SOE 8: Poster

Poster boards are in A0 portrait format. Posters can and should be on display on whole Monday.

Time: Monday 18:00–20:00   Location: Poster E

SOE 8.1   Mon 18:00   Poster E

Sustainable Monetary Agency — •Stephen I. Ternyik — POB. 201 D-82043 Munich

We may like it or not, ours is a monetary civilization, since ˜ 5000 years. The last 250 years saw the rise of the monetary production economy, with the latest consequence that all human needs are now reduced to the need for money. This technical 'simplification' of economic complexity comes with a high price, concerning the physical sustainability of the human-nature-capital interplay. Money (m) has become physical access to all types of energy (e), drives the temporal (t) length (l) of economic production (p) cycles and determines the 'speed' of the human economy. The cybernetic wave circuit reads: m/quantizes/e=e/quantizes/t=t/quantizes/p. Every economic wave length (l) is quantitatively proportional to the liquidity frequency (f); the greater the monetary volume (x) in a wave, the higher is f (l=f (x/r); r (reserve requirement) is the decisive factor in this equation. The temporal (t) acceleration of p (e.g. machine operating time, logistics) is a result of x in demand for e (p=t (x/e); every customer payment finalizes p. As a result, the economic behavior of gradual monetary excess increases the exponential need for energy and causes the temporal acceleration of economic wave cycles (crises). Only an efficient monetary technique of narrow reserve banking can lead to more economic systems sustainability.

SOE 8.2   Mon 18:00   Poster E

Aspiration–Based Full Cooperation in Finite Systems of Players — •Tadeusz Platkowski — Department of Mathematics, Informatics and Mechanics, University of Warsaw, Warsaw, Poland

We propose a mathematical model of evolution of a finite well–mixed population of players who change their behavior if the payoff obtained from Prisoner's Dilemma based interactions is smaller than a threshold (aspiration level). The threshold can be a fixed constant or a dynamical variable, which depends on some overall dynamically changing characteristics of the system. We investigate the dependence of full cooperation on the group size, game payoffs, aspiration level, and heterogeneity of the system. For endogenous aspirations we find analytically conditions which guarantee full cooperation in the long run for all initial configurations and group sizes. The result is robust to a stochastic choice of strategies by the heterogeneous players, as documented by numerical simulations [1].
[1] T. Platkowski, to appear in Applied Mathematics and Computations (2015)

SOE 8.3   Mon 18:00   Poster E

Hidden scaling patterns and universality in written communication — •Marco Formentin[1], Alberto Lovison[2], Amos Maritan[3], and Giovanni Zanzotto[4] — [1]UTIA, Czech Accademy of Sciences, Prague, Czech Republic — [2]University of Padova, Padova, Italy — [3]University of Padova, Padova, Italy — [4]University of Padova, Padova, Italy

The temporal statistics exhibited by written correspondence appear to be media dependent, with features which have so far proven difficult to characterize. We explain the origin of these difficulties by disentangling the role of spontaneous activity from decision-based prioritizing processes in human dynamics, clocking all waiting times through each agent's "proper time" measured by activity. This unveils the same fundamental patterns in written communication across all media (letters, email, sms), with response times displaying truncated power-law behavior and average exponents near -3/2. When standard time is used, the response time probabilities are theoretically predicted to exhibit a bi-modal character, which is empirically borne out by our new years-long data on email. These novel perspectives on the temporal dynamics of human correspondence should aid in the analysis of interaction phenomena in general, including resource management, optimal pricing and routing, information sharing, emergency handling.

SOE 8.4   Mon 18:00   Poster E

Constrained Dynamic Models (CD-Models) in Economics as a missing link of commonly used Economic Models — •Erhard Glötzl — Karl-Kautsky-Weg 26, A-4040 Linz, Austria

Constrained dynamics are well known from classical Mechanics. Identifying *economical forces* with physical forces, *economical power* with the reziproke value of mass and realizing that economical constraints mostly are given by accounting identities one can transform the concept of constraint dynamics to economic models. It can be shown, that commonly used economic models such as Classic, Neoclassic, GE, DSGE, Keynesian, Post-Keynesian, ABM and SFC models can be interpreted as special cases of CD-Models. CD-Models provide the basis for a variety of different closures of economic models, which are ultimately the result of different assumptions about the power relations between economic agents.

SOE 8.5   Mon 18:00   Poster E

Structural characterization of complex networks based on edge-to-edge relations from failure-induced flow redistributions — Michael T. Schaub[1], •Jörg Lehmann[2], Sophia N. Yaliraki[1], and Mauricio Barahona[1] — [1]Imperial College London, U.K. — [2]ABB Switzerland Ltd, Corporate Research, Baden-Dättwil, Switzerland

The structural analysis of complex networks mostly focuses on nodes and their relations, e.g., in node communities. However, for many dynamical processes on networks, in particular those related to the flow of energy or information, edges are at least as important as the nodes and an analysis based on relations between edges is more appropriate. Here, we put forward a corresponding approach, which is based on the flow redistribution induced by edge failures [1]. We find that there is a potential long-range interaction between edges, which can reveal interesting non-local edge-communities. Furthermore, we introduce the concept of an edge embeddedness, which reflects the importance of an edge in weighted cuts of the network. We exemplify the significance of our approach with analyses of the Iberian power grid, traffic flows in road networks and the C. elegans neuronal network.
[1] M. T. Schaub et al., Network Science **2**, 66 (2014).

SOE 8.6   Mon 18:00   Poster E

Secure message passing on networks with insecure classes of nodes — •Sebastian M. Krause[1], Michael M. Danziger[2], and Vinco Zlatic[1] — [1]Rudjer Boskovic Institute, Zagreb, Croatia — [2]Bar Ilan University, Ramat Gan, Israel

Nodes in a network such as the Internet may be able to communicate even if many connecting nodes fail. If instead of failing, the nodes manipulate or intercept messages silently, such nodes have to be avoided in advance. This is possible if the message is split into parts which are only useful together, and the parts are sent over independent paths. It is an open question, if this is possible on realistic large scale networks, where whole classes of nodes need to be avoided at the same time due to software bugs.

Here we consider the case of a network partitioned into sets of nodes (each labeled with one color) with the assumption that no single subset can be trusted. This corresponds, for example, to routers running different software versions or controlled by different entities. For transmitting the parts of a message, we ask whether sufficient paths exist, such that no color of nodes is needed to transmit all message parts. We develop a new mathematical framework based on percolation theory. With analytic solutions for Poisson and scale-free graph ensembles, we discuss a new kind of critical phenomena in which the critical exponent is determined by the number of colors. We also present a numerical algorithm which is suitable for analyzing real world networks. Applied to the Internet on the level of autonomous systems, we find that a large fraction of servers would be able to securely communicate.

SOE 8.7   Mon 18:00   Poster E

Empirical analysis of the order book and order flow of a Bitcoin marketplace and comparison with traditional markets — •Alexander Eckrot, Jan Jurczyk, and Ingo Morgenstern — University of Regensburg, Germany

Bitcoin marketplaces have some features that distinguish them from traditional marketplaces. Examples of this features are: Very high transparency, low trading volumes, 24 hours of trading a day without free days. Especially the high trading transparency makes this mar-

ketplaces a good resource for collecting data about the order book and order flow. We collected about 1,2 Million snapshots of order books for a Bitcoin marketplace from June to September 2014. The snapshots have a time interval of 7 seconds, which is small enough to reconstruct the order flow. We analyze these order books and compare our results with traditional stock markets.

SOE 8.8 Mon 18:00 Poster E

Effects of microscopic limit order book structure on price formation — •Winfried Sebastian Reimann, Hannes Blut, and Stephan Eule — Max-Planck-Institut für Dynamik und Selbstorganisation, Goettingen, Deutschland

Most modern financial markets nowadays employ limit order books to manage the priority of unexecuted limit orders. Analysis of large amounts of historical order book data in continuous double auction markets have discovered the dynamics to be influenced by a number of observables:

(i) Structural properties such as imbalance of orders and gap size;

(ii) order flow statistics, e.g. limit order placement and cancellation rates;

(iii) price determining quantities including spread size, and price jump distributions.

Especially the third group of observables is recognized for its essential role in execution strategies and risk estimation. Whereas past modeling has mainly aimed for reproducing the properties of prices by investigating the order flow, we focus on the effects of price gaps. These and other structural properties of the order book are expected to have a large influence on the book's dynamics, in particular in high volatility markets. We extend the standard double auction model by Mike and Farmer[1] to make predictions about the relation between gaps and price statistics and compare these to real data.

[1]Mike, S., Farmer, J. D., 2008. An empirical behavioral model of liquidity and volatility. J. Econ. Dyn. Control 32 (1), 200-234.

SOE 8.9 Mon 18:00 Poster E

How multiplex affects the Abrams-Strogatz model — •Roberta Amato, Nikos Kouvaris, and Albert Diaz-Guilera — departament de fisica fonamental, universitat de barcelona, marti franques 1, 08028 barcelona, spain

The Abrams-Strogatz model studies the competition between two languages or, more in general, two states, in a given society. each individual starts with a random language and, during the time, can choose to change his language according to: the prestige of both languages in his society and the most spoken language by his friends. if the individuals live on a random network almost fully connected, and we consider just the first neighbours interaction, at some point all the people will speak the same language.

In agreement with reality, the people interact to each others in different situations or environments like the work, the family, the pub, etc... to represent these different interaction situations we can use multiplex. In a multiplex each situation is as a network on a layer, and the layers are connected by connecting a node and his counterpart in the other layer. The new question we place is: can multilayer human interaction ensure the lives of both languages? We introduce a new parameter that controls, for each individual, how the language spoken in a layer influence the language spoken in the other layer. In this new situation an individual may choose to change his language in a layer also in according to: his language in the other layer. What we find is that, for some values of the parameter a metastable state of two language consistence exists.

SOE 8.10 Mon 18:00 Poster E

The network of inter-organizational movements in the Stockholm region, 1990-2003 — •Hernan Mondani[1], Petter Holme[2,3,1,4], and Fredrik Liljeros[1,4] — [1]Department of Sociology, Stockholm University, 10691 Stockholm, Sweden — [2]Department of Energy Science, Sungkyunkwan University, 440-746 Suwon, Korea — [3]IceLab, Department of Physics, Umeå University, 90187 Umeå, Sweden — [4]Institute for Futures Studies, Box 591, 10131 Stockholm, Sweden

This study uses Swedish register data to bring a network perspective into the statistical analysis of organizational growth. The data is a unique individual-level longitudinal database on organizational membership for all workers in the Stockholm region, during the period 1990-2003. We can keep track of organizations and individuals over time, and people's movements between organizations can be known on a yearly basis.

We construct a network where the nodes are organizations, and the links are movements of people between them, during a given year. Firstly, we study the network properties of a collapsed network for the whole time period, and compute probability distributions for the main connectivity and centrality statistics. Secondly, we look at the time evolution of network measures and flows of people between organizations. We explore the scaling of network properties with company size, as well as differences in the statistics for the public and private sectors.

Keywords: complex networks, sociophysics, organizational growth process, scaling.

SOE 8.11 Mon 18:00 Poster E

Impact of Meta Orders on Continuous Double Auction Order Book Dynamics with Inhomogeneous Placement and Cancellation Rates — •Hannes Blut, Winfried Sebastian Reimann, and Stephan Eule — Max-Planck-Institut für Dynamik und Selbstorganisation, Am Faßberg 17, D-37077 Göttingen, Deutschland

Most modern financial markets nowadays employ limit order books to manage the priority of unexecuted limit orders. Analyses of large amounts of historical order book data in continuous double auction markets have discovered the dynamics to be influenced by a number of observables: (i) Structural properties such as imbalance of orders and gap size; (ii) order flow statistics, e.g. limit order placement and cancellation rates; (iii) price determining quantities including spread size, and price jump distributions. Especially the third group of observables is recognized for its essential role in execution strategies and risk estimation. On the basis of such analyses, models for the microscopic dynamics of order books have been developed and tested by means of simulation. Here, existing models are extended. The modified models aim to include inhomogeneous order placement and cancellation rates, which have been detected in data analyses. Furthermore, long-term correlations in order signs are applied to account for meta orders.

SOE 8.12 Mon 18:00 Poster E

On commonalities between computational economics and computational neuroscience — •Bernhard A. Kaplan — Department of Computational Biology, Royal Institute of Technology, KTH, Stockholm, Sweden

Numerical simulations of mathematical models have become a valuable tool in all fields of science. However, there is rather little exchange between different disciplines regarding the challenges that are faced, e.g. the development of software tools for simulations or the descriptions of models. This contribution aims to show commonalities between two different disciplines, neuroscience and socio-economic modeling, and highlights perspectives for a beneficial exchange regarding modeling and simulation methods. Both disciplines deal with highly complex, temporally evolving systems, and scientists face similar challenges when it comes to building models that simultaneously cover multiple levels of detail and different temporal scales. An exchange of the ideas and best practices regarding software and methodology used in this endeavour could be highly beneficial for both disciplines. One of the major challenges in computational neuroscience includes the integration of experimental data, the development of models and the simulation of multi-scale models that are supposed to cover many levels of complexity. I will present some of the ideas and approaches in use and will argue for the benefits of using similar methods in the field of socio-economics and agent-based economic modeling.

SOE 8.13 Mon 18:00 Poster E

Extending the efficient frontier of the mean variance model and value at risk model by utilizing groundstate behavior of portfolios — •Jan Jurczyk — University of Regensburg, Regensburg, Germany

The cornerstone of portfolio investments is the analysis of the efficient frontier and its development in time. We extend this approach by investigating the behavior of the connected optimal portfolios and its physical observables, connected to the mean variance model and value at risk model. For finding the optimal solutions for a certain time frame, we use an algorithm based on simulated annealing. This approach leads to a measure, which is able to represent the overall market behavior.

SOE 8.14 Mon 18:00 Poster E

Search space approximation for multi-objective optimization problems — •Thorsten Rehberg — University of Regensburg

A parallel optimization strategy based on simulated annealing and a

machine learning approach is used for the approximation of cost functions. This approach is exemplary applied to the portfolio selection problem for developing an efficient cost-function. For this purpose stock data from DAX, MDAX and S&P500 is used for training and validating the results.

SOE 8.15   Mon 18:00   Poster E
Effects of price transparency in a self organized cartel-formation model — ●PHILIPP C. BÖTTCHER, TIAGO P. PEIXOTO, and STEFAN BORNHOLDT — Institut für Theoretische Physik, Universität Bremen, Hochschulring 18, D-28359 Bremen

Fuel prices vary strongly over short time periods, often to the disadvantage of customers. It is commonly hypothesized that this might be a consequence of collusion among gas companies. A recent measure to counteract this in Germany is to force gas stations to list their prices, so that buyers can more easily choose the best option, in the spirit of an improved competition.

However, it has been shown recently that explicit collusion is not a necessary ingredient of cartel-like behavior. In a simple market model [T. Peixoto and S. Bornholdt, Phys. Rev. Lett. 108, 218702 (2012)], where buyers freely choose the seller, and the sellers adapt their prices without colluding, a cartel-like dynamics arises spontaneously. The parameter which controls the onset of the cartel-like dynamics is the relative speed with which the sellers update their strategies compared to the buyers.

We modify the original market model by placing the buyers and sellers in a two-dimensional lattice, and we include a portion of buyers which have access to a global list of prices. By varying this fraction, we can probe the effect of this particular measure in diminishing the typical prices and their fluctuations. We find that price transparency does indeed produce the intended effect in some situations while it can even intensify cartel-like behavior in others.

SOE 8.16   Mon 18:00   Poster E
Urbanization and Path Dependence in Urban Form — ●STEFFEN LOHREY, FELIX CREUTZIG, and MALTE ROEDL — Mercator Research Institute on Global Commons and Climate Change (MCC)

Urbanization trends forecast a tripling of urbanized areas by 2030. Impacts include loss of arable land and biodiversity, but also a strong increase of both urban energy consumption and CO_2 emissions. To a large part, these stem from urban transport. Transport emissions are known to be strongly influenced by urban form. A naive proxy of urban form, population density, is known to influence GHG emissions via the distance driven and modal shares. Urban form inhibits strong inertia, sudden change to a city*s layout is unlikely. Thus, the growth of today*s cities seems to determine tomorrow*s emissions with a high lock-in potential. In our work, we are assessing urban growth using non-linear modelling techniques, to assess whether path dependence is a pertinent concept to describe a possible carbon lock-in of urban transport systems. Techniques developed could help assess path dependence and help mitigate it. We here apply agent-based modeling motivated by urban economic concepts. Our results outline which parameters have crucial impact on potential lock-in, but also lock-out developments. We also tentatively suggest development strategies for different types of human settlements worldwide.

SOE 8.17   Mon 18:00   Poster E
Emergence of asynchronous local clocks in excitable media — RICHARD GERUM, ●ACHIM SCHILLING, BEN FABRY, and CLAUS METZNER — Department of Physics, Friedrich-Alexander University Erlangen-Nürnberg (FAU), Germany

Excitable media such as the myocardium or the brain consist of arrays of coupled excitable elements, in which the local excitation of a single element can propagate to its neighbors in the form of a non-linear autowave. Since each element has to pass through a refractory period immediately after excitation, the frequency of autowaves is self-limiting. In this work, we consider the case where each element is spontaneously excited at a fixed average rate and thereby initiates a new autowave. Although these spontaneous self-excitation events are modelled as independent Poisson point processes with exponentially distributed waiting times, the travelling autowaves lead collectively to a non-exponential, unimodal waiting time distribution for the individual elements. With increasing system size, a global 'clock' period T emerges as the most probable waiting time for each element, which fluctuates around T with an increasingly small but non-zero variance. This apparent synchronization between asynchronous, temporally uncorrelated point processes differs from synchronization effects between

perfect oscillators interacting in a phase-aligning manner. Finally, we demonstrate that asynchronous local clocks also emerge in non-homogeneous systems in which the rates of self-excitation are different for all individuals, suggesting that this novel synchronization mechanism can occur in a wide range of excitable media.

SOE 8.18   Mon 18:00   Poster E
Agent based model based on socio-physics and evolutionary economics to describe changes in technological regimes — ●FLORIAN SENGER — Fraunhofer ISI, Breslauer Str. 48, 76139 Karlsruhe

The work presented here is part of an ongoing PhD thesis, where I combined methods from physics of social systems with methods from evolutionary economics to develop an agent-based model to mimic the dynamics of regime changes in socio-technical systems. I therefore modelled the demand side as consumer agents according to a distribution of endowments and needs, connected to each other in a social network, influencing each other in a voter-model-like manner and the supply side as explicit company agents consisting of genes in an evolutionary sense, producing a technology in a quality depending on their particular fitness, taking influence on particular areas of the consumer network via marketing and changing the alleles of their genes by a process of imitating and stochastically innovating, getting feedback on their fitness by the degree of success with the consumers. In this presentation I will show results for the phase behaviour of the system and how different properties of the network and the company agents yield different scenarios of metastable technological regimes and technological regime changes as observed in reality.

SOE 8.19   Mon 18:00   Poster E
A Bayesian model for the propagation of social norms and identity formation — ●LEONHARD HORSTMEYER[1], FRANCESCA LIPARI[2], ALIREZA GOUDARZI[3], and BRAIS ALVAREZ[4] — [1]MPI for Mathematics in the Sciences — [2]University of Pennsylvania — [3]University of New Mexico — [4]European University Institute

We develop a dynamical agent-based model for identity formation in the presence of descriptive norms in order to address questions of social mobility.

Agents are endowed with a social identity and beliefs thereon, subjected to updating rules. We introduce a social payoff function as a map from the identity space to a discrete valued payoff space. Agents form beliefs about these functions, modelled as probability distributions. Each agent observes other agents' identities as a proxy for their beliefs and updates its own belief via a Bayesian rule. They assume a new identiy whenever it is accessible and the expected social payoff gain succeeds a threshold τ. Agents are also subjected to an external source, modelled as a probability distribution over the social payoff functions. These are then integrated into the updating process through a convex combination with parameter λ. We study social mobility on the (τ, λ)-parameter space and find that a linear relation separates a mobile and an immobile phase.

SOE 8.20   Mon 18:00   Poster E
Estimating Social Networks of Killer-Whales — ●SARAH HALLERBERG[1], YVONNE RADSTAKE[1], HEIKE VESTER[2], and MARC TIMME[1] — [1]Network Dynamics, Max Planck Institute for Dynamics and Self-Organization, 37077 Göttingen — [2]Ocean Sounds, Sauoya 01, 8312 Henningsvaer, Norway

Estimating social networks of animals becomes a challenging task if the animals under study are living in the wild and are visuable only for very short moments. We estimate the social network of a group of killer whales based on a database of pictures, taken while the animals breach the ocean surface for breathing. We are especially interested in identifying leader-follower relationships between individual whales.

SOE 8.21   Mon 18:00   Poster E
Discontinuous phase transition via cooperation of spreading agents — WEIRAN CAI[1], ●LI CHEN[2], FAKHTEH GHANBARNEJAD[3], and PETER GRASSBERGER[4] — [1]Medical Faculty Carl Gustav Carus, Technische Universität Dresden, 01307 Dresden, Germany — [2]Robert Koch-Institute, 13353 Berlin, Germany — [3]Max-Planck Institute for the Physics of Complex Systems, 01187 Dresden, Germany — [4]Forschungszentrum Jülich, 52425 Jülich, Germany

Spreading of infective agents like pathogens, computer viruses, fashions, or political opinions can exhibit a percolation transition that separates small outbreaks from giant ones which reach a non-zero frac-

tion of the population. Typically, such transitions are continuous (second order), but recently possible discontinuous (first order) transitions (DTs) have aroused huge interest. Here we present a model involving cooperativity between two different types of spreading agents: the presence of one facilitates the spreading of the other, and vice versa. We show that this mechanism can lead to DTs or to continuous ones, depending on the chosen order parameter, the topology of the underlying network, and on seemingly minor details of the implementation. Moreover, all DTs are also accompanied by various non-trivial power laws, which blurs the fundamental distinction between first and second order transitions.

SOE 8.22 Mon 18:00 Poster E
Long memory in a minimal trading model. — •Philipp Heyken, Felix Patzelt, and Klaus Pawelzik — Institute for Theoretical Physics, University of Bremen, Germany

In economics, markets are commonly assumed to absorb available information such that only previously unknown information states lead to price changes. How such 'learning' might be realized in real markets, however, is unknown. It was shown in a minimal multi-agent model, that the redistribution of assets can serve as a learning mechanism [1].

In particular, we find that information states which are presented frequently lead to decreasing price-change magnitudes over time. Detailed analysis shows how information is stored via imprints in the asset distribution. The memory capacity depends on the size of the system and is characterized by a phase transition. Beyond the critical point the system stores information states incrementally without any forgetting. At the critical point of the system size, forgetting exhibits power-law-behavior over time such that once presented information states still leave permanent traces.

[1] F. Patzelt and K. Pawelzik: An Inherent Instability of Efficient Markets, Scientific Reports 3, 2784 (2013)

SOE 8.23 Mon 18:00 Poster E
Heterogeneity in synchronizing networks of mobile particles — •Jorge P. Rodríguez and Víctor M. Eguíluz — Institute for Cross-Disciplinary Physics and Complex Systems IFISC (UIB-CSIC), Universitat de les Illes Balears, E-07122 Palma de Mallorca, Spain

The Kuramoto model of synchronization proposes an interaction between particles which, in the case of every particle having the same natural frequency, makes their phases approach. We will explore the Fujiwara model, which considers that the particles move diffusively in a square, and they only interact via a Kuramoto update with the particles that are located within their circular zone of influence. Hence, we have a temporal random geometric graph, as the motion of particles modifies the topology of the spatial network.

First of all, we analyse the synchronization process if there is a fraction p of slow particles ($1 - p$ of fast). Comparing this process with that of a set of particles moving with the same homogeneous average velocity, we find that the heterogeneous case is slightly slower than the homogeneous. In order to characterize the role of heterogeneity, we consider a system with a Gaussian distribution of particle velocities, and analyze the characteristic synchronization time as a function of the distribution width. We find that the heterogeneity modifies the average relative velocity between particles, which is related with the average link time duration, influencing the characteristic synchronization time.

Finally, we consider that faster particles have a bigger zone of interaction. Links will be directed, and we will find a threshold for the width above which there is no global synchronization.

SOE 8.24 Mon 18:00 Poster E
Modeling the evolution of science in scientific space — •Jan Moritz Joseph[1] und Jens Christian Claussen[2,3] — [1]Institut für Technische Informatik, Universität zu Lübeck, Germany — [2]Computational Systems Biology Lab, Research II, Jacobs University Bremen, Germany — [3]INB, Universität zu Lübeck, Germany

How does the topological space of science emerge? Scientific disciplines form clusters and topical sub-clusters, overlap through interdisciplinary research, and dynamically emerge and grow over time. Inspired by the concept of mapping scientific topics to a scientific space [1], we introduce a dynamical process of authors collaborating and publishing papers [2]. The model fosters novelty and multidisciplinary of new papers, as well as a retirement mechanism which prevents large groups to dominate topics forever. We demonstrate that our model can generate a nontrivial topological structure comparable to [1]. We quantify the time-evolution of the spatial structure and discuss the influence of

inhomogeneity. Exploring further properties of the dynamics, we examine special and structural characteristics by measuring the fractal dimension. Furthermore, we compare the topology with real data given by the UCSD Map of Science [3].
[1] K.W. Boyack, R. Klavans and K. Börner, Mapping the backbone of Science, Scientometrics 64, 351 (2005)
[2] J.M. Joseph and J.C. Claussen, arXiv.org/abs/1407.8422
[3] K. Börner et al., Plos One 7, e39464 (2012)

SOE 8.25 Mon 18:00 Poster E
Conditional fixation in N-individual Hawk-Dove games in finite and infinite populations — Binghui Fan[1], Xinsheng Liu[1,3], •Jens Christian Claussen[2,3], and Wanlin Guo[1] — [1]Nanjing University, China — [2]Computational Systems Biology Lab, Jacobs University Bremen, Germany — [3]INB, Universität zu Lübeck, Germany

Evolutionary game theory usually describes contests between two individuals, but in reality, interactions can be more complex and involve more than two individuals. Here we present an N-individual generalization of the well-known Hawk-Dove game by considering the possible existence of a threshold of the frequency of Hawks in the interacting group above which the Doves get nothing and the Hawks fight for the total resource. When the frequency of Hawks is less than the threshold, the Doves can share a portion of the resource and the hawks fight for the remaining portion. Besides, as the frequency of Hawks increases, the portion of the resource that the Doves can gain decreases sharply according to a nonlinear function. Then we discuss evolutionary dynamics of the N-individual Hawk-Dove games with variation of reasonable range of some significant parameters in both infinite and finite populations. Specially, as for infinite populations, the system will always end up either in full Hawk or in a stable equilibrium where Hawks and Doves coexist. We discuss fixation probabilities and fixation times in finite populations by analytic and numerical methods. We find that the conditional fixation time exhibits a maximum with respect to the group size or the value-to-cost ratio.

SOE 8.26 Mon 18:00 Poster E
Evolutionary Dynamics for Persistent Cooperation in Structured Populations — Yan Li[1], Xinsheng Liu[1], •Jens Christian Claussen[2], and Wanlin Guo[1] — [1]Nanjing University, China — [2]Computational Systems Biology Lab, Jacobs University Bremen

In a public goods game, the total resulting payoff is divided equally among all participants. This still leads to the dominance of defection without substantially magnifying the public good by a multiplying factor. To explain the evolution of cooperative strategies, in a recent model only a portion of the total benefit is shared by all the players through introducing a new strategy named persistent cooperation. A persistent cooperator is a contributor who is willing to pay a second cost to retrieve the remaining portion of the payoff contributed by themselves. In a previous study, this model was analyzed in the framework of well-mixed populations. This paper focuses on discussing the persistent cooperation in lattice-structured populations. The evolutionary dynamics of the structured populations consisting of three types of competing players (pure cooperators, defectors and persistent cooperators) are revealed by theoretical analysis and numerical simulations. In particular, the approximate expressions of fixation probabilities for strategies are derived on one-dimensional lattices. The phase diagrams of stationary states, the evolution of frequencies and spatial patterns for strategies are illustrated on both one-dimensional and square lattices. We find that the existence of persistent cooperators greatly suppresses the spreading of defectors under more relaxed conditions in structured populations compared to well-mixed populations.

SOE 8.27 Mon 18:00 Poster E
Effect of heterogeneity on scaling laws in a stochastic macroeconomic model — •Cornelia Metzig — Department of Infectious Disease Epidemiology, Imperial College London, UK

Fat-tailed distributions in economic systems are typically explained by multiplicative noise, preferential attachment or similar stochastic models. A stochastic firm growth model introduced previously exhibits such scaling for several quantities, such as firm size and size fluctuations (both temporal and for the ensemble of firms at one time point). Here, the effect of introduction of heterogeneity is studied, i.e. of firms which differ in profitability. This introduces replicator dynamics in which more profitable forms outperform less profitable ones. Besides making the model easier to interpret in the context of macroeconomic agent-based models, heterogeneity affects both nature and

exponents of certain scaling laws, which has been studied theoretically and numerically.

SOE 8.28   Mon 18:00   Poster E

Prediction of lane changes with a mathematical model using steering wheel angle and velocity — •Kim Schmidt[1], Stefan Pichelmann[2], Matthias Beggiato[2], Karl Heinz Hoffmann[1], and Josef F. Krems[2] — [1]TU Chemnitz, Institut für Physik, D-09107 Chemnitz — [2]TU Chemnitz, Institut für Psychologie, Allgemeine & Arbeitspsychologie, D-09107 Chemnitz

To get adapted assistance of advanced driver assistance systems we want to predict lane changes. Therefore, we evaluate the quality of our previously developed mathematical model for prediction using steering wheel angle. We also focus on possible improvements. Hence, we developed two different approaches based on velocity.

SOE 8.29   Mon 18:00   Poster E

Study of the Ecology of Multi-Assets Stock Market: An Agent-Based Model Approach — •YowKeong Lew and Yu Chen — Graduate School of Frontier Sciences, The University of Tokyo, 5-1-5 Kashiwanoha, Kashiwa City, Chiba Province, Japan

We use an agent-based model for multi-assets stock market to study the ecology of random and mean-variance traders, in particular on the mechanism of price formation and the origin of cross-correlations between the assets. Furthermore, we will evaluate the market impact of mean variance optimized trading on the volatility and cross-correlation structure of the multi-asset stock market. As a preliminary result, the constructed model is able to reproduce related important stylized-facts of univariate and multivariate price processes. We show that mean-variance optimized trading make the market more efficient in terms of cross-correlation but, on the other hand, more volatile.

SOE 8.30   Mon 18:00   Poster E

Finite populations evolving in fluctuating environments — •Peter Ashcroft[1], Philipp M. Altrock[2,3,4], and Tobias Galla[1] — [1]The University of Manchester, Manchester, UK — [2]Program for Evolutionary Dynamics, Harvard University, Cambridge, MA, USA — [3]Harvard School of Public Health, Boston, MA, USA — [4]Dana Farber Cancer Institute, Boston, MA, USA

We have shown that a mutant invading a finite population can exploit environmental noise. This noise modifies the payoff structure of the evolutionary game. A dynamic environment that randomly switches between two states can lead to a probability of fixation that is higher than in any of the individual environmental states. We provide an intuitive interpretation of this surprising effect. We develop a general theory to describe the fixation of a mutant in a population of wild-types in an environment that randomly switches between an arbitrary number of states. We also investigate stationary distributions when mutations are present in the dynamics. In this regime, we find two approximations of the stationary measure. One works well for rapid switching, the other for slowly fluctuating environments.

[1] Ashcroft, Altrock & Galla (2014) J. R. Soc. Interface 11: 20140663.

SOE 8.31   Mon 18:00   Poster E

Transformation in range expansion assays — •Robert Zöllner, Enno Oldewurtel, Nadzeya Kouzel, and Berenike Maier — Universität zu Köln, Department of Physics, Germany

Numerous bacterial species generate biofilms that cause a decreased response to antibiotics. Biofilms are complex and dynamic communities of bacteria that are embedded in an extracellular matrix. For many species including the human pathogen Neisseria gonorrhoeae, extracellular DNA (eDNA) is an essential structural element of the biofilm. Here, we use a model biofilm to test the role of eDNA in development and spreading of multi-drug resistance in biofilms through transformation. The spatial expansion of densely growing bacteria on agar, also known as range expansion, provides an effectively two dimensional model for a biofilm. Using different fluorescence markers for different antibiotic resistance genes, horizontal gene transfer was directly visualized. The rate of generation of multi-resistant transformants and their spreading rate were measured at varying selection pressures set by the antibiotics.