion spreading via counter-parties defaulting, another important mechanism by which defaults can propagate in a network of banks is via ‘fire-sales’ of assets. The initial reasons for such a fire sale could be portfolio constraints, either set by a regulatory authority or due to acute financing needs. Asset liquidation by a bank then depreciate asset prizes and thereby put pressure on the balance sheet of other banks holding the same assets. The latter may then be forced to liquidate its assets thereby triggering further rounds of fire sales.

In this work, we use a quantitative framework to model such ‘asset-price-contagion’ on a bipartite network consisting of banks and assets. We propose a general centrality measure for this dynamic process which captures the systemic importance of banks as well as assets in the network. Using data from European Banking Authority (EBA), we show that bailing out banks and/or active buying of assets by an agency based on our centrality measure could significantly reduce the probability and extent of contagion. Yet, even such targeted interventions either cannot fully prevent contagion as it exhibits an all-or-nothing phenomenon or incur substantial implementation costs.

SOE 7.10 Mon 17:00 Poster E

Interactive dynamics vs. bursty networks — EBRAHIM SAJJADI¹, FAKHTEH GHANBARNEJAD³, MOHAMMAD REZA EJTEHADI^{1,2}, and FARIBA KARIMI^{4,5} — ¹Department of Physics, Sharif University of Technology, P.O. Box 11155-9161, Tehran 1458889694, Iran. — ²Center of Excellence in Complex Systems and Condensed Matter (CSCM), Sharif University of Technology, Tehran 1458889694, Iran. — ³Institut für Theoretische Physik, Technische Universität Berlin, Berlin, Germany — ⁴University of Koblenz, Landau, Germany — ⁵GESIS, Leibniz Institute for the Social Sciences, Germany

SIS and SIR are common models for describing and predicting the epidemics of the contagious diseases. But these models fail to predict well patterns of spreading dynamics in the case of co-infective diseases, i.e. getting infected by one disease, alters the chance of getting infected by the other one. Co-infection has been studied in the mean field approximation and on complex networks with different topologies [EPL 104 50001 (2013), Nature Physics 11, 936–940 (2015)]. Another study shows temporal correlations of the underlying transmission network, e.g. hospital network, play role on co-infection dynamics [Frontiers in Physics, V 5, P 46 (2017)]. Here we go one step further and study the interplay between burstiness of the temporal networks and different time scales of co-infective dynamics. We show that within which range of burstiness, co-infection can effectively spread.

SOE 7.11 Mon 17:00 Poster E

Clustering behaviour and long-range memory in a network-based financial market model with fitness-dependent preferential attachment — FLORIAN MIX^{1,2}, JULIAN MALUCK^{1,2}, and REIK V. DONNER¹ — ¹PIK Potsdam, Germany — ²HU Berlin, Germany

The Cont-Bouchaud model (CBM) is a classical network model of financial markets explaining heavy-tailed stock price fluctuations by the emergence of herding phenomena among traders. Here, we study a thorough extension of the CBM that replaces the uncorrelated random rewiring of links among traders by a simple dynamical process that accounts for the fitness of each trader (measured in terms of its respective economic performance in the past). Specifically, the network of traders exhibits a preferential attachment rule with the linking probability following a Fermi function in dependence on the difference between any two nodes’ fitness values. We perform an extensive numerical analysis of the resulting model dynamics in terms of stock price, long-range memory of returns, and probability distributions of emerging cluster

sizes, fitness and wealth. Unlike the fixed exponent of the cluster-size distribution of the classical CBM, our model allows for tuning the exponent in terms of the scale parameter of the Fermi function. However, we find that the (finite-time) power-law exponent and the maximum cluster size saturate (if at all) only for very long simulation times, indicating the presence of extraordinary long transients in the model.

SOE 7.12 Mon 17:00 Poster E

From Relational Data to Graphs: Inferring Significant Links using Generalized Hypergeometric Ensembles — GIONA CASIRAGHI, VAHAN NANUMYAN, INGO SCHOLTES, and FRANK SCHWEITZER — Chair of Systems Design, ETH Zürich, Zürich, Switzerland

The inference of network topologies from relational data is an important problem in data analysis. Exemplary applications include the reconstruction of social ties from data on human interactions, the inference of gene co-expression networks from DNA microarray data, or the learning of semantic relationships based on co-occurrences of words in documents. Solving these problems requires techniques to infer significant links in noisy relational data.

In this poster, we present a new statistical modeling framework to address this challenge. The framework builds on generalized hypergeometric ensembles, a class of generative stochastic models that give rise to analytically tractable statistical ensembles of directed, multi-edge graphs. We show how this framework can be used to assess the significance of links in noisy relational data. We illustrate our method in two data sets capturing spatio-temporal proximity relations between actors in a social system. The results show that our analytical framework provides a new approach to infer significant links from relational data, with interesting perspectives for the mining of Big noisy data on social systems.

SOE 7.13 Mon 17:00 Poster E

The Expertgame - Measuring Social Capital in the Lab — GORM GRUNER JENSEN¹, MARTIN BENEDIKT BUSCH², MARCO PIOVESAN³, and JAN OLAF MIRKO HÄRTER³ — ¹Institute for Theoretical Physics, University of Bremen, Otto-Hahn-Allee D-28359 Bremen Germany — ²Biocomplexity, University of Copenhagen, Blegdamsvej 17 2100 København Ø — ³Økonomisk Institut, University of Copenhagen, Øster Farimagsgade 5, Bygning 26, 1353 København

There is a great interest in studying the dynamics of the formation of social networks. A great number of dynamics have been proposed which lead to networks reproducing observed statistics, such as power law distributions of connectivities or clustering. Here we flip the table and propose an experimental setup, the so called Expert Game, which allow us to directly observe the formation of a self-organized communication network between the participants in the lab. The game consist of a sequence of rounds. At the beginning of each round each player is assigned a question and an expertise. The objective is to find out which players has the expertise matching your question. When a players achieve find their expert they are rewarded with monetary prize. Information is passed between players by sending messages, which are costly to the sender, but free to receive. We find a very high correlation between how many messages a player send, and how many that same player receive. This indicate a reciprocal type of behavior, which effectively punishes the inactive players for not investing in the common good, and helps protecting the active players against exploitation.

SOE 7.14 Mon 17:00 Poster E

Symbolic dynamics techniques for complex systems: Application to share price dynamics — DAN XU and CHRISTIAN BECK — School of Mathematical Sciences, Queen Mary, University of London, London E1 4NS, UK

The symbolic dynamics technique is well-known for low-dimensional dynamical systems and chaotic maps, and lies at the roots of the thermodynamic formalism of dynamical systems. Here we show that this technique can also be successfully applied to time series generated by complex systems of much higher dimensionality. Our main example is the investigation of share price returns in a coarse-grained way [1]. A nontrivial spectrum of Renyi entropies is found. We study how the spectrum depends on the time scale of returns, the sector of stocks considered, as well as the number of symbols used for the symbolic description. Overall our analysis confirms that in the symbol space transition probabilities of observed share price returns depend on the entire history of previous symbols, thus emphasizing the need for a modelling based on non-Markovian stochastic processes. Our method allows for quantitative comparisons of entirely different complex sys-

tems, for example the statistics of symbol sequences generated by share price returns using 4 symbols can be compared with that of genomic sequences.

[1] D. Xu and C. Beck, EPL 118, 30001 (2017)

SOE 7.15 Mon 17:00 Poster E

Investigating the effect of deliberate misreporting on opinion formation — •VINCENT KUHLEN and STEFAN BORNHOLDT — Institute for Theoretical Physics, University of Bremen, Germany

After elections one may observe the fact that opinion polls underestimated the votes for certain parties. If we assume no errors in the methodologies we are left with only a few possible explanations. One theory is that participants are deliberately misreporting their preferences in personal interviews due to an element of social stigma. This phenomenon is also known as "shy Tory factor", "shy Trump-ers theory" or "Bradley effect". To examine the effects of this behaviour on opinion formation we studied the voter model on a 2d grid where agents were either neutral, moderate or extremist. Further we assumed that extremists may act like moderates or neutrals while interacting with agents of different opinion and compared the results with the undisturbed case.

SOE 7.16 Mon 17:00 Poster E

Creating the origin of the first Darwinian species — •CHARLOTTE V VOGELBUSCH¹, STEVEN H STROGATZ², HINRICH ARNOLDT¹, and MARC TIMME¹ — ¹Chair for Network Dynamics, Institute for Theoretical Physics and Center for Advancing Electronics Dresden (cfaed), TU Dresden, Dresden, Germany — ²Department of Mathematics, Cornell University, Ithaca, NY 14853, USA

Today's Darwinian evolution based on vertical descent was preceded by collective evolution dominated by horizontal gene transfer (HGT). Currently, no mechanistic dynamical model consistently explains the transition to start Darwinian evolution. Here we introduce a simple model of collectively evolving progenotes, describing genotype changes influenced by individual fitness, mutation, selection and HGT. It is based on a recent proposal characterizing how individual progenotes are dynamically distributed in the space of all possible genotypes by the population entropy [1]. The 'competence', describing the inclination to perform HGT events, was so far considered a non-dynamical bifurcation parameter. In our new model, HGT competence itself evolves dynamically and interacts with the population dynamics. Combining stochastic and nonlinear mean field dynamics illustrates a path towards the first species and the start of Darwinian evolution.

Ref.: [1] Phys. Rev. E 92, 052909 (2015)

SOE 7.17 Mon 17:00 Poster E

On the power-law tail of financial returns: The role of coordinated trading behaviour of heterogeneous speculators — •IVONNE BLAUROCK, NOEMI SCHMITT, and FRANK WESTERHOFF — University of Bamberg, Department of Economics, Germany

We propose a novel agent-based financial market model in which the trading behaviour of heterogeneous interacting speculators causes bubbles and crashes, excess volatility, serially uncorrelated returns, fat-tailed return distributions, and volatility clustering. The first three statistical properties are basically due to the speculators' heterogeneity since they all follow their own individual trading signals derived from fundamental and technical analysis. Our main attention here is on the model's ability to produce fat-tailed return distributions and volatility clustering. Schmitt and Westerhoff (JEE, 2017) found that sunspot events may lead to temporary coordination of speculators' trading behaviour. If speculators collectively react to similar trading signals, heterogeneity spontaneously vanishes and extreme returns emerge. Instead of sunspots, our model endogenously generates short-lived periods in which speculators' behaviour is coordinated causing market turmoil. Periods of high volatility are long-lasting since speculators persistently receive strong trading signals due to past price movements.

SOE 7.18 Mon 17:00 Poster E

Opinion Dynamics: Modeling Social Influence as a Coordination Game. — •MICHAEL SCHNABEL and DANIEL DIERMEIER — University of Chicago, Chicago, USA

We explore the dynamics of binary opinions in a large population of agents that are interacting in an all-to-all fashion and can be described by a mean field model. Individual agents update their opinions by interacting with each other assuming a tendency to align their opinion

with that of their partners. The likelihood of an agent to keep or switch its opinion depends on the current state of the system and is described by a rate function that can vary in shape but has to satisfy certain symmetry constraints. Insights about the properties of the system, such as the emergence of collective order (e.g. group-think) are obtained from the diffusion approximation and by calculating the equilibrium distribution of opinions for a representative set of rate functions. From a game theory perspective this type of dynamics is equivalent to a coordination game involving two or more players. We show how to map a given rate function into the corresponding game form and vice versa.

SOE 7.19 Mon 17:00 Poster E

Compulsory Persistent Cooperation in Continuous Public Goods Games — •YAN LI^{1,2}, XINSHENG LIU¹, and JENS CHRISTIAN CLAUSSEN² — ¹Nanjing University of Aeronautics and Astronautics, China — ²Computational Systems Biology, Jacobs University Bremen

The public goods game (PGG), where players either contribute an amount to the common pool or do nothing, is a paradigm for exploring cooperative behaviors in biological systems, economic communities and other social systems. Since in many situations, including climate game and charity donations, any contribution, however large or small, should be welcome. Consequently, the conventional PGG is extended to a PGG with continuous strategy space, which still cannot escape the tragedy of commons without any enforcing mechanisms. Here we propose persistent cooperation investment mechanisms based on continuous PGG, including single-group games, multi-group games with even investment, non-even investment and non-even investment with preference. We aim to reveal how these investment styles promote the average cooperation level in the absence of any other enforcing mechanisms. Simulations indicate that the multi-group game outperforms the single-group game. Among the multi-group game, non-even investment is superior to even investment, but inferior to non-even investment with preference. Our results may provide an explanation to the emergence of cooperative actions in continuous phenotypic traits based on inner competition and self-management without extrinsic enforcing mechanisms.

SOE 7.20 Mon 17:00 Poster E

Behavioral spruce budworm predation models — •BHAGYASHREE HOTE¹ and JENS CHRISTIAN CLAUSSEN² — ¹Computational Life Science Program, Jacobs University Bremen, Germany — ²Computational Systems Biology, Jacobs University Bremen, Germany

The classical spruce budworm model of predation by birds [Murray, Mathematical Biology, 2002] describes a sublinear onset of predation, motivated by a metaphor that birds predate the spruce budworms only if this food source reaches awareness among the predators. Here we base on our previous extension [Hote et al., 2017], where we explicitly introduce the fraction of birds that are aware of the additional food source as an additional dynamical variable and formulate a plausible dynamics for its increase and decay. For suitable parameters, this model shows an attracting spiral node, which results in damped oscillations of the prey density towards the fixed points. Here we discuss the spatial extension of the model, as well as the transition towards the original model.

SOE 7.21 Mon 17:00 Poster E

Conformity, anticonformity and polarization of opinions: how independence influences the system? — •KATARZYNA HUBICKA and TOMASZ WERON — Faculty of Pure and Applied Mathematics, Wrocław University of Science and Technology, 50-370 Wrocław, Poland

Could independent choices alter a regime? Or are they merely a noise, that may be neglected? Although some research about conformity, anticonformity and their impact on social polarization have been done recently, it is still uncertain how these three can be influenced by the independence. How does it collaborate with them? Does it support the polarization of opinions or perhaps prevents the process? We would like to dispel all the doubts with an expansion of the model, proposed in the paper 'The interplay between conformity and anticonformity and its polarizing effect on society' and revised in the next, entitled 'Conformity, anticonformity and polarization of opinions: insights from a mathematical model of opinion dynamics'.

SOE 7.22 Mon 17:00 Poster E

Stable features in fluctuating supply chains — •ROBERT POLWIN^{1,2}, HANS EHM², ALEXANDER SEITZ², and SEBASTIAN M.

KRAUSE¹ — ¹Faculty of Physics, University of Duisburg-Essen, 47058 Duisburg, Germany — ²Infineon Technologies AG, Neubiberg, Germany

Supply chains are complex networks processing the flow of information, currencies and material required for satisfying the customer needs. They are the backbone of today's globally producing industries and enable production and service innovations. Also the semiconductor industry with its long and complex production process and volatile market conditions relies on a stable supply chain network. Here we analyze the supply-demands match of Infineon, a large German semiconductor manufacturer. The customers of Infineon place orders which are daily matched to changing (improved) supply. The daily supply demand match with hundreds of heuristics are performed on hundred thousands of order elements and thousands of supply elements. Despite the fact that real world changes of the confirmed delivery dates towards customers are rare, the detailed analyzes of the confirmation processes (below the customer level) show both statistical features of the order flow, which are stable in time and chaotic patterns. Although the latter once are rare when they occur they exhibit surprising features with causes are not yet understood. These are signs of emergent behavior that goes beyond the dynamics of the systems constituents and are on the one hand of high interest for research on complex system behaviors and give hints to hidden improvement potentials.

SOE 7.23 Mon 17:00 Poster E

Extracting the wide variety of trading in stock markets — MARTIN THEISSEN, ●SEBASTIAN M. KRAUSE, and THOMAS GUHR — Faculty of Physics, University of Duisburg-Essen, Lotharstr. 1, 47048 Duisburg, Germany

Stock markets are complex systems involving large numbers of traders and many correlated stocks. So far, the microscopic analysis and modeling of stock trading was heavily concentrated on single stocks. Here we analyze and compare the trading activity of a large number of stocks [1]. We find that the market microstructure of stocks shows a surprisingly wide variety. Further we identify groups of stocks with a similar behavior. This is helpful for a systemic understanding of stock markets, and for building agent based models of many interacting stocks.

[1] M. Theissen, S.M. Krause and T. Guhr, Regularities and irregularities in order flow data, *Eur. Phys. J. B* 90, 218 (2017).

SOE 7.24 Mon 17:00 Poster E

Phase transitions in demand driven public transport systems — ●NILS BEYER¹, DEBSANKHA MANIK¹, ANDREAS SORGE¹, and MARC TIMME^{1,2,3} — ¹Network Dynamics, Max Planck Institute for Dynamics and Self-Organization, 37077 Goettingen — ²Chair for Network Dynamics, Center for Advancing Electronics (cfaed) and Institute for Theoretical Physics, 01062 Dresden — ³Max Planck Institute for the Physics of Complex Systems, Dresden, 01062

Private cars are a significant source of pollution, energy consumption, congestion, the need for parking space and rising CO₂ emissions [1]. Consequently a major challenge of our society in the upcoming decades will be to organize more economic and ecofriendly mobility options. A demand driven public door to door transportation service could be the answer to these problems.

Alonso-Mora et al. developed an algorithm that allows for efficient ride-sharing using only a quarter of the cars currently needed to service New York's taxi customers in their simulations [2]. The influences on the fraction of rides that can be shared in an urban environment has been analyzed by R.Tachet et al. [3]

To offer this service, one not only needs an efficient algorithm to organize taxis or buses, but also basic knowledge of the scaling in the system, as it should function over a range of temporal demand and different topologies. This work uses a discrete event based simulation framework (d3t) [4] to analyze how detours and customer waiting times scale with the amount of buses and customer requests. We start with simple taxi systems and move on to more sophisticated dispatching policies, including the possibility of ride sharing. The main finding is a second order phase transition in the amount of people who cannot be efficiently served by the system.

[1] OECD/ITF (2017), ITF Transport Outlook 2017, OECD Publishing, Paris. <http://dx.doi.org/10.1787/9789282108000-en>

[2] Alonso-Mora, Javier, et al. "On-demand high-capacity ride-sharing via dynamic trip-vehicle assignment." *Proceedings of the National Academy of Sciences* (2017): 201611675.

[3] R.Tachet et al. "Scaling law of urban ride sharing." *Scientific reports* 7 (2017).

[4] A. Sorge et al. "Towards a unifying framework for demand-driven

directed transport (D3T)." (WSC '15). IEEE Press, Piscataway, NJ, USA, 2800-2811.

SOE 7.25 Mon 17:00 Poster E

Opinions and consensus in the paradigms-model on different networks — ●YANNIK SCHÄDLER and STEFAN BORNHOLDT — Institute for Theoretical Physics, University of Bremen, Germany

Opinion- and consensus formation in society is an interesting dynamical process, with fashion and paradigm bubbles as an intrinsic feature. Sociophysics models that concentrate on that particular feature have been proposed in recent years [1], [2]. We here study a variant of the paradigms model and study its dynamics on several network topologies. It contains agents with memory that can interact with neighbours, as well as an innovation and a group-pressure mechanism that generates herding-effects. So far this model has been studied mainly on grid-topologies. The motivation here is to include more realistic social network architectures, and to study the influence of topology in this particular model. We study innovation waiting times or innovation rates in different settings. We find that the network topology indeed changes the dynamics: Simulations show that the network structure strongly affects the likelihood of a consensus.

[1] Katarzyna Sznajd-Weron: Sznajd model and its applications, *Acta Physica Polonica B*, vol.36, no. 8 (2005)

[2] Bornholdt, S. and Jensen, M. H. and Sneppen, K.: Emergence and Decline of Scientific Paradigms, *Phys. Rev. Lett.* 106, 058701 (2011)

SOE 7.26 Mon 17:00 Poster E

Studying the Impact of the Filter Bubble effect on Opinion Formations — ●MARTIN GESTEFELD and STEFAN BORNHOLDT — Institut for Theoretical Physics, University of Bremen, Germany

In recent years, opinion formation in society appears to be more polarized than in the years before. One hypothesis is that this might be a consequence of online social media and, in particular, the so-called filter bubble effect. The term filter bubble [1] was introduced by Eli Pariser in 2010 and denotes the effect that online social networks and news portals display personalized content via filter algorithms. Therefore it is more likely that a user is confronted with the own opinion resulting in an effective isolation from opposing viewpoints. Here we use the sociophysics model of Deffuant et al.[2] to study this behaviour. Traditionally this continuous model is used to investigate the mixing of beliefs. In order to investigate a filter bubble effect, we modify the Deffuant model by adding a preferential pairing to more similar neighbours. We then study the modified model's dynamics and if this additional dynamics leads to opinion polarization.

[1] Pariser, Eli. *The filter bubble: What the Internet is hiding from you*. Penguin UK, 2011.

[2] Deffuant, Guillaume, et al.: Mixing beliefs among interacting agents, *Advances in Complex Systems* 3.01n04 (2000): 87-98.

SOE 7.27 Mon 17:00 Poster E

Opinion dynamics form the perspective of the evolutionary game theory — ●PIOTR NYCZKA — Jacobs University, Bremen, Germany

There are many models in the broad field of opinion dynamics. One of the very intensively studied is the voter model. Actually there are several generalizations of this model known as q-voter, q-r-voter etc. They create the whole class of binary opinion dynamics models. In most of the investigations parameters of these models are fixed, however it seems that nobody knows what could be these parameters in the real world. Moreover, nobody seems to know why their values are like they are.

In this work very important question is addressed: what could be the values of these parameters in the real world and why. A new approach was employed in order to deal with this task. A new model being a beautiful combination of opinion dynamics and the evolutionary game theory is proposed. This model seems to open the brand new perspective for the whole field of opinion dynamics and bring many new questions although.

SOE 7.28 Mon 17:00 Poster E

Bi-modal door-to-door public transportation: a mean-field approach — ●STEPHAN HERMINGHAUS — MPI für Dynamik und Selbstorganisation, Am Fassberg 17, 37077 Göttingen

One of the greatest problems in developing novel public transportation systems is the enormous dynamic range of possible demands. It therefore appears imperative to come up with schemes efficiently coupling

different ‘modes’ of service which feature different benefits. We study a bi-modal coupled system of ride-sharing minibuses and standard line services (like tram) in a mean-field setting. Criteria are developed for jointly optimizing the bi-modal operation, and pertinent scaling relations are derived.

SOE 7.29 Mon 17:00 Poster E

The Voter model with recurrent mobility and Stockholm voting behaviour — ●ATTILA SZILVA¹ and JÉRÔME MICHAUD² —

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In order to model the opinion dynamics of voting behaviour in the region of Stockholm, we would like to adapt the Social Influence with Recurrent Mobility (SIRM) variation of the Voter Model to the voting behaviour in the Stockholm region. The initial formulation of the SIRM model has some issues that should be addressed before applying this model to the multiparty situation of Stockholm county. We will present the problem and the data we have as well as preliminary results from simulations. For instance, we will introduce a generalized version of the SIRM model that does not suffer from the issues mentioned above.

SOE 7.30 Mon 17:00 Poster E

Earth system modeling with complex dynamic human societies: the copan:CORE World-Earth modeling framework —

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Possible future trajectories of the Earth system in the Anthropocene are determined by the increasing entanglement of processes operating in the physical, chemical and biological systems of the planet and those occurring in its human societies, their cultures and economies. Here, we introduce the copan:CORE open source library that provides a framework for developing, composing and running World-Earth

models, i.e., models of socio-ecological co-evolutionary dynamics up to planetary scales. copan:CORE is an object-oriented software package written in Python that is designed for users of different roles. Model end users are enabled to easily run parallel simulations combining already available and tested model components. Component developers can contribute their own building blocks, while framework developers work on the model infrastructure. copan:CORE’s modular design is tailored for community integration across disciplines, supporting rapid prototyping, ensemble simulations and sensitivity, robustness and structural stability analyses.

SOE 7.31 Mon 17:00 Poster E

Risk assessment of introduction of African Swine Fever (ASF) to disease free regions of Poland. Effective distance and Monte Carlo approaches — ●ANDRZEJ JARYNOWSKI^{1,2} and VITALY BELIK² — ¹Interdisciplinary Research Institute, Wrocław, Poland — ²Institute for Veterinary Epidemiology and Biostatistics, Free University of Berlin

African Swine Fever (ASF) is viral infection which causes acute disease in domestic pigs and wild boar. Although the virus does not cause disease in humans, the impact it has on the economy, especially through trade and farming, is substantial. Recent rapid propagation of the (ASF) from East to West of Europe encouraged us to prepare risk assessment and predict future geographical transmission paths.

We analyze 380 Polish counties (poviats), where 23 (located in Northeast Poland) have been affected (until 10.12.2017) for spatial propagation (risk assessment for future). We choose pseudo gravity propagation model by taking into account: swine amount significance, disease vectors (wild boards) significance, pork production chain significance, human failure to restrictions. We use effective distances methodology (Phys Rev E 95, 012313, 2017) as well as standard Monte Carlo simulation and fitted parameters for both approaches.

We have reconstructed the most probable infection paths for affected Polish counties with both methods. With Monte Carlo model, we project few likely scenarios for future spread with risk assessment based on social network analysis.