SOE 11: Poster Session

Time: Tuesday 18:00–18:45 Location: P2

Please note: To ensure maximum attendance, the poster session will only start after the conclusion of the Prize Ceremony.

SOE 11.1 Tue 18:05 P2

Ageing in the 3D random-bond Ising model along the ferromagnetic - spin glass transition line — •Markus Manssen and Alexander Hartmann — Institut für Physik, Carl-von-Ossietzky-Universität Oldenburg

Spin glasses, magnetic alloys showing disorder and frustration, are prototypical models of disordered systems and during the last decades they have been one of the main research topics in statistical physics. Since finite-dimensional spin glass models cannot be solved analytically, they are usually studied by computer simulations[1]. Yet the investigation of their main characteristic, their slow glassy behavior, demands long computation times and thus spawned dedicated specialized computing systems[2]. Using the huge computational resources on graphic cards promises noticeable speedups for largely parallel problems compared to common CPUs at a reasonable cost. Simulations of simple Ising models have already been realized[3].
Building on this we turn our attention to the random-bond $\pm J$ Ising model which allows us to investigate ageing effects when crossing from the ferromagnetic to the spin-glass phase by measuring two-time correlation functions.
[1] A.K. Hartmann, *Practical Guide to Computer Simulations*, World Scientific, 2009
[2] F. Belletti et al., *Ianus: An Adaptive FPGA Computer,* Computing in Science and Eng., vol. 8, no. 1, 2006, pp. 41-48.
[3] M. Weigel, *Simulating spin models on GPU*, Preprint arXiv:1006.3865v1

SOE 11.2 Tue 18:05 P2

Adaptive network models of swarm dynamics — Cristián Huepe[1], •Gerd Zschaler[2], Anne-Ly Do[2], and Thilo Gross[2] — [1]unaffiliated, C. Huepe Labs Inc., Chicago — [2]Max-Planck-Institut für Physik komplexer Systeme, Dresden

A simple adaptive network model describing recent swarming experiments is introduced. By exploiting an analogy with human decision-making models, its dynamics is captured using a low-dimensional system of equations permitting analytical investigation. The model reproduces several characteristic features of swarms, including spontaneous symmetry breaking, noise- and density-driven order-disorder transitions that can be of first or second order, intermittency, and metastable configurations displaying memory effects. By considering only minimal components of the swarming dynamics, it highlights the essential elements required to reproduce the observed behavior.

SOE 11.3 Tue 18:05 P2

Investigating the topology of interacting networks - Theory and application to coupled climate networks — •Jonathan F. Donges[1,2], Hanna C.H. Schultz[1,3], Norbert Marwan[1], Yong Zou[1], and Jürgen Kurths[1,2] — [1]Potsdam Institute for Climate Impact Research, P.O.Box 60 12 03, 14412 Potsdam, Germany — [2]Department of Physics, Humboldt University of Berlin, Newtonstr. 15, 12489 Berlin, Germany — [3]Department of Physics, Free University Berlin, Arnimallee 14, 14195 Berlin, Germany

Network theory provides various tools for investigating the structural or functional topology of many complex systems found in nature, technology and society. Nevertheless, it has recently been realised that a considerable number of systems of interest should be treated, more appropriately, as interacting networks or networks of networks. Here we introduce a novel graph-theoretical framework for studying the interaction structure between subnetworks embedded within a complex network of networks. This framework allows us to quantify the structural role of single vertices or whole subnetworks with respect to the interaction of a pair of subnetworks on local, mesoscopic and global topological scales.

Climate networks have recently been shown to be a powerful tool for the analysis of climatological data. Applying our general framework, we introduce coupled climate networks to represent and investigate the topology of statistical relationships between the fields of distinct climatological variables. This yields interesting insights into the atmosphere's general circulation structure.

SOE 11.4 Tue 18:05 P2

Epidemiological investigation of time-dependent complex networks — •Mario Konschake[1], Hartmut H K Lentz[1,2], and Thomas Selhorst[1] — [1]Friedrich-Loeffler-Institut, Institute of Epidemiology, Seestr. 55, 16868 Wusterhausen, Germany — [2]Department of Physics, Humboldt University, Newtonstr. 15, 12489 Berlin, Germany

The trade of live animals is a major route of infection. Therefore, in Germany every movement of live pigs is registered in the HI-Tier database. These data (121.287 premises with 3.5 million trade connections) form a special case of a time-dependent network with heavy-tail degree distribution and community structure [1].

We investigate the maximum size of epidemic as a function of infection date and infectious period. A threshold behavior for the infectious period and a strong dependency on the date of infection is found.

Furthermore, a confinement of epidemics to communities can be shown. Our results show that structure and time dependency are integral to the epidemiological investigation of real-world networks.

[1] Lentz, H.H.K., et al., Trade communities and their spatial patterns in the German pork production network. PREVET (2010), doi:10.1016/j.prevetmed.2010.10.011

SOE 11.5 Tue 18:05 P2

Graph-theoretic analysis of material flow layouts in packaging industry — Kristian Götze[1], •Reik V. Donner[1,2], and Thomas Seidel[1,3] — [1]Institute for Transport and Economics, Dresden University of Technology, Germany — [2]Potsdam Institufe for Climate Impact Research, Potsdam, Germany — [3]AMC Managing Complexity GmbH, Monheim am Rhein, Germany

We present a detailed analysis of the material flow systems of six different factories of a packaging manufacturer from a complex network perspective. For this purpose, the functional factory layout is interpreted as a directed graph, the vertices of which correspond to material handling and processing stations, while edges represent transportation devices such as conveyors, forklifts, or similar objects. The resulting networks are of sufficient size (between 134 and 334 vertices) to allow meaningfully studying graph properties on both local and global scale. Centrality measures such as degree and betweenness reveal vertices that are particularly crucial for the function of the overall system and should therefore be designed in a redundant way in order to avoid high economic risks in case of failures. Regarding the meso-scale network properties, the observed motif distributions are found to differ considerably from those of known superfamilies of networks, which is mainly due to a very low abundance of closed 3-loops. Possible implications of our findings for the design of efficient and robust material flow infrastructures are discussed.

SOE 11.6 Tue 18:05 P2

Effects of rapid evolution of connectivity on epidemic dynamics — •Amir Akbari Kalhor, Gerd Zschaler, and Thilo Gross — Biological Physics Section, Max-Planck Institute for the Physics of Complex Systems, Nöthnitzer Straße 38, 01187 Dresden, Germany

In epidemic dynamics on networks the most connected nodes play crucial role for spreading and prevention strategies. Recent empirical results on large social networks has revealed that the effective connectivity evolves rapidly so that at different times different nodes are most connected. We investigate how dynamic contact structure affects epidemic spreading. Further we explore in this framework how social distancing reduces the prevalence of the epidemic.

SOE 11.7 Tue 18:05 P2

Identifying damage functions through density transformation — •Diego Rybski[1], J. Micha Steinhäuser[1,2], and Jürgen P. Kropp[1] — [1]Potsdam Institute for Climate Impact Research (PIK), P.O. Box 60 12 03, 14412 Potsdam, Germany — [2]University of Oldenburg, 26129 Oldenburg, Germany

In order to estimate future damage caused by natural disasters, it is desirable to know the damage caused by single events. So called damage functions provide – for a natural disaster of certain magnitude – a specific damage value. However, in general, the functional

form of such damage functions is unknown. We study the distributions of recorded damage values and deduce which damage functions lead to such distributions when the natural disasters obey Generalized Extreme Value statistics. We find broad damage distributions and investigate two possible functional forms to characterize the data. In the case of Gumbel distributed extreme events, (i) a power-law distribution density with an exponent close to 2 (Zipf's law) implies an exponential damage function. (ii) Stretched exponential distribution densities imply power-law damage functions. In the case of Weibull (Frechet) distributed extreme events we find correspondingly steeper (less steep) damage functions.

SOE 11.8 Tue 18:05 P2

A percolation model for trust in financial markets — •Tobias Tubbenhauer and Stefan Bornholdt — Institut für Theoretische Physik, Universität Bremen, Otto-Hahn Allee, 28359 Bremen

Trust is an important feature of real markets. Motivated by the financial crisis in 2007, we want to study the building and evaporation of trust in an agent-based toy market, where agents are connected by their commercial relationships. The evolution of trust takes place in the clash between a necessity to take risk by having as much business partners as possible and a desire for security from losses received by bankrupt business partners. Between these two conflicting interests our toy market shows self organized critical behavior.

[1] E. Samanidou, E. Zschischang, D. Stauffer and T. Lux, Agent-based Models of Financial Markets, Rep. Prog. Phys. 70, 409 - 450 (2007)

[2] B. Drossel, F. Schwabl, Phys. Rev. Lett. A 69, 1629 (1992)

SOE 11.9 Tue 18:05 P2

Regional clustering of automotive stocks revealed by linear and nonlinear multivariate analysis — Richard Neuberg[1] and •Reik V. Donner[2,3] — [1]Faculty of Economics, Dresden University of Technology, Germany — [2]Institute for Transport and Economics, Dresden University of Technology, Germany — [3]Potsdam Institute for Climate Impact Research, Potsdam, Germany

Stock markets are extremely dynamic systems with fluctuations on a broad range of different time scales. In this work, we study mutual interrelationships between the 10-day returns of stocks from a set of globally acting car manufacturers recorded for about the last decade. By applying linear as well as nonlinear dimensionality reduction techniques, we find a non-trivial regional clustering in the respective leading-order components, which allows splitting the mean sectoral market evolution into well-defined regional components. The robustness of the respective results obtained with the different multivariate analysis methods is systematically assessed. Finally, we study the temporal changes in the correlation structure between the different stocks and discuss our results in the light of varying global economic conditions.

SOE 11.10 Tue 18:05 P2

relationship between ARCH model and stochastic dealer model — •Kenta Yamada[1], Sidney Redner[2], Hideki Takayasu[3], and Misako Takayasu[1] — [1]Tokyo Institute of Technology, Japan — [2]Boston University, USA — [3]Sony CSL, Japan

In order to understand statistical properties of time series of market prices from the viewpoint of microscopic dealers' action, we clarify a relationship between ARCH model and stochastic dealer models. ARCH model is an autoregressive type of time series model developed in the field of financial technology which reproduces the empirically known power law distribution of price changes, and there are many derived models such as GARCH model. On the other hand stochastic dealer model, which is studied mostly by physicists, is consisted of minimal configuration of dealers in an artificial market, and by tuning the parameters the models reproduce most of empirically stylized facts of financial markets including the power law distribution of price changes.

A. Sato and H. Takayasu showed that ARCH model can be derived from a deterministic dealer model in the special case that dealers have tendency of following trends of price changes. In this presentation we pay attention to the dealer's spread, that is, the price difference between the dealer's buying and selling prices, which has been set as a constant in the dealer model. By taking into account a feedback effect of volatility to the dealer's spread, we can theoretically derive ARCH model from the dealer model with fluctuation of spread.

SOE 11.11 Tue 18:05 P2

Agent based reasoning of the nonlinear stochastic models — •Aleksejus Kononovičius, Vygintas Gontis, and Bronislovas Kaulakys — Institute of Theoretical Physics and Astronomy, Vilnius University, A. Gostauto 12, LT-01108 Vilnius, Lithuania

Recently we introduced a double stochastic process driven by the nonlinear scaled stochastic differential equation reproducing the main statistical properties of the return, observed in the financial markets [1,2]. The proposed model is based on the class of nonlinear stochastic differential equations, providing the long-range processes, the power-law behavior of spectra and the power-law distributions of the probability density [3]. Stochastic framework mainly gives only a macroscopic insight into the modeled system, while microscopic behavior currently is also of big interest. In this contribution we will provide a version of agent based herding model with transition to the nonlinear stochastic equations of trading activity and return in financial markets.

[1] V. Gontis, J. Ruseckas and A. Kononovicius, Physica A 389, 100 (2010).

[2] V. Gontis, J. Ruseckas and A. Kononovičius, A Non-Linear Double Stochastic Model of Return in Financial Markets, Stochastic Control, Chris Myers (Ed.), ISBN: 978-953-307-121-3, Sciyo, (2010), http://www.intechopen.com/articles/show/title/a-non-linear-double-stochastic-model-of-return-in-financial-markets

[3] B. Kaulakys, J. Ruseckas, V. Gontis and M. Alaburda, Physica A 365, 217 (2006); J. Ruseckas and B. Kaulakys, Phys. Rev. E 81, 031105 (2010).

SOE 11.12 Tue 18:05 P2

Universal behavior in the dynamics of finanical markets — •Josef Ludescher[1], Constantino Tsallis[1,2], and Armin Bunde[1] — [1]Institut fur Theoretische Physik, Justus-Liebig-Universitat Giessen, 35392 Giessen, Germany — [2]present address: Centro Brasileiro de Pesquisas Fisicas 22290-180 Rio de Janeiro-RJ, Brazil

In financial markets, the central quantity are the relative losses or gains of an asset in a certain fixed period of time. The time evolution of these returns can be characterized by the set of interoccurence times r between losses below a negative threshold Q, in particular by their mean interoccurence time R_Q and their distribution function $P_Q(r)$. Here we consider daily losses in 16 representative financial records (stocks, indices, commodities and exchange rates). We find that in all cases $P_Q(r)$ follows the q-exponential form $P_Q(r) = 1/(1 + (q-1)\beta_Q r)^{1/(q-1)}$, where β is a monotonously decreasing function for small R_Q and becomes a constant for $R_Q > 10$. A is a normalization constant. The q-value appearing in the exponent of P_Q decreases logarithmically with decreasing R_Q, such that for $R_Q \to 2$, q tends to 1 and thus $P_Q(r)$ becomes a simple exponential. The fact that P_Q does not scale with R_Q is due to the multifractality of financial markets. The analytic form of the distribution allows also to estimate both the functional form of the risk function as well as the value-at-risk, and thus to improve estimation of the financial risk.

SOE 11.13 Tue 18:05 P2

Study of persistence in the foreign exchange market: analysis of the Hurst exponent — •Marcus Fernandes da Silva[1] and José Garcia Vivas Miranda[2] — [1]Brazil — [2]Brazil

This paper uses concepts of persistence to describe the behavior of currency fluctuations between the regimes of fixed Exchange rates and floating Exchange. Therefore, we used the Hurst exponent, which is a tool that can characterize the persistence of a particular profile. The first objective of this work is observes the behavior of the Hurst exponent in the switching between regimes of fixed exchange rates and floating exchange rate for the developing countries: Brazil, Mexico and Argentina. The second is to observe, also from the Hurst analysis, if there is a pattern behavior of floating exchange rate regime for the developed countries Canada and Australia if this happens, we will associate the efficiency of the foreign exchange market with the Hurst exponent. We observed a pattern behavior for the developed countries in the shift between the two exchange rate regimes. This pattern was characterized by persistence, followed by a rapid decrease antipersistentes values for and followed by a rapid increase to persistent values. It was observed that the Hurst exponent values for the developing countries distance themselves from 0.5 (ordinary Brownian motion) then the developed ones. This corroborates the hypothesis that the exchange market efficiency is associated with the ordinary Brownian motion.

SOE 11.14 Tue 18:05 P2

Emotional agents at the square lattice — •Agnieszka Czaplicka, Anna Chmiel, and Janusz A. Hołyst — Faculty of Physics Warsaw University of Technology, Warsaw, Poland

We introduce and investigate by numerical simulations a number of models of emotional agents at the square lattice. Our models describe the most general features of emotions such as the spontaneous emotional arousal, emotional relaxation, and transfers of emotions between different agents. Group emotions in the considered models are periodically fluctuating between two opposite valency levels and as result the mean value of such group emotions is zero. The oscillations amplitude depends strongly on probability p_s of the individual spontaneous arousal. For small values of relaxation times τ we observed a stochastic resonance, i.e. the signal to noise ratio SNR is maximal for a non-zero p_s parameter. The amplitude increases with the probability p of local affective interactions while the mean oscillations period increases with the relaxation time τ and is only weakly dependent on other system parameters. Presence of emotional antenna can enhance positive or negative emotions and for the optimal transition probability the antenna can change agents emotions at longer distances. The stochastic resonance was also observed for the influence of emotions on task execution efficiency.

SOE 11.15 Tue 18:05 P2

Language change in a multiple group society — •Cristina-Maria Pop and Erwin Frey — Arnold Sommerfeld Center and CeNS, Ludwig-Maximilians-Universität München, Theresienstr. 37, 80333 München, Germany

The use of language in society serves several purposes. On the one hand, the necessity to communicate meaning leads to agreement on a conventional sign for a recurring problem. On the other hand, there is the wish to identify with different social groups depending on the situation. This promotes the use of various linguistic variants. Through innovations in language and the influence of other social groups, novel forms are spread across the speech community, resulting in a competition between variant forms.

A mathematical formulation of the linguistic interactions inside an isolated social group is offered by the Utterance Selection Model [1], which explains the mechanisms inducing variant fixation and analyzes the distribution of variant frequencies.

In the attempt of describing language change in a society consisting of multiple groups, we take the Utterance Selection Model beyond the one-group boundary. The interactions between groups counterbalance the formation of consensus in the individual groups and thus offer a further mechanism for the propagation of linguistic changes.

[1] G. J. Baxter, R. A. Blythe, W. Croft, Phys. Rev. E **73**, 046118 (2006)

SOE 11.16 Tue 18:05 P2

Contact processes on directed adaptive networks — Michael Seissinger, •Gerd Zschaler, Güven Demirel, and Thilo Gross — Max-Planck-Institut für Physik komplexer Systeme, Dresden

We propose the application of directed adaptive networks in models of opinion formation and epidemic spreading to capture the effect of asymmetry in real-world relationships. In our approach, agents can rewire their out-going connections while leaving the network's out-degree distribution fixed. Thus, the influence of different realistic out-degree distributions on the adaptive network dynamics can be investigated. As the out-degree distribution remains constant in time, it can be taken into account in a low-dimensional approximate ODE description in terms of its moments. Here we discuss the case of the voter model on directed adaptive networks. In this example, we observe a transition between an active and an absorbing phase at a critical rewiring rate, which depends on the first moments of the out-degree distribution.

SOE 11.17 Tue 18:05 P2

The effect of the forget-remember mechanism on spreading — •jiao gu and wei li — Max-Planck-Institute for Mathematics in the Sciences

We introduce a new mechanism, the forget-remember mechanism, into the spreading process. Equipped with such a mechanism an individual is prone to forget the message received and remember the one forgotten, namely switching his state between active (with message) and inactive (without message). The probability of state switch is governed by linear or exponential forget-remember functions of history time which is measured by the time elapsed since the most recent state change. Our extensive simulations reveal that the forget-remember mechanism has significant effects on the saturation of message spreading, and may even lead to a termination of spreading under certain conditions. This finding may shed some light on how to control the spreading of epidemics. It is found that percolation-like phase transitions can occur. By investigating the properties of clusters, formed by connected, active individuals, we may be able to justify the existence of such phase transitions.

SOE 11.18 Tue 18:05 P2

Biochemical reaction networks meet Coalitional Game Theory: The importance of not being single — •Max Sajitz-Hermstein[1] and Zoran Nikoloski[1,2] — [1]Max-Planck Institute of Molecular Plant Physiology — [2]Institute of Biochemistry and Biology, University of Postdam, Potsdam, D-14476 Germany

A fundamental question in the analysis of complex biological networks is how to determine which components (e.g. reactions) are most important regarding specific function. Virtually all existing approaches for establishing the importance of a reaction in a biological network are based on vitality-like indices. The importance of a reaction is then specified by the effect of its removal, emulating single knockout experiments in biology. However, such technique neglects topological features, like bypassing pathways, which are crucial for network robustness. Coalitional game theory provides a framework for extending the vitality-like indices by considering the contribution of single network elements with respect to all of its interactions in the network, based purely on the network topology. Here we propose a method combining cooperative game theory with flux balance analysis, a standard technique in the investigation of metabolic networks. We employ the method to rank reactions in metabolic networks with respect to a biologic function, in particular biomass production. Furthermore, our method is used in the design of a novel approach for determining network robustness to changes imposed by gene knock-outs.

SOE 11.19 Tue 18:05 P2

Causality & Stability: The Basis of Physics – Principles of Everything? — •Alexander an Haack, Paul Flachskampf, and Sabina Jeschke — Institute for Management Cybernetics e. V., Associate Institute of RWTH Aachen University, Germany

The basis for any physical consideration lies in the fundamental assumption that a real system behaves on the basis of cause and effect and always develops towards a maximum of stability: A System, residing in the stable state X will never shift without plausible cause to the otherwise adiabatically inaccessible state Y. Judging the importance of these principles, Helmholtz even is said to have considered their formal agents – the laws of thermodynamics – as "the laws of the world". On the level of socioeconomic systems however, neither is their validity proven nor are their consequences systematically elaborated. "How correct" was Laplace's famous assumption ("Laplace's demon") for example? Does the Heisenberg uncertainty principle have a practical effect on this level? As a first step in this process of enlarging the fundamental understanding of socioeconomic systems, we present our research on the scientific work of the past that has touched this specific question. Ultimately, our goal as management cybernetics scientists is to attain the ability to deduce well-founded and practically relevant insights on the behavior and development of real complex systems.