PHYSIK SOZIO-ÖKONOMISCHER SYSTEME (AKSOE)

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ÜBERSICHT DER HAUPTVORTRÄGE UND FACHSITZUNGEN

(Hörsaal TU P-N203)

Hauptvorträge

AKSOE 1.1	Fr	10:00	(TU P-N203)	**Self-Organized Complexity in Economics and Finance**, Luis A. Nunes Amaral
AKSOE 4.1	Sa	09:30	(TU P-N203)	**Evolutionary Games: Non-linear Dynamics at Work**, Karl Sigmund
AKSOE 9.1	Mo	16:00	(TU A151)	**The Dynamics of Networks, and their Relevance to Infectious Diseases, IT, and Many Other Things**, Robert M. May
AKSOE 10.1	Di	10:00	(TU P-N203)	**Information Horizons and Self Organization in Social Networks**, Kim Sneppen
AKSOE 13.1	Mi	10:00	(TU P-N203)	**Quantifying Extreme Risk - Critical Phenomena in Natural and Social Sciences**, Didier Sornette

Fachsitzungen

AKSOE 1	**Dynamics of Groups and Organizations I**	Fr	10:00–12:30	TU P-N203	AKSOE 1.1–1.4
AKSOE 2	**Dynamics of Groups and Organizations II**	Fr	14:00–16:00	TU P-N203	AKSOE 2.1–2.4
AKSOE 3	**Evolutionary Game Theory**	Fr	16:30–18:00	TU P-N203	AKSOE 3.1–3.3
AKSOE 4	**Evolutionary Game Theory**	Sa	09:30–10:30	TU P-N203	AKSOE 4.1–4.2
AKSOE 5	**Traffic Dynamics, Urban and Regional Systems I**	Sa	10:30–12:30	TU P-N203	AKSOE 5.1–5.4
AKSOE 6	**Traffic Dynamics, Urban and Regional Systems II**	Sa	14:00–16:00	TU P-N203	AKSOE 6.1–6.4
AKSOE 7	**Symposium: Biological and Social Networks (SYBN)**	Mo	09:45–13:20	TU HE101	AKSOE 7.1–7.1
AKSOE 8	**Poster Session**	Mo	14:00–15:30	Poster TU E	AKSOE 8.1–8.22
AKSOE 9	**Special Session: Young Scientist Award**	Mo	16:00–18:00	TU A151	AKSOE 9.1–9.3
AKSOE 10	**Social, Information and Production Networks I**	Di	10:00–12:30	TU P-N203	AKSOE 10.1–10.4
AKSOE 11	**Social, Information and Production Networks II**	Di	14:00–16:00	TU P-N203	AKSOE 11.1–11.4
AKSOE 12	**Macro and Micro Economic Models**	Di	16:30–18:30	TU P-N203	AKSOE 12.1–12.4
AKSOE 13	**Financial Markets and Risk Management I**	Mi	10:00–12:30	TU P-N203	AKSOE 13.1–13.4
AKSOE 14	**Financial Markets and Risk Management II**	Mi	14:00–16:00	TU P-N203	AKSOE 14.1–14.4

Sondersitzung:
Verleihung des Young-Scientist Award for Socio- and Econophysics
Mo 16:00–18:00, TU A151
1. Keynote Talk: Lord Robert M. May
2. Preisverleihung
3. Vortrag der Preisträgerin / des Preisträgers

Mitgliederversammlung des AKSOE

Fr. 18:00-19:00 TU P-N203

1. Bericht des Vorsitzenden des AKSOE
2. Wahl des AKSOE Vorsitzenden / stellv. Vorsitzenden für die kommenden drei Jahre
3. Diskussion über geplante Aktivitäten
4. Verschiedenes

gez. Frank Schweitzer

Fachsitzungen

– Haupt-, Kurzvorträge und Posterbeiträge –

AKSOE 1 Dynamics of Groups and Organizations I

Zeit: Freitag 10:00–12:30 Raum: TU P-N203

Hauptvortrag AKSOE 1.1 Fr 10:00 TU P-N203

Self-Organized Complexity in Economics and Finance — •Luis A. Nunes Amaral — Department of Chemical and Biological Engineering, Northwestern University, Evanston, IL 60208, USA

In my talk I will first discuss the reason why I use the word "complexity". In particular, I will differentiate between complicated and complex. Then, I will briefly review the set of tools and concepts that appear to be particularly useful when studying complex systems. I will then present some arguments for how uncertainty, on one hand, and the network of interactions, on the other, determine the type of strategies implemented by the agents. I will then discuss a simple model that illustrates the constraints imposed by uncertainty and connectivity on strategy evolution and selection. [**1**] Complex networks - augmenting the framework for the study of complex systems. Amaral, LAN, & Ottino, JM, Eur. Phys. J. B 38, 147-162 (2004). [**2**] Efficient system-wide coordination in noisy environments. Moreira, AA, Mathur, A, Diermeier, D, & Amaral, LAN, Proc. Natl. Acad. Sci. U. S. A. 101, 12085-12090 (2004). [**3**] Different scaling behaviors of commodity spot and future prices. Matia, K, Amaral, LAN, Goodwin, SP, & Stanley, HE, Phys. Rev. E 66, art. no. 045103, 1-4 (2002). [**4**] Application of statistical physics methods and concepts to the study of science & technology systems. Amaral, LAN, Gopikrishnan, P, Matia, K, Plerou, V, & Stanley, HE, Scientometrics 51, 9-36 (2001). [**5**] Inverse cubic law for the distribution of stock price variations. Gopikrishnan, P, Meyer, M, Amaral, LAN, & Stanley, HE, Eur. Phys. J. B 3, 139-140 (1998). [**6**] Power law scaling for a system of interacting units with complex internal structure. Amaral, LAN, Buldyrev, SV, Havlin, S, Salinger, MA, & Stanley, HE, Phys. Rev. Lett. 80, 1385-1388 (1998). [**7**] Universal features in the growth dynamics of complex organizations. Lee, YK, Amaral, LAN, Canning, D, Meyer, M, & Stanley, HE, Phys. Rev. Lett. 81, 3275-3278 (1998). [**8**] Scaling behaviour in the growth of companies. Stanley, MHR, Amaral, LAN, Buldyrev, SV, Havlin, S, Leschhorn, H, Maass, P, Salinger, MA, & Stanley, HE, Nature 379, 804-806 (1996).

— 15 min. Break —

AKSOE 1.2 Fr 11:00 TU P-N203

Opinion formation and election results: analytical approach — •František Slanina — Institute of Physics, Academy of Sciences of the Czech Republic, Na Slovance 2, 18221 Praha, Czech Republic

The Sznajd model, which describes opinion formation and social influence, is treated analytically on a complete graph. We prove the existence of the phase transition in the original formulation of the model, while for the Ochrombel modification we find smooth behaviour without transition. We calculate the average time to reach the stationary state as well as the exponential tail of its probability distribution. An analytical argument for the observed $1/n$ dependence in the distribution of votes in Brazilian elections is provided.

AKSOE 1.3 Fr 11:30 TU P-N203

Monte Carlo simulation of the rise and the fall of languages — •Dietrich Stauffer and Christian Schulze — Institute for Theoretical Physics, Cologne University, D-50923 K"oln

Similar to biological evolution and speciation we define a language through a string of 8 or 16 bits. The parent gives its language to its children, apart from a random mutation from zero to one or from one to zero; initially all bits are zero. The Verhulst deaths are taken as proportional to the total number of people, while in addition languages spoken by many people are preferred over small languages. For a fixed population size, a sharp phase transition is observed: For low mutation rates, one language contains nearly all people; for high mutation rates, no language dominates and the size distribution of languages is roughly log-normal as for present human languages. A simple scaling law is valid.

AKSOE 1.4 Fr 12:00 TU P-N203

Multiplicative Models for Company Dynamics — •Frank Schweitzer — D-MTEC, ETH Zentrum, CH-8032 Zuerich

Since the pioneering work of Gibrat (1931) stochastic models with multiplicative noise are used to describe the growth of companies. The talk reviews current results in this field, with particular emphasis on US and Japanese firms. Further, a simple model of investment strategies is discussed.

AKSOE 2 Dynamics of Groups and Organizations II

Zeit: Freitag 14:00–16:00 Raum: TU P-N203

AKSOE 2.1 Fr 14:00 TU P-N203

Modelling the population dynamics of agricultural societies — •Dieter F. Ihrig — FH Suedwestfalen, Iserlohn, Germany

The growth of populations are generally described by the theories of Maltus (only birth and dead rate) and Verhulst (calculates the maximum food production, too). In agricultural societies there are much more influences: Fertilisation is increased with the amount of food production. This leads to a positive feedback because the value of the soil increases. Reversible forms of non-agricultural soil use (for example settlement) and non-reversible loss of soil (for example pollution) lead to a negative feedback. These effects are modelled and results are shown. The meagre the soil is the lower is the use or loss stimulated by socio-economic processes. Assuming that growth of socio-economic insight are following the same mathematical laws then other growing processes such effects are modelled; first results are shown. It is tried to apply the found solutions to other socio-economic phenomena like stock exchange prices.

AKSOE 2.2 Fr 14:30 TU P-N203

Let s have a party — •Marian Brandau and Steffen Trimper — Fachbereich Physik, Martin-Luther-Universität, Friedemann-Bach-Platz, 06108 Halle

We consider a homogeneous population of N agents which are interested in a party. Based on a simple model we analyse the behaviour of such a meeting particularly with regard to the appearance of a depletion effect. The agents evaluate their party by the comparison of their party with any other party. We take as criterion the number of friends at the several parties. The friends of each agent are exponentially distributed. After this proceeding they take the decision, either they stay on the party or they leave it and go to another one. Due to this interaction effects a collective movement will lead to enrich or become extinct of some parties. The simulations on a network show such an effect depending on the initial condition and the distribution of friends. In some cases all agents accumulate at one party at the end of the simulation. The simulations are confronted with an analytical approach based on an evolution model.

AKSOE 2.3 Fr 15:00 TU P-N203

The Impact of Election Results on the Member Numbers for the Large Parties in Germany — •Christian Hirtreiter[1] and Johannes J. Schneider[2] — [1]Institute of Organic Chemistry, University of Regensburg, Universitätsstr. 31, 93053 Regensburg, Germany — [2]Institute of Physics, Johannes Gutenberg University of Mainz, Staudinger Weg 7, 55099 Mainz, Germany

We investigate the relations between the numbers of members of various parties and their results in the elections in German states. The talk focuses on the question whether there is the same relationship between these data as in Bavaria, where we found for the CSU and the Bavarian SPD that the results in the two last elections induce a positive or negative trend on their member numbers.
[1] J. J. Schneider and Ch. Hirtreiter, The Impact of Election Results on the Member Numbers for the Large Parties in Bavaria and Germany, to be published in Int. J. Mod. Phys. C.

AKSOE 2.4 Fr 15:30 TU P-N203

Affecting Network Structures Through Selection Mechanisms — •Adrian Marcelo Seufert[1] and Frank Schweitzer[2] — [1]TU Berlin, Institut für Theoretische Physik — [2]D-MTEC ETH Zürich

We present a modification of a model due to Sanjay Jain and Sandeep Krishna of interacting components on a network structure that evolves in time. The nodes in the network can be identified with species in a common environment, and the interactions between different species are represented by links in a directed graph. Each species can be characterized by its population. The nodes are submitted to a simple linear dynamics that affects their populations. The dynamics is determined by the structure of the network, while at the same time influencing it by determining which nodes will be selected for mutation. Mutating nodes lose all their links and randomly set new links, thus modifying the network. A connected network appears in the model once an autocatalytic set appears by chance and engulfs the whole set of nodes.

We modify the model by introducing a new selection mechanism which makes selection dependent on the relative performance of the nodes. We show that by varying the performance threshold required for survival, we affect the structure of the emerging network, as measured by the size of its core, the clustering coefficient, and the out-degree distribution. Also, we observe a separation into two distinct regimes, a high performance regime and a low performance regime, as a function of the threshold.

AKSOE 3 Evolutionary Game Theory

Zeit: Freitag 16:30–18:00 Raum: TU P-N203

AKSOE 3.1 Fr 16:30 TU P-N203

Iterated prisoners dilemma on networks with adaptive topology under perfect rationality — •Christoly Biely and Stefan Thurner — Complex System Research Group, Medical University of Vienna - HNO Bauteil 86, Waehringer Guertel 18-20, A-1090 Vienna, Austria

Up to now analysis of the actions chosen by agents playing the iterated prisoners dilemma game on networks has concentrated on the time evolution of the respective system with constant link structure and rules based on imitation.

In contrast, we present the results of a model which determines the time evolution of the draws in a system with variable link structure and update rules based on perfect rationality. The model is based on the conception that defecting players are sanctioned by the potential termination of the game by their co-players. Conversely, cooperating agents are implicitly rewarded by the possibility to acquire new co-players for the subsequent games.

Conducted simulations show that in spite of the rationality of the respective actors - which would result in the nash equilibrium of overall defection in a system of constant network-topology - cooperation emerges. Choosing appropriate model-parameters we obtain time-dependent networks, which are characterized by high density of cooperating agents and isolation of defecting players.

AKSOE 3.2 Fr 17:00 TU P-N203

Stochastic gain in population dynamics — •Arne Traulsen, Torsten Röhl, and Heinz Georg Schuster — Institut für Theoretische Physik und Astrophysik, Christian Albrechts Universität Kiel, Leibnizstraße 15, D-24098 Kiel

A standard approach to model evolutionary games is the replicator dynamics. We introduce an extension of the usual replicator dynamics to adaptive learning rates [A. Traulsen, T. Röhl, and H. G. Schuster, Phys. Rev. Letters 93, 028701 (2004)]. Is is shown that a population with a dynamic learning rate can gain an increased average payoff in transient phases. It can also exploit external noise, leading the system away from the Nash equilibrium, in a reasonance-like fashion. The payoff versus noise curve resembles the signal to noise ratio curve in stochastic resonance. Seen in this broad context, we introduce another mechanism that exploits fluctuations in order to improve properties of the system. Such a mechanism could be of particular interest in economic systems.

AKSOE 3.3 Fr 17:30 TU P-N203

Transition to Cooperative Behaviour in a Route Choice Game — •Martin Schönhof[1], Dirk Helbing[1], Hans-Ulrich Stark[1], and Janusz Hołyst[2,3] — [1]Institute for Transport & Economics, Dresden University of Technology, Andreas-Schubert-Str. 23, D-01062 Dresden, Germany — [2]Faculty of Physics and Center of Excellence for Complex Systems Research, Warsaw University of Technology, Koszykowa 75, PL-00-662 Warsaw, Poland — [3]Max Planck Institute for Physics of Complex Systems, Nöthnitzer Str. 38, D-01187 Dresden, Germany

We present experimental results of humans playing a certain iterated normal form game. The game is related to the route decision problem of commuters trying to minimize their mean travel time over many days by choosing one of two possible routes. The focus is on whether and how the participants are able to find a cooperative and fair nonstationary strategy leading to the system-optimal road usage. The dynamics of the decisions has been modelled by a new model of reinforcement learning, furthermore some system properties can be described analytically.

AKSOE 4 Evolutionary Game Theory

Zeit: Samstag 09:30–10:30 Raum: TU P-N203

Hauptvortrag AKSOE 4.1 Sa 09:30 TU P-N203

Evolutionary Games: Non-linear Dynamics at Work — •Karl Sigmund — Institute for Mathematics, University of Vienna, Austria

This is a survey on a type of non-linear dynamics which has been motivated by ideas of the theoretical biologist John Maynard Smith, and which has blossomed remarkably during the last decade. Evolutionary games are not only essential for understanding biological and cultural evolution, they also proved seminal for experimental studies in economics and social sciences. This talk offers an overview of the different types of dynamics (replicator, best reply, imitation, myopic adjustment, cellular automata...), using as examples models stemming from a wide variety of backgrounds, all having in common a rock-paper-scissors structure which cannot be reduced to an equilibrium analysis.

AKSOE 5 Traffic Dynamics, Urban and Regional Systems I

Zeit: Samstag 10:30–12:30 Raum: TU P-N203

AKSOE 5.1 Sa 10:30 TU P-N203

Self-Organized Adaptive Signal Control in a Fluid-Dynamic Traffic Flow Model of Urban Queuing Networks — •Dirk Helbing and Stefan Lämmer — Institute for Transport & Economics, Dresden University of Technology, D-01062 Dresden

We present a fluid-dynamic model for the simulation of urban traffic networks with street sections of different lengths and capacities. The model allows one to efficiently simulate the transitions between free and congested traffic based on an integrated Lighthill-Whitham model. On top of this, we observe non-linear dynamic patterns which are produced by the respective network topology. Synchronization is only one interesting example and implies the emergence of green waves. In this connection, we will discuss adaptive strategies of traffic light control which can considerably improve throughputs and travel times, using self-organization principles based on local interactions between vehicles and traffic lights. Similar adaptive control principles can be applied to other queueing networks such as production systems.

References:
[1] D. Helbing: A section-based queueing-theoretical traffic model for congestion and travel time analysis in networks, *J. Phys. A: Math. Gen.* **36**, L593-L598 (2003).
[2] S. Lämmer, D. Helbing, and J.-P. Lebacque, Self-organized traffic control in urban road networks, preprint (2004).

AKSOE 5.2 Sa 11:00 TU P-N203

Modelling Traffic Flow Fluctuations — •Peter Wagner — Institute of Transport Research, German Aerospace Centre, Rutherfordstrasse 2, 12489 Berlin

The analysis of time headway distributions of traffic flow yield an interesting result: when viewed as a function of speed, the headway distribution undergo a transition from a Poissonian dominated regime (for large speeds) to a power-law regime (for intermediate speeds in the range $10 \leq v \leq 30$ m/s). The power-law distribution can be modelled by a simple stochastic process (stochastic differential equation) that act on the preferred headway of an individual driver.

Additionally, more detailed empirical results will be presented related to the so called slow-to-start mechanism identified for models as one of the major reasons for jam stability.

Finally, the comparison of German and US-American data-sets demonstrates similarities, as well as differences on the level of the time headway distributions.

By inserting this mechanism into microscopic traffic flow models, the models become more realistic in term of their fluctuation structure, which so far has been difficult to model. This is different from the usually fluctuation mechanism used in microscopic modelling, where the noise is acting as additive noise on the acceleration directly.

AKSOE 5.3 Sa 11:30 TU P-N203

Simulating vehicular traffic in a network using dynamic routing — •Florian Siebel and Wolfram Mauser — Department of Earth and Environmental Sciences, University of Munich, Luisenstraße 37, D-80333 Munich

We present a new numerical code which solves the Lighthill-Whitham model, the classic macroscopic model for vehicular traffic flow, in a network with multi-destinations. We use a high-resolution shock-capturing scheme with approximate Riemann solver to solve the partial differential equations of the Lighthill-Whitham-theory. These schemes are very efficient, robust and moreover well adapted to simulations of traffic flows. We develop a theory of dynamic routing including a procedure for traffic flow assignment at junctions which reproduces the correct propagation of irregularities and ensures at the same time conservation of the number of vehicles.

AKSOE 5.4 Sa 12:00 TU P-N203

Collective effects in traffic on bi-directional ant-trails — •Alexander John[1], Andreas Schadschneider[1], Debashish Chowdhury[2], and Katsuhiro Nishinari[3] — [1]Institute for Theoretical Physics, Universitaet zu Koeln, D- 50937 Koeln, Germany — [2]Department of Physics, Indian Institute of Technology, Kanpur 208016, India — [3]Department of Applied Mathematics and Informatics, Ryukoku University, Shiga 520-2194, Japan

Motivated by recent experimental work [Burd et al.], we propose models of single- and bidirectional traffic on ant-trails. Although these models are formulated in the simple language of cellular automata, they capture the main features of the dynamics of ants moving on a trail. Crucial differences like altruism vs. egoism between traffic on ant-trails and human vehicular traffic are discussed. In addition, predictions from both models can be tested experimentally. The main feature of the single-lane model is a non-monotonicity of velocity vs. density. Our bidirectional model shows a constant flux over an intermediate density regime. Many properties of the dynamics can be understood by the formation of clusters and coarsening processes.

AKSOE 6 Traffic Dynamics, Urban and Regional Systems II

Zeit: Samstag 14:00–16:00 Raum: TU P-N203

AKSOE 6.1 Sa 14:00 TU P-N203

Spontaneous formation and decay of platoons in continuous microscopic traffic models — •Martin Treiber, Arne Kesting und Dirk Helbing — Institute for Transport & Economics, Dresden University of Technology

We investigate adaptations of the time gap of car-following models as a function of the smoothness of traffic flow measured by the local velocity variance. We simulate open systems with an on-ramp as bottleneck and analyze one-minute data and single-vehicle data generated by several "virtual detectors".

Both the widely scattered and hysteretic fundamental diagram and microscopic results such as the distributions of the netto time headways derived from these "virtual" data indicate that spontaneous formation and decays of platoons take place. Moreover, there is a nearly quantitative agreement with actual traffic data.

We explain these results by a self-organized process driven by the adaptations of the time headway that leads to spontaneous emergences and decays of platoons even for deterministic dynamics of identical vehicles on a single lane.

AKSOE 6.2 Sa 14:30 TU P-N203

Information Propagation in an Ad-hoc Car2Car Network — •Arne Kesting, Martin Schönhof, Martin Treiber, and Dirk Helbing — Institute for Transport & Economics, Dresden University of Technology

Traditional sensors of Adaptive-Cruise Control Systems only detect the immediate vehicle environment. To extend these limitations information transport on freeways based on car-to-car communication is a possible scenario for a next generation of Driver-Assistance Systems.

Therefore, we consider an ad-hoc radio network formed by equipped vehicles with a limited range for broadcasting messages to each other. By using equipped cars as relays messages about the actual traffic situation are transported further upstream in a self-organized manner without a central traffic management station on a short timescale.

For small percentages of equipped cars the message hopping within one driving direction is obviously rather limited. We propose to use the vehicles in the other driving direction as relays, too. Analytic results based on a Poisson approximation show the efficency and velocity of information propagation by means of transverse message hopping. The propability distributions are compared to numerical results of microscopic traffic simulations.

AKSOE 6.3 Sa 15:00 TU P-N203

Towards a Traffic Telematics Testbed at TUB — •Gunnar Flötteröd and Kai Nagel — Transport Systems Planning and Transport Telematics Group, Sekr. SG 12, Salzufer 17-19, D-10587 Berlin

We present a microsimulation based traffic telematics testbed for integrative evaluation of telematics devices and strategies. As a synthetic reality, we apply the SUMO traffic simulator which microscopically represents traffic dynamics, driver's long ranging route choice and spontateous en route replanning; we also prepare to extend SUMO by a module for activity based demand generation. On the traffic telematics side, we currently focus on two aspects: Traffic Monitoring/Prediction and Traffic Control. The former is based on a macroscopic model which we adjust by means of mathematical programming and evaluate by feeding it with synthetic measurements from our SUMO testbed. The latter serves as an extension to SUMO itself and allows for the evaluation of different (mainly agent based) control strategies. To keep the entire system expandable, we systematically integrate all aforementioned subsystems into a general traffic telematics control loop, strongly focussing on real world applications and effortless expandability.

AKSOE 6.4 Sa 15:30 TU P-N203

Bologna Revisited — •Rainer E. Zimmermann — a,b

The following paper is on the emergence of observable complexity in urban networks visualized as product of essentially non-observable social processes. The methodology unfolded here draws on recent insight of econophysics in the strict sense under a top-down perspective of laying the foundations for a modern view to the evolution of dynamical structures in nature. The basic result of the present paper is to demonstrate the interaction of networks on the microlevels and macrolevels of the historical centre of the city of Bologna visualized as an emergent computational urban system, respectively.

AKSOE 7 Symposium: Biological and Social Networks (SYBN)

Zeit: Montag 09:45–13:20 Raum: TU HE101

AKSOE 8 Poster Session

Zeit: Montag 14:00–15:30 Raum: Poster TU E

AKSOE 8.1 Mo 14:00 Poster TU E

Simulation of Pedestrians with the Social Force Model — •Anders Johansson and Dirk Helbing — Institute for Transport & Economics, Dresden University of Technology

In order to fully understand and analyze how the infrastructure in public facilities as well as in urban regions affects the overall characteristics of pedestrian crowds within these areas, computer simulations need to be performed. An implementation of the Social Force Model is discussed, which is suitable for both small-scale pedestrian simulations as well as computationally fast large-scale pedestrian simulations. We show simulations of proposed design solutions for maximizing the throughput and avoid peaks of density and pressure at critical locations. Among the applications one can find; Pilgrim streams on the Jamarat bridge, evacuation of soccer arenas and theaters. Also, self-organization phenomena such as lane formation, stripe formation and oscillations at bottlenecks are discussed.

AKSOE 8.2 Mo 14:00 Poster TU E

Autonomous Agents Controlling Traffic Lights — •Jürgen Mikat, Elmar Brockfeld, and Peter Wagner — Institute of Transport Research, German Aerospace Center (DLR) in der Helmholtz-Gemeinschaft, 12489 Berlin-Adlershof, Germany

In todays' road networks, traffic management methods are of more and more importance with steadily increasing traffic. Detector values are related to pre-assigned, fixed signal programs or used to adapt the signal phases within a signal phase frame. Drawbacks of these detectors are high installation costs and limitations in data usage. From a single detector information on vehicle speeds or number of vehicles waiting is not available. With the development of information technologies new kinds of detectors allow a more flexible operation of traffic signals by using additional information on traffic flow. This allows in turn the development of concepts of autonomous acting traffic lights reacting on the demand at the intersection or within the approaches. We give examples of autonomous acting traffic lights equipped with simple rule sets optimizing the traffic flow along a road segment and between several neighboured intersections.

AKSOE 8.3 Mo 14:00 Poster TU E

Social and traffic networks in an agent-based freight transport demand model — •Michael Spahn and Peter Wagner — Institute of Transport Research, German Aerospace Center (DLR) in the Helmholtz Association, Rutherfordstrasse 2, 12489 Berlin, Germany

An agent-based, microscopic freight transport demand model is presented. Agents represent producers and consumers of goods in an economy. Through their economic actions demand for freight transport is generated and satisfied via agents representing transport providers. The resulting traffic flow is treated microscopically and allows for a detailed examination of the consequences of policy measures, technical innovations and economic changes for freight transportation.

For a simplified version of this complex model the resulting social networks between firms and traffic networks are presented and characterized.

AKSOE 8.4 Mo 14:00 Poster TU E

Stochastic Description of Traffic Breakdowns — •Jevgenijs Kaupužs[1] and Reinhard Mahnke[2] — [1]Univ. Latvia, LV–1459 Riga, Latvia — [2]Inst. of Physics, Univ. Rostock, D–18051 Rostock

We analyse the characteristic features of jam formation on a circular one-lane road. We have applied an optimal velocity model including stochastic noise, where cars are treated as moving and interacting particles. From the *probabilistic point of view* we investigate a quite classical dynamical system given by stochastic differential equations, i. e. ordinary differential equations with multiplicative noise. Based on this Langevin approach the distributions of vehicular velocity difference as well as headway distances are calculated and discussed.

In analogy to the gas-liquid phase transition in supersaturated vapour at low enough temperatures, we observe three different regimes of traffic flow. There are the free flow regime (like gaseous phase) at small densities of cars, the coexistence of a jam and free flow (like liquid and gas) at intermediate densities, and the homogeneous dense traffic (like liquid phase) at large densities.

[1] J. Kaupužs, H. Weber, J. Hinkel, R. Mahnke, Application to Traffic Breakdown on Highways, In: Progress in Industrial Mathematics at ECMI 2002, Springer, Berlin, pp. 133 – 138, 2004
[2] R. Mahnke, J. Kaupužs, Phys. Rev. E **59**, 117, 1999
[3] P. E. Kloeden, E. Platen, Numerical Solution of Stochastic Differential Equations, Springer, Berlin, 1992

AKSOE 8.5 Mo 14:00 Poster TU E

Stochastic Description of Traffic Breakdowns — •Julia Hinkel[1], Reinhard Mahnke[1], Jevgenijs Kaupužs[2], and Anna Berezovskaya[3] — [1]Inst. of Physics, Univ. Rostock, D–18051 Rostock — [2]Univ. Latvia, LV–1459 Riga, Latvia — [3]Univ. Kiev, UA–01033 Kiev, Ukraine

We analyse the characteristic features of jam formation on a circular one-lane road. We have applied an optimal velocity model including stochastic noise, where cars are treated as moving and interacting particles. From the *probabilistic point of view* we investigate a quite classical dynamical system given by stochastic differential equations, i. e. ordinary differential equations with multiplicative noise. Based on this Langevin approach the distributions of vehicular velocity difference as well as headway distances are calculated and discussed.

In analogy to the gas-liquid phase transition in supersaturated vapour at low enough temperatures, we observe three different regimes of traffic flow. There are the free flow regime (like gaseous phase) at small densities of cars, the coexistence of a jam and free flow (like liquid and gas)

at intermediate densities, and the homogeneous dense traffic (like liquid phase) at large densities.

[1] J. Kaupužs, H. Weber, J. Hinkel, R. Mahnke, Application to Traffic Breakdown on Highways, In: Progress in Industrial Mathematics at ECMI 2002, Springer, Berlin, pp. 133 – 138, 2004

[2] R. Mahnke, J. Kaupužs, Phys. Rev. E **59**, 117, 1999

[3] P. E. Kloeden, E. Platen, Numerical Solution of Stochastic Differential Equations, Springer, Berlin, 1992

AKSOE 8.6 Mo 14:00 Poster TU E

Envy: from the economic theory to the computer simulation — •Elena Ramirez-Barrios, Juan G. Diaz-Ochoa, and Johannes J Schneider — Institute of Physics, Johannes Gutenberg University of Mainz, Staudinger Weg 7, 55099 Mainz, Germany

The normative meaning and the low measurability make "Fairness" a concept that is very difficult to apply, but occupies a good place in the political decisions as it is e.g. used as an indicator of social welfare. Using Monte Carlo, we simulate with two different models the economical agents' behavior and measure the fairness exploring different concepts from the economical theory, finding a trend behavior such that their improved actions result in a justice horizon as suggested by the first and second welfare theorems. In our models, we consider two different situations in an economy without production: each agent owns an initial allocation of a finite number of commodities. The price system shall avoid that the agents choose a net trade according to their preferences, which is maximal in their budget set. These scenarios should result in an equilibrium under optimal conditions. Fairness follows the fact that all agents have the same trading possibilities and the same access to the entire set of commodities. Also the information flow between the agents and their personal comparisons play a fundamental role.

AKSOE 8.7 Mo 14:00 Poster TU E

Pricing of path-dependend derivatives with truncated Levy-Flights — •Thomas Schwiertz[1] and Wolfgang Paul[2] — [1]Koenigsbergerstr. 2, 65462 Gustavsburg — [2]Institut fuer Physik, Staudingerweg 9, 55099 Mainz

In general, derivatives are priced by the assumption that the return of a price fluctuation is a Gaussian process (e.g. Black-Scholes-Theory: Brownian Motion). It is known that the distribution of price fluctuations on short time scales shows fat-tails. Random walks with truncated Levy-flights can explain price fluctuations on short time scales more accurately. Since payoffs of path-dependend derivatives are often influenced by price fluctuations on short time-scales (e.g. barrier options with a barrier close to the actual price of the underlying or exotic options), we analysed properties of random walks with truncated Levy increments by computer simulations. We discuss extremes, recurrent events and the convergence to a Gaussian process for these random walks.

AKSOE 8.8 Mo 14:00 Poster TU E

Analysis of the performance of microscopic models of stock markets. — •Roberto Monetti, Wolfram Bunk, Ferdinand Jamitzky, Christoph Raeth, and Gregor Morfill — CIPS, Max-Planck-Institut für extraterrestrische Physik, Giessenbachstr 1, 85748 Garching, Germany

Recently, several microscopic models have been proposed to reproduce certain aspects of the stock markets dynamics. They are motivated by a quest for a possible universal dynamics underlying different markets. Here, we discuss the ability of two recently proposed models (Phys. Rev. Lett. **89**, 158701, 2002; Phys. Rev. E **69**, 046112 2004) to mimic nonlinear properties as expressed by the Fourier Phase Maps. Using the Fourier phases $\{\phi_{\vec{k}}\}$ and a phase shift $\vec{\Delta}$, we represent the phase information on a 2D space via the phase maps $M = \{(\phi_{\vec{k}}, \phi_{\vec{k}+\vec{\Delta}})\}$. The information rendered on this space is analyzed using the spectrum of weighting scaling indices to detect phase coupling at any scale $\vec{\Delta}$. Our analysis reveals that the logarithmic stock returns of the Dow Jones displays a novel characteristic scale of non-linearities. Our method is then used as a "test bed" for model generated time series which should reproduce this property. The results may help to improve microscopic models of the dynamics of the stock market.

AKSOE 8.9 Mo 14:00 Poster TU E

Default probabilities in non-uniformly regulated banking networks — •Klaus Dragosits and Stefan Thurner — Compex Systems Research Group, HNO, Meduniwien, Währinger Gürtel 18-20,A-1090 Wien

The global financial market can be regarded as a pool of local (national) banking networks. Some global rules as the Basle Capital Accord have been established, still any local regulator is free to set stronger rules, and any participating bank may try to disobey the regulations (moral hazard) at least for a limited period of time.

By extending the properties of an established iterative risk-trading game, we investigate interactions between banks which are more or less strongly regulated. Our evaluation criterion is the stability of the resulting networks, which we benchmark by the default probability of the involved banks.

Aside from a profound analysis for various networks with different topologies and different ratios of regulated vs. unregulated banks, focus was put on a realistic real world set-up, where the most wealthy banks are stronger regulated (example is motivated by a recent proposal of Austrian local banks).

As expected, different topology-dependent transitions between totally regulated and totally unregulated networks are obtained. In our wealth-dependent setup we find a phase were the default risk in a non-uniformly regulated network is even higher than in a totally unregulated network, a result we consider of fundamental significance for network regulation.

AKSOE 8.10 Mo 14:00 Poster TU E

Investigation on risk of a CAPM-portfolio — •vladimir reznik und uli willibald spreitzer — Dr. Dr. Heissmann GmbH, Abraham-Lincoln-Str. 22, 65189 Wiesbaden

We investigate a portfolio, consisting of an investment without risk and an investment with a variable rate of return. We use "lower partial moments" to calculate the loss. We investigate the relation between the loss of the portfolio and several parameters, as construction of the portfolio, rate of return of the investment, variance of investment etc.

AKSOE 8.11 Mo 14:00 Poster TU E

Investigation of different index-based portfolios by using the measures: loss, expected rate of return, average loss and possibility of an loss — •Uli willibald spreitzer[1], vladimir reznik[1] und thomas riepl[2] — [1]Dr. Dr. Heissmann GmbH, Abraham-Lincoln-Str. 22, 65189 Wiesbaden — [2]Thomas-Mann-Straße 22, 93077 Bad Abbach

We investigate several portfolios consisting of a save investment and an investment without risk. For the later we use a typical share, which is describen by the characteristic data (rate of return, variance) of several indices (EuroSToxx, MSCTI Europe and DAX 30). We evaluate the different portfolios with respect to the aim of the investor.

AKSOE 8.12 Mo 14:00 Poster TU E

When Fundamentalists Benfit From Chartists — •Roland Rothenstein and Klaus Pawelzik — Universität Bremen, Institut für Theoretische Physik, Otto-Hahn-Allee 1, 28359 Bremen

Agent based stock market models serve to test long standing hypothesis in economics. Here we investigated if agents representing fundamental traders do indeed take advantage from the presence of speculators. We use a paradigmatic stock market model in which the fundamentalists are modeled by stochastic orders whose mean is predictable while agents representing chartists base their orders on predictions of returns. Our simulations reveal that the fundamentalists generally attain a larger mean turnover of stocks and money when a large population of chartists with random prediction parameters participates in trading. Interestingly, the system self-organizes into a stationary state where the remaining price fluctuations are unpredictable and have a power-law distribution such that the mean profit rate for the speculators seem to vanish. Our results confirm that speculative markets can provide an efficient feedback control to a dynamical system from which in the long run only the fundamentalists take advantage.

AKSOE 8.13 Mo 14:00 Poster TU E

Market leader detection with Langevin equation — •Thorsten Schneider, Andreas Nawroth, and Joachim Peinke — Carl-von-Ossietzky-Universität Oldenburg

We present a stochastic analysis of different data sets from the NYSE that consist of all trades from August 2001 to January 2004. The smallest set comprises $7 \cdot 10^5$ quotes. We regard on the one hand the price timeseries and on the other hand the resulting increment timeseries. Directly from these timeseries which are neither continuous nor equidistant the drift and diffusion coefficients of the corresponding Langevin equation are extracted. We use this equation to find out dependencies between differ-

ent companies for example to determine a market leader and to detect situations where the statistic behavior of an asset changes.

AKSOE 8.14 Mo 14:00 Poster TU E

Wealth distribution of wealth-scattered agents — •Hynek Lavička — Department of Physics, Faculty of Nuclear Sciences and Physical Engineering, Czech Technical University in Prague, Břehová 7, CZ-11519, Praha 1, Czech Republic

A model describing networked society of interacting particles-agents characterised by single internal variable - wealth, is investigated. Interaction between the agents is like inelastic scattering where overall wealth increases during the interaction. Every agent is associated to a node in the network of possible interactions. Two types of networks will be considered: small-world and scale-free networks. Simulations show the Pareto power-law tail in the wealth distribution. Moreover, correlations between wealth and connectivity and more detailed effects of the netwotk topology are found. Comparison with analytical results is provided.

AKSOE 8.15 Mo 14:00 Poster TU E

Risk Strategies in Random Environments — •Jesus Emeterio Navarro Barrientos — Institut fuer Informatik; Humboldt Universitaet zu Berlin

The performance of agents with different risk strategies in different multiplicative additive stochastic processes is studied. By means of Monte Carlo simulations different probability distributions (some of them power law distributions) for the budget of agents are obtained. We compare some of the results against simpler strategies (small constant risk) and finally we discuss for which cases it pays to use a more complex risk strategy.

AKSOE 8.16 Mo 14:00 Poster TU E

Effects of network topology on strategy distributions in a IPD — •Robert Mach and Frank Schweitzer — D-MTEC, ETH Center, CH-8092 Zurich

Agents are assumed to interact repeatedly in an iterated Prisoner's Dilemma (IPD) game. The agents are endowed with a one-step memory and thus can play one of 8 different strategies. The interaction is locally restricted by a network topology, where each agent represents one node. The agents try to increase their individual payoff by adopting the strategy of their most successful partner at the end of each generation. This adaptation process leads to strategy distribution, that crucially depends on the network topology.

AKSOE 8.17 Mo 14:00 Poster TU E

Similarity-based cooperation and spatial segregation — •Arne Traulsen and Jens Christian Claussen — Theoretical Physics, University Kiel

We analyze a cooperative game, where the cooperative act is not based on the previous behavior of the coplayer, but on the similarity between the players. This system has been studied in a mean-field description recently [1]. Here, the spatial extension to a two-dimensional lattice is studied [2], where each player interacts with eight players in a Moore neighborhood. The system shows a strong segregation independent of parameters. The introduction of a local conversion mechanism towards tolerance allows for four-state cycles and the emergence of spiral waves in the spatial game. In the case of asymmetric costs of cooperation a rich variety of complex behavior is observed depending on both cooperation costs [2]. Finally, we study the stabilization of a cooperative fixed point of a forecast rule in the symmetric game, which corresponds to cooperation across segregation borders. This fixed point becomes unstable for high cooperation costs, but can be stabilized by a linear feedback mechanism [2].

[1] A. Traulsen and H. G. Schuster, Phys. Rev. E **68**, 046129 (2003)
[2] A. Traulsen and J. C. Claussen, Phys. Rev. E **70**, 046128 (2004)

AKSOE 8.18 Mo 14:00 Poster TU E

Nongaussian fluctuations arising from finite populations: Exact results for the evolutionary Moran process — •Jens Christian Claussen and Arne Traulsen — Theoretical Physics, University Kiel

The appropriate description of fluctuations within the framework of evolutionary game theory is a fundamental unsolved problem in the case of finite populations. The Moran process recently introduced into this context [1] defines a promising standard model of evolutionary game theory in finite populations for which analytical results are accessible. Here we derive the stationary distribution of the Moran process population dynamics for arbitrary 2×2 games for the finite size case [2]. We show that a nonvanishing background fitness can be transformed to the vanishing case by rescaling the payoff matrix [2]. In contrast to the common approach to mimic finite-size fluctuations by Gaussian distributed noise, the finite size fluctuations can deviate significantly from a Gaussian distribution [2].

[1] M. A. Nowak, A. Saski, C. Taylor, and D. Fudenberg, Nature 428, 646 (2004).
[2] J. C. Claussen and A. Traulsen, cond-mat/0409656.

AKSOE 8.19 Mo 14:00 Poster TU E

Estimate Memory Effects from Time Series — •Daniel T. Schmitt and Michael Schulz — Department of Theoretical Physics, University of Ulm, D-89069 Ulm

From Mori-Theory we know that any microscopically deterministic dynamics of a complex system can be described by an integro-differential equation, the so called generalized langevin equation.

Our objective is to estimate the memory kernels and frequency terms form artificially generated as well as real world time series. Results can be used to classify the dynamics. Possible applications include forecasting in finance and economics.

AKSOE 8.20 Mo 14:00 Poster TU E

Random Matrix Theory and Robust Covariance Matrix Estimation for Generalized Elliptical Distributions — •Gabriel Frahm[1] and Uwe Jaekel[2] — [1]Center of Advanced European Studies and Research, Financial Engineering, Ludwig-Erhard-Allee 2, 53175 Bonn, Germany — [2]C&C Research Laboratories, NEC Europe Ltd., Rathausallee 10, 53757 Sankt Augustin

The traditional class of elliptical distributions is extended to allow for asymmetries. A completely robust covariance matrix estimator (the "spectral estimator") for the new class of "generalized elliptical distributions" is presented. It is shown that the spectral estimator corresponds to an M-estimator proposed by Tyler (1983) in the context of elliptical distributions. Both the generalization of elliptical distributions and robust covariance matrix estimation are motivated by the stylized facts of empirical finance. Further, some elements of Random Matrix Theory (RMT) are presented. RMT can be used for analyzing high-dimensional stochastical systems. It is shown that the fundamental theorem of RMT (the "Marčenko-Pastur law") fails if the sample covariance matrix is considered as a random matrix in the context of elliptically distributed and heavy tailed data. But substituting the sample covariance matrix by the spectral estimator resolves the problem and the Marčenko-Pastur law remains valid.

AKSOE 8.21 Mo 14:00 Poster TU E

Analyzing systems of connected machines by Hidden Markov Models — •Andre Löser and Günter Radons — TU Chemnitz, Institut für Physik, 09107 Chemnitz

The probabilistic behavior of machines connected by finite buffers is analyzed by fitting Markov processes to the time dependence of the system state. In many practical cases the system behavior is dominated by blocking and starving due to finite buffers connecting (un)reliable machines. This results in a quite complex behavior of the system, which makes it difficult to analyze in practice, especially if the system is large and heterogeneous. Therefore the state space has to be reduced to get a manageable model at least for a specific part of the full system. Because there is no one-to-one correspondence between the real state space and the reduced state space, we use Hidden Markov Models (HMM) for this purpose. The Baum-Welch and a modified Baum-Welch algorithm is used to fit the HMM parameters. It is worth mentioning that an application of our approach to other problems with a complex state space and blocking (starving), such as systems of quantum dots, is possible.

AKSOE 8.22 Mo 14:00 Poster TU E

General models as an approach to socio-economic systems — •Thilo Gross — ICBM, Carl von Ossietzky Universität, 26111 Oldenburg

The central problem of mathematical modelling is to formulate theoretical and experimental insights in the language of mathematics. Because of the complexity of socio-economic systems it can be very difficult to derive explicit mathematical functions that describe them. An alternative is the investigation of general models. In these models the processes are described with general mathematical functions, which are not specified. Despite their generality such models can be analysed efficiently in

the framework of local bifurcation theory. In the past this modelling approach has been applied to ecological systems. It has been shown that general models can be used to generalize findings, identify key parameters and to point out degeneracies in specific models.

AKSOE 9 Special Session: Young Scientist Award

Zeit: Montag 16:00–18:00 Raum: TU A151

Hauptvortrag AKSOE 9.1 Mo 16:00 TU A151

The Dynamics of Networks, and their Relevance to Infectious Diseases, IT, and Many Other Things — •Robert M. May — Department of Zoology, University of Oxford, Oxford OX1 3PS

The transmission of infection among humans or other animals, the spread of viruses or worms among computers, and the way ecosystems respond to disturbance are three examples of nonlinear dynamical systems whose behaviour depends upon the nature of the network of connections among nodes (that is individuals, computers, species, respectively). Recent and current concern about HIV/AIDS, SARS, and foot and mouth disease among livestock have prompted advances in our understanding of the interplay between network patterns and effective control measures. Separate, but ultimately related, work has recently focussed (often in the context of "homeland security") on protecting IT networks from attack. Perhaps surprisingly, this work has made relatively little contact with older questions about ecosystem resilience. My talk aims to be an opinionated overview of all this.

AKSOE 9.2 Mo 17:00 TU A151

Young Scientist Award

AKSOE 9.3 Mo 17:15 TU A151

Presentation of the laureate

Efficient immunization: how physics can help — •Reuven Cohen — Dept. of Computer Science and Applied Mathematics, Weizmann Institute of Science, 76100 Rehovot, Israel

In recent years many technological, social and biological networks have been studied. These studies have shown that thesenetworks belong to a new class of networks, and one of their main characteristics is a wide degree distribution.We will discuss the special proprieties of such networks. We demonstrate how percolation theory, used in statistical physics forvarious models, from oil extraction to egg boiling, can be used to study the stability of the Internet, or to analyze epidemic spreading in populations and computer networks. We show the strengths and weaknesses of heterogeneous networks and demonstrate how this knowledge may be used to evaluate and design immunization strategies. Finally, we present a new strategy for efficient immunization which requires no prior knowledge of the network topology.

AKSOE 10 Social, Information and Production Networks I

Zeit: Dienstag 10:00–12:30 Raum: TU P-N203

Hauptvortrag AKSOE 10.1 Di 10:00 TU P-N203

Information Horizons and Self Organization in Social Networks — •Kim Sneppen — NORDITA, Blegdamsvej 17, Dk 2100, Copenhagen, Denmark

Life without information is not life. From the genetic blueprint in our DNA to the world-wide Internet, information and its dynamic counterpart communication define our civilization. However, we live under the limited information horizon, in the sense that information is often imperfect and communication is always finite. In a society the information horizon is set by each individual's social contacts, which in turn is a part of the global network of human communication. One simple goal for individuals is to be central. Thus we model a society where players try to be as close as possible to everybody else by moving their social connections. Thus we suggest a model that quantify the interplay between local communication and the emergent global organization of social networks.

The concept of a limited information horizon in a complex network can be quantifyed by counting the number of bits needed to navigate between nodes in the network. We discuss the thereby introduced search information, and show how different real world networks organize with respect to this measure. We discuss how to navigate in these networks, and quantify how limited information access influence our ability to search a network.

— 15 min. Break —

AKSOE 10.2 Di 11:00 TU P-N203

Network analysis of markets — •Jörg Reichardt and Stefan Bornholdt — Institute for Theoretical Physics, University of Bremen

Many systems in economy and society may be viewed as networks which often show a surprising modularity. An analysis of this modular structure is often of considerable interest for empirical market research.

Considering a market data set, we apply a recently developed algorithm [1] to the *de novo* detection of product or consumer communities. To do so, we map the problem of network community detection onto finding the minima in the Hamiltonian of a Potts spin glass. Communities are found to coincide with the domains of equal spin value in these minima. Comparing global and local minima of the Hamiltonian allows for the detection of hierarchies and overlapping ("fuzzy") communities and quantifying the association of nodes with multiple communities as well as the robustness of a community. The resulting product communities are compared with standard classifications and the consumer communities clustering allows for targeted marketing.

[1] J. Reichardt, S. Bornholdt, Phys. Rev. Lett. **93**, 218701, (2004)

AKSOE 10.3 Di 11:30 TU P-N203

Interaction Network Approach to Catastrophe Dynamics — •Christian Kühnert, Dirk Helbing, and Hendrik Ammoser — Institute for Transport & Economics, Dresden University of Technology

Catastrophes like the Weißeritz and Elbe flooding in 2002 or recent blackouts in the US and Italy exhibit a lot of domino-effects: one critical situation triggers another and therefore worsens the situation even more. These connected effects complicate accessing decisions in disaster management. They bear the risk that decisions are made which consider short-term effects only and neglect possible negative long-term consequences.

We describe the interdependencies between the sectors by an interaction network model. Analyses of former events allow to identify the network structures of different types of catastrophes. We simulate the temporal development of the catastrophe and evaluate the total effect on the system. This allows the disaster management to compare several options in fighting the catastrophe in advance and to choose the most suitable one.

AKSOE 10.4 Di 12:00 TU P-N203

Social Networks of Money analyzed with Feynman-Graphs — •Dieter Braun — Noether Group on Dissipative Biosystems, Applied Physics, LMU München, Amalienstr. 54, D-80799 München

Social networks are created by transfer of goods which are memorized in the asset-liability nomenclature of double entry bookkeeping. These social webbings can be analyzed with a revealing analogy based on that positive momentum mimics asset, negative momentum liability [1-4]. From this axiom, it follows that particle pair creation stands for money creation, force for profit and energy for the quantity of money. Bookkeeping - like quantum mechanics - implements conservation of momentum, but no strict conservation of energy. Feynman-graphs decompose monetary networks into their axiomatic asset-liability pair creations/annihilations. We find:

(i) Economies under random transfer suffer information overload under a diverging quantity of money [3].

(ii) They converge under transfers from a concave potential. The wealth distribution is given by a Boltzmann law [3].

(iii) Bank bookkeeping should implement a system of two independent

currencies for debit and credit.

(iv) Tunneling metastable transfer potentials can lead to catastrophic wealth concentration.

[1] Physica A 324:266-271 (2003)
[2] Physica A 290:491-500 (2001)
[3] Physica A 321:605-618 (2003)
[4] www.bookkeepingmechanics.com

AKSOE 11 Social, Information and Production Networks II

Zeit: Dienstag 14:00–16:00 Raum: TU P-N203

AKSOE 11.1 Di 14:00 TU P-N203

Complete decomposition of communication patterns social networks: an approach based on complex Hermitian adjacency matrices — •Bettina Hoser and Andreas Geyer-Schulz — Lehrstuhl f. Informationsdienste u. elektronische Märkte, Universität Karlsruhe (TH), Zirkel 2, 76131 Karlsruhe

In this paper the method of eigensystem analysis of complex Hermitian adjacency matrices is used to describe asymmetric communication patterns in social networks. As an example a well known data set (EIES data set) is analyzed.

The eigensystem of the complex Hermitian adjacency matrix is such, that it offers a decomposition of the original matrix into all detectable patterns and groups. The eigenvalues represent the relative amount of traffic volume being communicated in a pattern, while the sign of the eigenvalue helps to identify patterns that exist within a subgroup and as well as between this subgroup and the rest of the network. The distribution of eigenvalues yields information about the overall structure of communication.

The absolute value of the eigenvector components give information about the relevance of different network members within any of the detected patterns. The phase information of the eigenvector component gives the additional information about directional preference of communication in that pattern.

Also an outlook on other applications will be given. Preliminary results show that forecasting markets, like political stock markets, can be analyzed in structure as well as prognostic quality by this method.

AKSOE 11.2 Di 14:30 TU P-N203

Selfish vs. Unselfish Optimization of Network Creation — •Johannes J. Schneider[1] and Scott Kirkpatrick[2] — [1]Institute of Physics, Johannes Gutenberg University of Mainz, Staudinger Weg 7, 55099 Mainz, Germany — [2]School of Engineering and Computer Science, The Hebrew University of Jerusalem, Givat Ram, Jerusalem 91904, Israel

In the last few years, many properties of the Internet have been detected which are not found in simple random networks. The question arises which basic mechanisms lead to this structure of the Internet. In fact, the Internet appears to be a "game", in which many independent agents manage its components to suit their own needs, e.g., by buying and selling links. In the "network creation" model [1], agents have to buy links in order to establish a network for sending messages to each other. Buying each link costs a constant amount, α, sending a message costs the minimum number of hops between sender and receiver. Depending on the value of α and on the allowed behaviors of the agents, we get to different types of networks created with this model [2].

[1] A. Fabrikant, A. Luthra, E. Maneva, C. H. Papadimitriou, and S. Shenker, *On a Network Creation Game*, PODC Proceedings, 2003, 347-351.
[2] J. J. Schneider and S. Kirkpatrick, *Selfish vs. Unselfish Optimization of Network Creation*, submitted to J. Stat. Mech.

AKSOE 11.3 Di 15:00 TU P-N203

Analysis of self organized scale-free networks in presence of merge and split processes — •Roman Faber, Klaus Dragosits, and Stefan Turnher — Complex Systems Research Group, HNO, Meduniwien, Währingerstr. 18-20, A-1090 Wien

Merging of nodes within networks is one of the most interesting alternatives to obtain scale-free networks in growth models. An analysis of this issue was recently published by Trusina et al. We used this work as starting point to analyze the impact of node splitting on the properties op these networks.

The process of merging selects at chosen intervals of points in time one random node and merges this node either with one of its neighbors or with another random node. At separately chosen time intervals nodes with highest degree are split into uniformly or randomly distributed parts thereby balancing system size by compensating the loss of nodes in merging.

We analyze the effects of the rate of splits on the power-law behavior of the degree distribution. Overall, we observe an eventual breakdown of the scale-free behavior.

AKSOE 11.4 Di 15:30 TU P-N203

Multi-Goal Control in Supply and Production Networks — •Stefan Lämmer — University of Technology Dresden, A.-Schubert-Str. 23, 01062 Dresden, Germany

Supply networks consist of many manufacturing and distribution organizations, interconnected by the flow of information, money and goods. Each organization has a number of functions, specializing in the flow of typically more than one kind of product. A low inventory of one product may call for an increase in the production rate, but the warehouse for another product, which is generated at the same time, may be already full. Recent supply network models indicate that the network of material flow can itself be a source of instability, and oscillatory variations are an inherent feature of decentralized adjustment processes. We conjecture that multi-goal control of production networks may imply additional sources of dynamical instabilities and that some of the problems may be solved by price adjustments, which can influence the consumption rates.

AKSOE 12 Macro and Micro Economic Models

Zeit: Dienstag 16:30–18:30 Raum: TU P-N203

AKSOE 12.1 Di 16:30 TU P-N203

On the relationship of energy consumption, economic growth and standard of living — •Jürgen Mimkes — Physik Department Universität Paderborn

The production factors labour (W) and energy (E) are related to economic growth (Q) by the first law of thermodynamics. Q is an inexact differential form, which may be transformed into the exact form of entropy (d S) by an integrating factor (T). This is the second law of thermodynamics. The factor T is the mean energy consumption per household, GNP per capita or standard of living. Inexact differential forms are important for cyclic production, one may pay little energy or capital going one way (C) and receive much coming back (Y). This is equivalent to the law of economic production. Economic production is a Carnot process, in the production of goods the process runs clock wise like in a motor. In the same time capital flows in the opposite way like in a heat pump. The functions of production (Y) and consumption (C) may be calculated from the entropy. For several production factors x, y, z the production function is related to the entropy of mixing.

AKSOE 12.2 Di 17:00 TU P-N203

Artificial consumer societies in risky markets - the case of food scares and information release strategies — •Volker Saggau — Institut für Agrarökonomie, Uni Kiel, Olshausenstr. 40, 24098 Kiel

Our motivation is lying on the question How does a food scare and information of a food scare influence the buying decision of one single agent and the aggregate demand?. Since we investigate a society of consumers which do have their own decision functions, we can observe how new information could influence the behaviour of each consumer and more interesting the aggregate changes in the demand by creating a population of agents. This multiagent simulation can be used to investigate

how different information releases and decision functions influence the aggregate demand. Our intention is to measure how different information strategies influence the aggregate demand. For this purpose we use a multiagent method in order to follow a bottom up approach where each agent acts individually. The interaction between the agents leads to an emergence of an aggregate demand that comes from the bottom up. Each agent follows its internal updating and decision algorithms so that on the aggregate level the demand changes according to the outcomes of the interaction and its related updating processes. After the communication phases the aggregation of the outcomes of each agent shows the result of the information strategy that was selected.

AKSOE 12.3 Di 17:30 TU P-N203

Herd Behaviour equal to Traffic Jams?: New insides in complex economic interaction with Many-Particle-Physics and Wavelet Theory — •Bodo Herzog — Lichtenhaidestr.11; D-96052 Bamberg

Since Econphysics starts, new theories and models have been implemented in explaining pure economic phenomenon. The main focus was to learn something new and understand collective interactions in economic systems. One example is herd behaviour in economics that have a corresponding equivalent in physics (traffic jams). A wonderful by-product for the economic profession has been the emergence of a new research topic. But the models from physics does not fit the economic situation one to one. In the following paper we examine the phenomenon of herding behaviour in financial markets and try to build a new model. In the tradition of 'Many-Particle-Physics', particularly 'Traffic-Models', we explore in our new model herding behaviour in financial markets from an economic perspective. Moreover we propose an identification of herding behaviour in financial markets with wavelet theory. That approach helps us to show when herding behaviour starts. The current development in Econphysics helps to close the gap between natural and social systems. Conclusions from traffic models are relevant for the functionality, stability, reliability, and efficiency of societies, organizations etc. The theoretical understanding of traffic dynamics is a good starting-point for studying elementary human interactions under experimental conditions but we must go beyond that first step.

AKSOE 12.4 Di 18:00 TU P-N203

Asset Price and Wealth Dynamics with Heterogeneous Expectations under a Market Maker Scenario — •Florian Heitger — Institut fuer VWL, Lehrstuhl fuer Geld, Waehrung und Int. Finanzmaerkte, Olshausenstr. 40, 24118 Kiel

The asset price model of Brock and Hommes (1998) is a prominent example of a behavioral model of financial markets in discrete time and considers heterogeneous economic agents who are faced with a standard asset allocation problem in each trading period using a traditional utility maximization scheme. The heterogeneity of agents is expressed in terms of different perceptions on the expectations of future price movements on the risky asset. A modified variant on that framework is proposed by Chiarella and He (2001) and assumes a more realistic type of utility function which generates both growing price and wealth processes. The model can be formulated as a stationary model in terms of the return on the risky asset and the wealth proportion among heterogeneous investors. Within this framework we consider a slightly different model setup under a Market Maker scenario which uses the main ideas of both the BH and the CH model, but, which, however, overcome some of the main inconsistencies (and unrealistic assumptions) detected in the original models (e.g. refering to a correct expectation formation of the heterogeneous agents at the fundamental price level).

AKSOE 13 Financial Markets and Risk Management I

Zeit: Mittwoch 10:00–12:30 Raum: TU P-N203

Hauptvortrag AKSOE 13.1 Mi 10:00 TU P-N203

Quantifying Extreme Risk - Critical Phenomena in Natural and Social Sciences — •Didier Sornette — CNRS-Univ. Nice and UCLA

Portfolio analysis, risk assessment, risk management and portfolio optimization require ideally to determine (1) the distributions of returns at different time scales and (2) the nature and properties of dependences between the different assets. This talk focuses on the multidimensional nature of financial risks and dependences by using concepts and tools that remain valid for large and extreme price moves. We will discuss the state of the art on (i) the different distributions of financial returns for various applications (VaR, stress testing) and (ii) the most important and useful measures of dependences, both unconditional and conditional and a study of the impact of conditioning on the size of large moves on the measure of extreme dependences with application to contagion. A large emphasis is put on the theory of copulas, their empirical testing and calibration, as they offer intrinsic and complete measures of dependences. The talk is based in the book "Extreme Financial Risks (from dependence to risk management" by Y. Malevergne and D. Sornette, Springer (2005).

— 15 min. Break —

AKSOE 13.2 Mi 11:00 TU P-N203

Evidence of non-uniform scale properties of financial data — •Andreas P. Nawroth and Joachim Peinke — Universität Oldenburg

The statistics of returns for financial assets are dependent on the time scale. This poses great challenges to risk management and other applications. We present a method of analysing the scale dependent complexity of financial data. This method is applied to different sets of financial data, namely individual stocks which are members of the German Stock Index DAX and the index itself. The high frequency datasets contain all trades during the years 1993-2003. In order to analyse the differences in the return distributions for different time steps, a measure of distance between the return probability density functions is introduced. This measure describes the change in the shape of the probability density function if one goes from one scale to another. We found evidence of a universal behaviour of the distance of the return distributions between different timescales. Evidence is given that the functional form of the distance measure depends on the scale itself. Especially for small scales a different regime is observed.

AKSOE 13.3 Mi 11:30 TU P-N203

Riskmanagement and Pricing for Insurance Portfolios with Exposure to Storms — •Magda Schiegl — Versicherungskammer Bayern, Maximilianstr. 53, D-80530 Munich

We observe number of claim distributions emerging from insurance portfolios with storm exposure to have fat tail distributions. As the distribution of severity of claims in such portfolios is much more rapidly decreasing than claim number distribution the later is the main source of risk.

We use mixed Poisson distributions to construct fat tailed number of claim distributions. We investigate the properties of the distributions as well as the dynamics of the underlying process by taking a variety of different sampling times. Our aim is to receive a probability distribution for the annual number of claims for a given portfolio. We combine analytical and numerical methods to reach this aim.

AKSOE 13.4 Mi 12:00 TU P-N203

Limited profit in predictable stock markets — •Roland Rothenstein and Klaus Pawelzik — Universität Bremen, Otto-Hahn-Alle 1, 28359 Bremen

It has been assumed that arbitrage profits are not possible in efficient markets, because future prices are not predictable. Here we show that predictability alone is not a sufficient measure of market efficiency because of the influence an order has on its dynamics. We instead propose to measure inefficiencies of markets in terms of the maximal profit an ideal trader who can perfectly predict the future behavior of the market can take out from a market. In a stock market model with an evolutionary selection of agents this method reveals that the mean relative amount of realizable profits P is very limited and we find that it decays with rising number of agents. Our results show that markets may self-organize their collective dynamics such that it becomes very sensitive to profit attacks which demonstrates that a high degree of market efficiency can coexist with predictability.

AKSOE 14 Financial Markets and Risk Management II

Zeit: Mittwoch 14:00–16:00 Raum: TU P-N203

AKSOE 14.1 Mi 14:00 TU P-N203

Connection between autocorrelated order flow and uncorrelated stock returns — •Philipp Weber and Bernd Rosenow — Institut für Theoretische Physik der Universität zu Köln, Zülpicher Straße 77, 50937 Köln

Trades at a stock exchange are initiated by market orders, i.e. orders to buy or sell a certain amount of stocks immediately. The flow of market orders has strong autocorrelations, hence the knowledge of past order flow allows a prediction of future order flow for a time period of several hours. In contrast, stock returns are almost completely uncorrelated and cannot be predicted for more than a few minutes. This is quite surprising because the execution of market orders has a strong influence on stock price changes.

In order to explain this puzzle, we analyzed trading strategies taking advantage of the predictability of order flow. For example, a "front runner"uses her knowledge about future order flow. If she predicts a large market buy order, she buys these shares just before the predicted order arrives and sells them at a profit afterwards. We describe models based on such profitable strategies and show that by using the order flow correlations for earning money the correlations of returns are destroyed. Our model reproduces the empirically found correlations between returns and order flow.

AKSOE 14.2 Mi 14:30 TU P-N203

On optimization of CAPM-Portfolios by calculation and underwriting the loss — •Uli willibald spreitzer[1], Vladimir reznik[1] und Thomas riepl[2] — [1]Dr. Dr. Heissmann GmbH, Abraham-Lincoln-Str. 22, 65189 Wiesbaden — [2]Thomas-Mann-Straße 22, 93077 Bad Abbach

For a portfolio, consisting of an investment without risk and an investment with variable return we calculate the loss by "lower partial moments". We show constellations, when it is preferable to invest in the investment with variable rate of return and to safeguard the possible loss of this investment by an insurance. We discuss this for different insurance premiums.

AKSOE 14.3 Mi 15:00 TU P-N203

Tobin Tax and market depth — •Gudrun Ehrenstein[1,2], Dietrich Stauffer[1], and Frank Westerhoff[3] — [1]Institute for Theoretical Physics , Cologne University — [2]School of Engineering and Science, International University of Bremen — [3]Department of Economics, University of Osnabrück

This paper investigates - on the basis of the Cont-Bouchaud model - whether a Tobin tax can stabilize foreign exchange markets. Compared to earlier studies, this paper explicitly recognizes that a transaction tax-induced reduction in market depth may increase the price responsiveness of a given order. We find that the imposition of a transaction tax may still achieve a triple dividend: (1) exchange rate fluctuations decrease, (2) currencies are less mispriced, and (3) central authorities raise substantial tax revenues. However, if the price impact function is too sensitive with respect to market depth, stabilization may turn into destabilization.

AKSOE 14.4 Mi 15:30 TU P-N203

Stock markets cross-levels correlations: Short-range stock return linear regression models for developing stock markets — •Michael Romanovsky, Vladislav Kharlamov, Andrew Shurup, and Igor Zhukov — General physics Institute, Vavilov str., 38, 119991 Moscow Russia

An account of levels of international stock markets is convenient for analysis of one-level and cross-level correlations of securities on stock markets since one may expect a reaction of stock rates on cumulative indexes changes, especially in developing economics. Cross-level correlations between stocks of developing markets (beginning Russian and Brazil markets) and indices of all highest levels are investigated. Linear multi-regression models are generated. It includes basic model variables: various MSCI indexes and several commodity price returns, and the function: the investigated stock price return. The result was done for the Russian Trade System index RTSI (Russian electronic stock exchange) using 2 variables of MSCI indexes WRLD/ENERGY and WRLD/INFORMATION TECH as well as 2 variables of commodities OIL and ALUMINIUM. Using the base of correlation matrices traced for all 2001, the value R2adj for the first 10 days of 2002 is 0.248. The same analysis was conducted for Brazil national stock index BOVESPA. There were used two variables (MSCI indexes) WRLD/CONSUMER STAPLES and WRLD/INFORMATION TECH only. The prediction coefficient was smaller than for RTSI: R2adj = 0,168. The proposed method could be used for short-range forecasts of developing stock markets dynamics.