

ARBEITSKREIS PHYSIK SOZIO-ÖKONOMISCHER SYSTEME (AKSOE)

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 ÜBERSICHT DER HAUPTVORTRÄGE UND FACHSITZUNGEN
 (Hörsäle)

Plenarvortrag des AKSOE

PV II Mo 17:30 (HSZ/01) **Social Dilemmas and Information Networks: a Physics Approach,**
Bernardo A. Hubermann

Hauptvorträge

AKSOE 1.1 Mo 09:30 (BAR/205) **From financial data to physics models: A new science ?**, Marcel Ausloos
 AKSOE 4.1 Di 09:30 (BAR/205) **Social Coagulation: Power Law Distributions of Business Firm Sizes,**
Robert Axtell
 AKSOE 6.1 Di 16:00 (HSZ/04) **Physicists attempt to scale the ivory towers of finance**, J. Doyne Farmer
 AKSOE 9.1 Do 09:30 (BAR/205) **Transitions to global culture from a statistical physics viewpoint,**
M. San Miguel, K. Klemm, V. M. Eguiluz, R. Toral

Fachsitzungen

AKSOE 1	Finanzmärkte und Risikomanagement I	Mo 09:30–12:30	BAR/205	AKSOE 1.1–1.6
AKSOE 2	Finanzmärkte und Risikomanagement II	Mo 14:00–15:30	BAR/205	AKSOE 2.1–2.3
AKSOE 3	Postersitzung	Mo 15:45–17:15	P1	AKSOE 3.1–3.19
AKSOE 4	Mikro-ökonomische Modelle und Multi-Agenten-Systeme	Di 09:30–12:30	BAR/205	AKSOE 4.1–4.6
AKSOE 5	Makro-ökonomische Modelle und Wirtschaftswachstum I	Di 14:00–15:30	BAR/205	AKSOE 5.1–5.3
AKSOE 6	Sondersitzung: Verleihung des Young-Scientist Award for Socio- and Econophysics	Di 16:00–18:00	HSZ/04	AKSOE 6.1–6.3
AKSOE 7	Makro-ökonomische Modelle und Wirtschaftswachstum II	Mi 14:00–15:30	BAR/205	AKSOE 7.1–7.3
AKSOE 8	Urbane Systeme und Verkehrsdynamik	Mi 16:00–18:00	BAR/205	AKSOE 8.1–8.4
AKSOE 9	Soziale Systeme und Entscheidungsmodelle	Do 09:30–12:30	BAR/205	AKSOE 9.1–9.7
AKSOE 10	Finanzmärkte und Risikomanagement III	Do 14:00–15:30	BAR/205	AKSOE 10.1–10.3
AKSOE 11	Finanzmärkte und Risikomanagement IV	Do 16:00–18:00	BAR/205	AKSOE 11.1–11.4

Sondersitzung:**Verleihung des Young-Scientist Award for Socio- and Econophysics**

Di 16:00–18:00, HSZ/04

1. Hauptvortrag: J. Doyne Farmer
2. Preisverleihung
3. Vortrag der Preisträgerin / des Preisträgers

Mitgliederversammlung des Fachverbands Arbeitskreis Physik sozio-ökonomischer Systeme

Mi 18:00–19:00 BAR/205

Tagesordnung:

1. Bericht des Vorsitzenden des AKSOE
 2. Diskussion über geplante Aktivitäten
 3. Verschiedenes
- gez. Frank Schweitzer

Zeit	Montag	Dienstag	Mittwoch	Donnerstag
09:30–10:15	HV: Ausloos	HV: Axtell		HV: San Miguel
10:30–11:00	F1: Schulz	A: Zimmermann		S: Kropp
11:00–11:30	F1: Wagner	A: Schweitzer		S: Hoser
11:30–12:00	F1: Holyst	A: Helbing		S: Danielmeyer
12:00–12:30	F1: Nögel	A: Schneider		S: Ortmanns / Vogt
14:00–14:30	F2: Jamitzky	M1: Welfonder	M2: Brenner	F3: Weber
14:30–15:00	F2: Karth	M1: Barth	M2: Hirthreiter	F3: Willmann
15:00–15:30	F2: Reese	M1: Mimkes	M2: Ihrig	F3: Santos
16:00–16:30	Poster- sitzung 15:45 – 17:15	HV: Farmer	U: Werner	F4: Borrmann
16:30–17:00		Young-Scientist- Award	U: Mahnke	F4: Koll
17:00–17:30			U: Treiber	F4: Schaale
17:30–18:00		V: Preisträger/in	U: Nagel	F4: Schumacher
18:00–19:00			Mitglieder- Versammlung	

PV: Plenarvortrag, **HV:** Hauptvortrag, **F1-F4:** Finanzmärkte und Risikomanagement I-IV, **A:** Mikro-ökonomische Modelle und Multi-Agenten-Systeme, **M1-M2:** Makro-ökonomische Modelle und Wirtschaftswachstum I-II, **U:** Urbane Systeme und Verkehrsdynamik, **S:** Soziale Systeme und Entscheidungsmodelle.

Fachsitzungen

– Haupt-, Kurzvorträge und Posterbeiträge –

AKSOE 1 Finanzmärkte und Risikomanagement I

Zeit: Montag 09:30–12:30

Raum: BAR/205

Hauptvortrag

AKSOE 1.1 Mo 09:30 BAR/205

From financial data to physics models: A new science ? —
 ●MARCEL AUSLOOS — University of Liege , B5 B-4000 Liege, Belgium

Econophysics is a science in its infancy, at the crossing roads of physics, mathematics, computing and of course economics and finance. It also implies human consideration or even sciences, because all economics is ultimately driven by human decision. From this human factor, econophysics has no hope to achieve the status of an exact science, but it is interesting to discover what can be achieved, trying try to push further away any limit, or discovering these potential limits. The role of a physicist is to observe, measure, analyze data, make theories based on models, predict and suggest ways of verifying the theory or models. Much work has already been published on various economic and financial "problems". Some brief review will attempt to emphasize "statistical physics modern ideas" i. e. fractional Brownian motion and the scaling hypothesis in the microscopic-like aspects, and self-organized complexity in the macroscopic-like aspects.

AKSOE 1.2 Mo 10:15 BAR/205

Pause 10:15 – 10:30 — ● —

AKSOE 1.3 Mo 10:30 BAR/205

Financial Markets: Memory Effekts and Forecasting —
 ●MICHAEL SCHULZ — Abteilung Theoretische Physik, Uni Ulm, 89069 Ulm, Germany

Financial data such as asset prices show remarkable memory effects. A well known phenomena is the volatility correlation function with a characteristic relaxation time of an order of magnitude 10^2 trading days. But also the price autocorrelation shows at short time scales a significant memory. It will be demonstrated that this behavior is a consequence of the complex dynamics at the financial markets which can be described by a nonlinear Fokker-Planck equation allowing the determination of the conditional probability distribution function and some related critical exponents as well as the scaling behavior observed in financial data.

Furthermore, it will be demonstrated that the memory effects can be used for the prediction of the evolution of financial time series. Especially the combination of Bayesian statistics and neural networks allows a real forecasting of the volatility and the trend over $1 - 10^2$ trading days.

AKSOE 1.4 Mo 11:00 BAR/205

Neural Networks for Volatility Predictions — ●FRIEDRICH WAGNER — Institut für theoretische Physik, Universität Kiel, Leibnizstr., D 24098 Kiel

Neural nets can be used to predict the volatility averaged over one month in the period 1990-2002 from the data in the years 1974 -1989. Important for the application is the choice of the input data and less important the net work architecture. An approach with neural nets has the nice feature that upper and lower bounds can be constructed. Technically

the serious problem of over fitting has to be solved.

The quality of the predictions is slightly better than the those from a GARCH(1,1) model, which is considered as a bench mark model by economists. Also the time structure of the volatility cluster is studied and compared with the result from herding models.

AKSOE 1.5 Mo 11:30 BAR/205

Volatility clustering and scaling for financial time series due to attractor bubbling — ●JANUSZ HOLYST^{1,2}, ANDRZEJ KRAWIECKI^{1,2}, and DIRK HELBING² — ¹Faculty of Physics and Center of Excellence for Complex Systems Research, Warsaw University Of Technology, Koszykowa 75, Pl-00-662 Warsaw, Poland — ²Institute for Economics and Traffic, Dresden University of Technology, D-01062 Dresden, Germany

A microscopic model of financial markets is considered, consisting of many interacting agents (spins) with global coupling and discrete-time thermal bath dynamics, similar to random Ising systems. The interactions between agents change randomly in time. In the thermodynamic limit the obtained time series of price returns show chaotic bursts resulting from the emergence of attractor bubbling or on-off intermittency, resembling the empirical financial time series with volatility clustering. For a proper choice of the model parameters the probability distributions of returns exhibit power-law tails with scaling exponents close to the empirical ones. The necessary conditions for the applicability of the model are (i) random fluctuations in time of the average interaction strength between agents (corresponding to their average reaction to price changes), (ii) an uncertainty of decision making analogous to thermal heat bath dynamics, and (iii), in the thermodynamic limit, small additive noise simulating the effect of the external environment.

References: A. Krawiecki, J.A. Holyst and D. Helbing, "Volatility Clustering and Scaling for Financial Time Series due to Attractor Bubbling", Phys. Rev. Lett.89 (15), 158701(4) (2002)

AKSOE 1.6 Mo 12:00 BAR/205

Geometric Brownian motion and option pricing — ●ULRICH NÖGEL — Fraunhofer ITWM, Gottlieb-Daimler-Strasse 49, 67663 Kaiserslautern, Germany

Geometric Brownian motion is maybe one of the most important models used in modern finance. Built upon it is the famous Black-Scholes theory, which was the major break-through in option pricing and its reliability as a workhorse in daily trading and risk-management was one of the main reasons for the rapidly growing market for plain vanilla and exotic options.

However, the more and more complex options which are nowadays traded on the market (especially structured products like cliquet options) require more sophisticated models. We present some possible extensions of the geometric Brownian motion, where we focus on these models which are actually used and considered to the state-of-the-art in today's financial business.

AKSOE 2 Finanzmärkte und Risikomanagement II

Zeit: Montag 14:00–15:30

Raum: BAR/205

AKSOE 2.1 Mo 14:00 BAR/205

Construction of a state space embedding for time-dependent stock market — ●FERDINAND JAMITZKY and WOLFRAM BUNK — MPE Garching

Using methods from information dynamics and graph theory we present a construction algorithm for a state space embedding of multivariate time series. The embedding is unique in such a way that it is an isometric mapping of the (high-dimensional) minimal spanning tree

and its derivatives of a given point set. As an example for the method we present an analysis of multivariate stock market data covering a time period of eleven years of day-to-day variations of stock prices and order volumes. By using a metric (based on either linear correlation or mutual information) the mutual relation of the data is represented as a point set in a high-dimensional state space. This point set is further analyzed by computing the so-called minimal spanning tree and the corresponding adjacency matrices of higher order. Finally, an embedding is sought that isometrically maps the minimal spanning tree and its higher order deriva-

tives into a lower dimensional space by using an optimization algorithm. In the resulting projected state space the cluster dynamics of the stock titles can be visualized and investigated.

AKSOE 2.2 Mo 14:30 BAR/205

Dynamical features and cascade-like structures in foreign exchange (FX) rate data — ●MATHIAS KARTH and JOACHIM PEINKE — Carl-von-Ossietzky-Universität Oldenburg, 26111 Oldenburg, Germany

We present an analysis of the exchange rate of the US Dollar against the German Mark. Emphasis is put on the description of dynamical properties of the basic stochastic process and on a comprehensive statistical description in terms of probabilities of changes in the FX rate over different time-scales τ . In particular, we investigate returns and logarithmic returns as relevant quantities for the financial market, also in comparison to price increments. We demonstrate how it is possible to discern between deterministic and diffusive influences in the FX rate dynamics by means of a Langevin model for the process. Here we describe differences in the dynamical behaviour in comparison to often used stochastic models like (G)ARCH-processes.

Furthermore we show how to describe the evolution of the probability density functions of incremental changes in the FX data over the corresponding time-scale by usage of a Fokker-Planck-equation, whose coefficients can be estimated out of the data without the need for a concrete model of the stochastic process.

AKSOE 2.3 Mo 15:00 BAR/205

Forecasting Dynamical Cross Correlations — ●CHRISTOF REESE and BERND ROSENOW — Institut für Theoretische Physik, Universität zu Köln, D-50923 Köln

The risk of an investment into the stock market is determined by both the volatilities of individual stocks and the correlations between these stocks. The volatility dynamics of individual stocks is characterized by volatility clustering which can be described by GARCH models which relate the present volatility to both past volatility and past innovations in stock prices.

While GARCH models have been quite successful in the univariate setting, their application to multivariate volatility forecasting for a large number of stocks has been hampered by both the difficulty to estimate the large number of model parameters and the poor performance of these models. Motivated by recent results [1, 2] we use methods of Random Matrix Theory (RMT) to suggest two classes of multivariate GARCH models which are able to describe correctly both the structure of correlations and their dynamics. We present empirical results using high frequency data of 118 stocks traded in the German stock market.

[1] P. Gopikrishnan, B. Rosenow, V. Plerou, and H.E. Stanley, Phys. Rev. E 64, R035106 (2001)

[2] B. Rosenow, V. Plerou, P. Gopikrishnan, and H.E. Stanley, Europhys. Lett. 59, 2002

AKSOE 3 Postersitzung

Zeit: Montag 15:45–17:15

Raum: P1

AKSOE 3.1 Mo 15:45 P1

Pricing of American style options with a hybrid method — ●UWE JAEKEL — NEC Europe Ltd, C&C Research Laboratories, Sankt Augustin

A semianalytical method for the computation of the early exercise premium of American style options is proposed. The method can be used on top of existing numerical methods like finite difference schemes or Monte Carlo methods to improve price estimates obtained on rather coarse grids. This should open new possibilities to price numerically demanding basket options.

AKSOE 3.2 Mo 15:45 P1

Probabilistic Analysis of DAX High Frequency Data — ●RALF REMER¹, REINHARD MAHNKE¹, and ALIAKSEI KONASH² — ¹FB Physik, Univ. Rostock, 18051 Rostock — ²Inst. Physics, Nat. Acad. Sci., 220072 Minsk, Belarus

The Heston model is a well established model for the description of the stock price dynamics. Drăgulescu et al. discovered a solution for long time behaviour that seems to be very interesting due the good agreement with empirical data from the New York stock exchange (NYSE). Based on this result we took the calculated stationary standardized probability density distribution and compared it with our empirical data from the German stock exchange. We use the German tick-by-tick data of the stock index DAX and its stocks from May 1996 until December 2001. We calculated the probability density distributions for different time lags and compared them with the theoretical solution for the long time behaviour of the Heston model developed by Drăgulescu et al.

[1] Drăgulescu, Adrian A., Yakovenko, Victor M.: Probability distribution of returns in the Heston model with stochastic volatility. Quantitative Finance, 2, 443–453 (2002)

[2] stock prices received by: Karlsruher Kapitalmarktdatenbank, DAX and its stocks, Karlsruhe (2002)

AKSOE 3.3 Mo 15:45 P1

Efficiency and the Efficient Market Hypothesis in stock market models — ●ROLAND ROTHENSTEIN and KLAUS PAWELZIK — University of Bremen, Institut für Theoretical Physics, Otto-Hahn-Alle 1, D-28334 Bremen

We investigate the conditions under which the notion of an efficient market (as stated by the efficient market hypothesis in economy) matches the capability of an agent based market model to estimate a 'true' value (which is equivalent to the term of efficiency studied by most physicists). For this purpose, we present a novel approach to create an informationally efficient market and study the connection between both interpretations

of efficiency e.g. by investigating the ability of the model to estimate a fundamental value. Our results demonstrate, that an informationally efficient market does not automatically induce Gaussian fluctuations. We also show that in such an efficient market the performance of an agent does not depend on the complexity (of prediction mechanism) of an agent.

AKSOE 3.4 Mo 15:45 P1

Agent-based chaos in stockmarket simulations — ●KAI NAGEL — Institute for Computational Science, ETH Zurich

A simple aggregate stockmarket model is taken and recast in terms of a controller. For this controller, linear stability can be explored. Beyond the stable region, the model shows a typical bifurcation transition to chaos. The same controller can be obtained by the interaction of many even simpler agents, which are just based on their own personal estimation of the value of the stock plus a simple threshold behavior. That model displays the same transition to chaos.

AKSOE 3.5 Mo 15:45 P1

Cash, Credit, Reputation and Net – A Simulation of an Economy with a Central Bank, Private Banks and Small Producer-Consumers — ●KAI NAGEL¹ and MARTIN SHUBIK² — ¹Institute for Computational Science, ETH Zurich — ²Cowles Foundation for Economics Research, Yale University

This paper is devoted to the exploration of a monetary system with government and commercial bank money with a competitive banking system. As there are several conceptual problems, both in considering a representative agent or many small player models and in specifying the goals of a commercial bank we limit this paper to consumers with a central bank or a single for profit commercial bank. The stress on a fully defined process model requires that several basic accounting problems be addressed. These include the definition of periodic profits, the convention on dividends and ownership and control.

AKSOE 3.6 Mo 15:45 P1

Simple multi-actor model of the energy economy — ●MARKUS BIBERACHER¹, THOMAS HAMACHER¹, and ANDREAS PYKA² — ¹Max-Planck-Institut für Plasmaphysik, Boltzmannstrasse 2, D-85748 Garching — ²Lehrstuhl für Volkswirtschaftslehre V der Universität Augsburg, Augsburg

Final aim of the presented project is the development of a model to describe technological change within the energy economy. The model has two different levels: a technological level describing in detail energy flows and conversion processes and an economic decision model of the major

actors involved. The technology and physics modelling of the energy system is based on a simulation model highly resolved in space and time. On the economic level major actors: companies, utilities, industrial and private consumers, regulators and so on are identified and characterised by a certain set of strategies.

Presented are two first simple applications. In the first example an oil market with final consumers and oil traders will be modelled. The oil price for the traders follows the exogenous world market price. Both traders and final consumers have a certain oil storage capacity, the strategies of the different traders differentiate now between different ways to utilise the stores. In a second example the model is used to find a decision to construct a new power plant. Here two different market situations are assumed: one in which a 'perfect' market with 'unlimited' access to the electricity network is assumed and a second market in which the access to the electricity network is dominated by only a few actors.

AKSOE 3.7 Mo 15:45 P1

Sustainable Social Economic Evolution of the Globalized Society, Part2: Simulation Results — ●THILO FREDERKING and ERNST WELFONDER — Allmandring 5b, 70550 Stuttgart

This paper deals with the quantitative application of the developed socio-economic model introduced in /1/. Therein the interaction of national/supranational areas like Germany, Rest-EC, Rest-OECD, threshold and developing countries is considered. In the first step the main input and output variables of the part models have been balanced by time series taken from the corresponding statistical yearbooks. For further investigation all time series determined from 1980 to 2000 have been adapted by corresponding regression curves using the least square method. After such preparation of the statistical data the part model parameters have been identified. Then the part models have been coupled and the following kinds of simulations have been carried out: a) simulations to compare the modeled socio-economic behaviour with the reality b) forecast simulations up to the year 2030 c) sensitivity simulations for the evaluation of the main model parameters and external influences d) aimed simulations for improving the socio-economic behaviour by foreseeing realistic countermeasures. In the paper results of each kind of simulation are presented. /1/ Welfonder, E. and T. Frederking: Sustainable Social Economic Evolution of the Globalized Society Part 1: Structure and Functionality of the whole Dynamic Model. Jahrestagung des Arbeitskreises Physik sozio-ökonomischer Systeme (AK-SOE), 24.-28.03.2003, Dresden.

AKSOE 3.8 Mo 15:45 P1

War and Peace and Game Theory: Can game theory help us understand the origins of armed conflict? — ●ADRIAN SEUFERT — Technische Universität Berlin

We present a game-theoretical model of international conflict introduced by Bruce Bueno de Mesquita et. al. in their paper "An Institutional Explanation of the Democratic Peace" (American Political Science Review, Vol. 93, No. 4, December 1999) and an extension to that model made by us.

Democratic Peace is an expression coined by political scientists to describe the observation that democracies almost never fight wars against one another. Evidence of its regularity is so strong, that it is sometimes regarded as the closest thing to an empirical law of international relations. Associated to this are many other observations about the behavior of democracies in the face of conflict, which can be verified empirically. Some of these are: 1) Democracies do fight wars against autocratic regimes 2) Democracies tend to fight shorter wars with less costs of human life than do autocracies 3) Democracies tend to win the wars they fight.

The model attempts to explain these observations based on simple assumptions about the different nature of political institutions in democracies and autocracies. These institutions affect leaders' values for staying in power, and consequently their choice of a course of action in a conflict situation.

AKSOE 3.9 Mo 15:45 P1

Formation of Coalitions in an Investor's Game — ●EMETERIO NAVARRO¹ and FRANK SCHWEITZER^{2,3} — ¹Institute for Informatics, Humboldt University, D-10099 Berlin — ²Fraunhofer Institute for Autonomous Intelligent Systems, Schloss Birlinghoven, D-53754 Sankt Augustin — ³Institute for Physics, Humboldt University, D-10099 Berlin

We consider a multi-agent system in which agents form coalitions in order to realize common investment projects. Each project is conducted by an initiator who has to convince other agents to invest until a threshold

value is reached. The decision of an agent to invest depends on the previous experience with the particular initiator, i.e., on the failure or success of the projects conducted by him. We investigate (i) the formation of coalitions, i.e., networks of partners that repeatedly invest together, (ii) the lifetime of these coalitions, and (iii) we show how the dynamics depends on crucial parameters such as the memory or the risk disposition of the agents.

AKSOE 3.10 Mo 15:45 P1

Spatial Patterns in Iterated Prisoner's Dilemma Games with Various Strategies — ●ROBERT MACH^{1,2} and FRANK SCHWEITZER^{2,3} — ¹Institute for Theoretical Physics, Cologne University, D-50923 Koeln, Germany — ²Fraunhofer Institute for Autonomous Intelligent Systems, Schloss Birlinghoven, D-53757 Sankt Augustin, Germany — ³Institute for Physics, Humboldt University, D-10099 Berlin

By means of a two-dimensional cellular automaton we investigate an iterated Prisoner's Dilemma (IPD) game with 8 different strategies and one-step memory. Spatially distributed agents are assumed to interact in a local neighborhood and to adopt the strategy of their most successful neighbors after each generation, this way increasing their individual payoff. Particular emphasis is on the temporal change of the spatial distribution of the different strategies and their global frequencies. In order to get a better insight into the dynamics, we further vary the stochasticity, the size of the local neighborhood and the number of interactions per generation.

AKSOE 3.11 Mo 15:45 P1

Emergence of Complex Networks from Game-Theoretic Interactions — HOLGER EBEL¹ and ●STEFAN BORNHOLDT² — ¹Institut für Theoretische Physik, Universität Kiel, 24098 Kiel, Germany — ²IZBI, Universität Leipzig, Kreuzstr. 7b, 04103 Leipzig, Germany

The emergence of complex networks from coevolutionary games is studied occurring when agents are allowed to switch interaction partners [1]. For this purpose a coevolutionary iterated Prisoner's Dilemma game is defined on a random network with agents as nodes and games along the links [2]. The agents change their neighborhoods to improve their payoff. The system relaxes to stationary states corresponding to cooperative Nash equilibria with the additional property that no agent can improve its payoff by changing its neighborhood. Small perturbations of the system lead to avalanches of strategy readjustments reestablishing equilibrium. The different regimes of relaxation dynamics can be explained in detail by the introduction of a confined branching process. For critical and supercritical avalanche dynamics, the network of interactions develops non-trivial topological properties as a broad degree distribution suggesting scale-free behavior, small-world characteristics, and assortative mixing.

[1] H. Ebel and S. Bornholdt, e-print cond-mat/0211666 (2002).

[2] H. Ebel and S. Bornholdt, Phys. Rev. E **66**, 056118 (2002).

AKSOE 3.12 Mo 15:45 P1

Scale-Free Topology of E-Mail Networks — HOLGER EBEL¹ and ●STEFAN BORNHOLDT² — ¹Institut für Theoretische Physik, Universität Kiel, 24098 Kiel, Germany — ²IZBI, Universität Leipzig, Kreuzstr. 7b, 04103 Leipzig, Germany

E-mail networks are recorded and analyzed for the first time, mapping the communication structure of a large set of individual users [1]. The nodes of the e-mail network are given by e-mail addresses which are connected if a message has been exchanged between them. Pronounced small-world behavior (i.e., high clustering and a small network diameter) are observed as well as a scale-free distribution of the degree (i.e., a node's number of next neighbors). The experimental results are compared to recent models [2,3], and it is discussed how the network's topology facilitates spreading and persistence of e-mail viruses.

[1] H. Ebel, L.-I. Mielsch, and S. Bornholdt, Phys. Rev. E **66**, 035103(R) (2002).

[2] S. Bornholdt and H. Ebel, Phys. Rev. E **64**, 035104(R) (2001).

[3] J. Davidsen, H. Ebel, and S. Bornholdt, Phys. Rev. Lett. **88**, 128701 (2002).

AKSOE 3.13 Mo 15:45 P1

Probabilistic Traffic Flow Breakdown In Stochastic Car Following Models — ●KAI NAGEL and DOMINIC JOST — Institute for Computational Science, ETH Zurich

There is discussion if traffic displays multiple phases (e.g. laminar, jammed, synchronized) or not. This paper presents computational evi-

dence that a stochastic car following model, by changing one of its parameters, can be moved from having two phases (laminar and jammed) to having only one phase. Models with two phases show three states: two being homogeneous states corresponding to each phase, and a third state which consists of a mix between the two phases (phase coexistence). Although the gas-liquid analogy to traffic models has been widely discussed, no traffic-related model ever displayed a completely understood *stochastic* version of that transition. Having a stochastic model is important to understand the potentially probabilistic nature of the transition. Most importantly, if indeed 2-phase models describe certain aspects correctly, then this leads to predictions for breakdown probabilities. Alternatively, if 1-phase models describe these aspects better, then there is no breakdown. Interestingly, such 1-phase models can still allow for jam formation on small scales, which may give the impression of having a 2-phase dynamics.

AKSOE 3.14 Mo 15:45 P1

Applications to Traffic Breakdown on Highways — ●REINHARD MAHNKE¹, ALIAKSEI KONASH², and JULIA TOLMACHEVA³ — ¹FB Physik, Univ. Rostock, 18051 Rostock — ²Inst. Physics, Nat. Acad. Sci., 220072 Minsk, Belarus — ³Res. Inst., Nat. Acad. Sci., 61001 Kharkov, Ukraine

We consider a traffic flow car-following model (proposed by Bando et al. and known as optimal velocity model OVM) where N cars are moving along a circular road of length L . We observe jump-like phase transitions in the coexistence region from small to large densities.

Based on subcritical and supercritical bifurcation diagrams we investigate power-like singularities to calculate critical exponents.

The critical behaviour in the OVM follow-the-leader traffic model described by power laws and critical exponents is a common feature of phase transformations.

[1] Bando et al., Phys. Rev. E **51**, 1035 (1995)

AKSOE 3.15 Mo 15:45 P1

Open boundaries in a traffic flow model with a non-unique flow-density relation — ●MICHAEL SPAHN and PETER WAGNER — Institute for Transportation Research, German Aerospace Center, Rutherfordstr. 2, D-12489 Berlin, Germany

Kerner et. al. recently introduced a cellular automaton traffic flow model with a two-dimensional region of possible stationary states in the flow-density plane [1]. Open boundaries are studied in detail for this model. Additionally, there exists a general extremal principle established by Schütz et. al. connecting the flow through the open link with the fundamental diagram observed with periodic boundary conditions [2], although it is only known to be valid for models with a unique flow-density relation. We explored the applicability of this principle to Kerner's cellular automaton model. The preparation of the boundaries plays a crucial role for this investigation and therefore several boundary strategies are compared.

[1] B.S. Kerner, S.L. Klenov and D.E. Wolf, Cellular automata approach to three-phase traffic theory, arXiv:cond-mat/0206370

[2] V. Popkov and G.M. Schütz, Europhys. Lett. **48**, 257 (1999)

AKSOE 3.16 Mo 15:45 P1

Spatiotemporal States of Congested Traffic - an Empirical Investigation — ●MARTIN SCHÖNHOF, MARTIN TREIBER, and DIRK HELBING — Institut für Wirtschaft und Verkehr, TU Dresden

We present a new method to obtain spatio-temporal information from aggregated data of stationary traffic detectors, the "adaptive smoothing method". In essential, a nonlinear spatio-temporal lowpass filter is applied to the input detector data. This filter exploits the fact that, in congested traffic, perturbations travel upstream at a near-constant speed, while in free traffic, information propagates downstream. As a result, one obtains velocity, flow, or other traffic variables as smooth functions of space and time.

We applied the method to traffic data on several German freeways. All of the about 400 observed congestions were composed of one or more of the following characteristic spatio-temporal structures: Oscillating and homogeneous congested traffic, moving and pinned localized clusters, and triggered stop-and go waves. More than 90% of all congestions occurred at bottlenecks, mostly intersections. For some bottlenecks, we plotted each congestion as a point in a plane spanned by the traffic flow and by a "generalized bottleneck strength" and found a certain concentra-

tion of each of the five spatiotemporal states in different regions in this "phase diagram". All this is in remarkable agreement with theoretical predictions from microscopic and macroscopic traffic models.

AKSOE 3.17 Mo 15:45 P1

Crystal growth as a model of opinion formation — ●JÜRGEN MIMKES and MARIO HILLEBRAND — Department Physik, Universität Paderborn

The model of complex structures is applied to socio-economic systems. Solid, liquid and gas in atomic systems correspond to collective hierarchy, individual democracy and global states in socio-economic systems. Opinion formation is equivalent to crystal growth. The direction (opinion) of one nucleus is expanding into the whole system. Crystal growth is only possible in the solid state. Accordingly, opinion formation is only possible in the collective hierarchic state. Liquids have no uniform order, and democratic structures like parliaments have no uniform opinions. However, under pressure a liquid may become solid, under pressure the fractions of a parliament may be forced to vote uniformly, under attack a democracy will turn to war, under pressure a company will turn to competition. The model simulates the evolution of binary decisions (opinions, crystal growth, battles of two armies or two companies). As a result we obtain either one uniform opinion (single crystal, winner) with many local dissidents (antisites) or several stable areas of different opinions (polycrystals, areas of influence) with a straight borderline (grain boundary). The simulation explains the long time stability of the two party system in the US as well as the party system in Germany. The model may be applied to elections, to opinion formation in politics, to peace talks or strikes, to markets and to every day life.

AKSOE 3.18 Mo 15:45 P1

The relation between the exactness of numerical decision processing and the selected numbers in the guessing game — ●STEFAN REIMANN¹, BODO VOGT², and ENRICO DE GIORGI¹ — ¹Institut fuer Empirische Wirtschaftsforschung, Universitaet Zuerich, Bluemlisalpstr. 10, CH-8006 Zuerich — ²Institut fuer Mathematische Wirtschaftsforschung, Universitaet Bielefeld, Postfach 100131, 33501 Bielefeld

The guessing game or beauty contest was proposed by Keynes as an example for boundedly rational decision processing in financial markets. While entirely rational strategies predict 0 as the unique stable (Nash) equilibrium, the winning number observed in several experiments is strictly greater than 0. Using the basic idea is that numbers are regarded as representatives of intervals, we show analytically that under boundedly rational conditions the resulting winning number is in fact strictly greater than zero, even if persons use infinitely many iterations of guessing. It is suggested that the level of guessing is bounded by the exactness of the numerical decision processing and vice versa.

AKSOE 3.19 Mo 15:45 P1

Quantenmechanische Formulierung ökonomischer Problemstellungen — ●HANS-DIEDRICH KREFT — 20512 Dassendorf

Mit einer besonderen Art mathematischer Objekte, den Q-Distributionen gelingt es, Eigenschaften von Wissen mathematisch operabel zu machen. In Q-Distributionen wird den vielfachen Kenntnissen und Faehigkeiten von individuellen Menschen ein Geldwert zugeordnet, der aehnlich wie der Angebots-Nachfragewert von boersennotierten Unternehmen zu sehen ist. Mit Hilfe mathematischer Operationen lassen sich neue oekonomische Einsichten gewinnen, bekannte oekonomische Gegebenheiten erhalten eine mathematische Grundlage. Einige Eigenschaften von Wissen legen es nahe, das Konzept der Q-Distributionen per quantenmechanischer Methoden zu erweitern. So koennen letztlich Q-Distributionen aus einer einheitlichen Wellenfunktion (Psi-Funktion) abgeleitet werden, wobei sich die kontinuierlichen Eigenschaften der Psi-Funktion in den diskreten Beschreibungsbereich der Q-Distributionen uebertragen. Derart ergeben sich Unschaerferelationen (Nichtverschwinden von Kommutatorklammern), die letztlich Wissenseigenschaften wie Praezision und Bedeutung von Begriffen als nicht kommutativ erscheinen lassen. Eine elegante Formulierung erhaelt der gewaehlte Ansatz, werden Alternativzahlen als Untermenge der komplexen Zahlen eingegefuehrt. Es laesst sich zeigen, dass diese Zahlen in ganz spezifischer Weise die Bell'sche Ungleichung verletzen, womit Nichtlokalitaet fuer mathematische Objekte nachweisbar ist, die auch Wissenscharakteristika beschreiben.

AKSOE 4 Mikro-ökonomische Modelle und Multi-Agenten-Systeme

Zeit: Dienstag 09:30–12:30

Raum: BAR/205

Hauptvortrag

AKSOE 4.1 Di 09:30 BAR/205

Social Coagulation: Power Law Distributions of Business Firm Sizes — ●ROBERT AXTELL — The Brookings Institution, 1775 Massachusetts Ave NW, Washington DC 20036, USA

I will describe data on business firm sizes in the U.S. and other countries. These data are very skew, both for publicly traded firms as well as privately held ones. Simple stochastic processes that generate such skew distributions will be reviewed. Then a multi-agent systems model that also yields empirically-significant distributions of firm sizes will be described. This model is written at the level of individuals and features unstable Nash equilibria. Essentially, individuals self-organize into productive teams in order to gain welfare from the economy.

AKSOE 4.2 Di 10:15 BAR/205

Pause 10:15 – 10:30 — ● —

AKSOE 4.3 Di 10:30 BAR/205

Cognitive Agents with Utility Functions — ●HANS-GEORG ZIMMERMANN, CHRISTOPH TIETZ, and RALPH GROTHMANN — Siemens AG, Corporate Technology, CT IC 4

A financial market consists of a large number of interacting agents. Thus, a natural way of explaining and predicting market prices is to analyze the decision making of the agents on the microeconomic level and to study their interaction on the macroeconomic side of the market. We present a new approach of multi-agent market modeling. The decision making of an agent is modeled with a homeostatic dynamic system. Homeostasis means, that the system maintains an internal equilibrium. On this basis, we derive the properties perception, internal processing and action of a cognitive system. As a structural representation of homeostasis, we propose so-called zero-neurons within a time-delay recurrent neural network. As an extension to this concept, we integrate a utility function into the cognitive system. By this, we are able to explain the decision behavior of an agent by a detailed analysis of his long-term objectives. The aggregation of agents decisions leads to a multi-agent based approach of market modeling. Merging the economic theory of multi-agent market modeling with neural networks, our models concern semantic specifications instead of being limited to ad-hoc functional relationships. In an empirical study, it turns out that our approaches are superior to a traditional econometric forecasting techniques.

AKSOE 4.4 Di 11:00 BAR/205

Evolution of Cooperation in a Spatial Prisoner's Dilemma — ●FRANK SCHWEITZER^{1,2}, LAXMIDHAR BEHERA^{1,3}, and HEINZ MÜHLENBEIN¹ — ¹Fraunhofer Institute for Autonomous Intelligent Systems, Schloss Birlinghoven, D-53754 Sankt Augustin — ²Institute of Physics, Humboldt University, D-10099 Berlin — ³Department of Electrical Engineering, Indian Institute of Technology, Kanpur 208 016, India

We investigate the spatial distribution and the global frequency of agents who can either cooperate or defect. The agent interaction is described by a deterministic, non-iterated prisoner's dilemma game, further each agent only locally interacts with his neighbors. Based on a detailed analysis of the local payoff structures we derive critical conditions for the invasion or the spatial coexistence of cooperators and defectors. These

results are concluded in a phase diagram that allows to identify five regimes, each characterized by a distinct spatiotemporal dynamics and a corresponding final spatial structure. In addition to the complete invasion of defectors, we find coexistence regimes with either a majority of cooperators in large spatial domains, or a minority of cooperators organized in small non-stationary domains or in small clusters.

F. Schweitzer, L. Behera, H. Mühlenbein: *Advances in Complex Systems* 5/2-3 (2002) 269-299

AKSOE 4.5 Di 11:30 BAR/205

Supply chains and business cycles as unstable transport phenomena — ●DIRK HELBING — Institute for Economics and Traffic, TU Dresden, Andreas-Schubert-Str. 23, 01062 Dresden

Concepts developed to describe instabilities in traffic flows can be generalized in a way that allows to understand the well-known instability of supply chains (the so-called "bull-whip effect"). That is, small variations in the consumption rate can cause large variations in the production rate of companies generating the requested product. Interestingly, the resulting oscillations have characteristic oscillations frequencies which are considerably lower than the oscillations in the assumed consumption rate. This suggests that instabilities of supply chains may be the reason for the existence of business cycles. The preconditions for these cycles are investigated in more detail.

[1] D. Helbing, *Traffic and related self-driven many-particle systems*, *Reviews of Modern Physics* 73, 1067 (2001).

[2] D. Helbing, *Supply chains and business cycles as unstable transport phenomena*, preprint (2002).

AKSOE 4.6 Di 12:00 BAR/205

Target Assignment by Physical Modelling — ●JOHANNES SCHNEIDER^{1,2} and SCOTT KIRKPATRICK² — ¹School of Engineering and Computer Science, The Hebrew University of Jerusalem, Givat Ram, Jerusalem 91904, Israel — ²Fachbereich Physik, Universität Mainz, Staudinger Weg 7, 55099 Mainz, Germany

A system of locally connected sensors has the task of tracking moving targets which pass by. We consider a system of 100 sensors which are deployed in the field by placing them close to an underlying grid. We consider square, honeycomb and triangular lattices, each with a nearest neighbor distance of 10 units. Each sensor is displaced from this lattice randomly by up to ± 1 unit in both the N-S and E-W axes. The probability that two sensors have a communications link depends on distance. It is close to unity for nearest neighbors, roughly 50% for second neighbors, and falls off exponentially beyond 19 units.

Targets appear from west and fly a twisting path through the sensor array. If a target leaves the area, a new target appears from west to keep the number of targets constant. Sensors can only detect targets within some range. Various range values R ($R=15, 20, 30, 40$) are considered. No sensor can track more than one target. Each sensor has three fixed 120 degree antenna sectors. At the start of the simulation, each sensor is given a random orientation, and subsequently they do not turn.

Our job is to ensure that each target is tracked by at least three communicating sensors for long enough to do something about it. Our model works well within a broad range of parameters and scales roughly linearly to larger arrays of sensors.

AKSOE 5 Makro-ökonomische Modelle und Wirtschaftswachstum I

Zeit: Dienstag 14:00–15:30

Raum: BAR/205

AKSOE 5.1 Di 14:00 BAR/205

Sustainable Social Economic Evolution of the Globalized Society, Part 1: Structure and Functionality of the whole Dynamic Model — ●ERNST WELFONDER and THILO FREDERKING — Allmandring 5b, 70550 Stuttgart

For the investigation of the social economic and ecological effects concerning a sustainable further evolution of the globalized society a flexible supranational dynamic model has been developed. The model is hierarchically structured for being able to consider special national problems as detailed as necessary on the lower model levels and general supranational

problems with correspondingly higher aggregation on the upper levels. Due to the functional structure of the model not only simulation studies are possible but also analytical investigations. This will be shown on the one hand by the influence of automation on reduced employment and on the other hand the diversified reasons for the momentum of the technical economic development are analyzed. Under additional regarding of the resources and environmental exploitation as well as of the growth of population it is shown that a further increase of these three integral acting influences inside of the strongly intermeshed social economic society can be lessened mainly by ecology improving global restrictions. The applied investigation is based on time dependent data series taken from

world-wide existing statistic data banks.

AKSOE 5.2 Di 14:30 BAR/205

Economic Growth in the Structural Dynamic Economic Model (SDEM) — ●VOLKER BARTH — Max-Planck-Institut für Meteorologie, Hamburg — Forschungsgruppe GELENA, Universität Oldenburg

The Structural Dynamic Economic Model (SDEM) describes growth as the consequence of profit-driven productivity increase. Entrepreneurs invest to enhance productivity, this generates profits that decay subsequently due to factor cost increases. Persistently growing profits require persistently growing productivity. Economic growth is achieved when part of the profits is invested to enlarge the capital stock.

Productivity also defines the ratio of capital and labour and thus determines employment. Due to the assumed fixed proportions production function, the model is very sensitive to changes in the dynamic parameters. This sensitivity can be substantially reduced by introducing social feedback mechanisms, e.g. a wage rate that depends on the employment rate.

AKSOE 5.3 Di 15:00 BAR/205

The economic change in Germany: income, jobs, property, 1950 to 1993 — ●JÜRGEN MIMKES, CHRISTIAN DENK, and THORSTEN FRÜND — Dept. Physik, Universität Paderborn

The model of complex structures leads to three states in socio-economic systems: hierarchy, democracy and the global state. Revolutions and wars are first order transitions. Before 1945 the political system in Germany was in hierarchic and collective order and - in a fractal way - this was true for all subsystems: economy, work, church, family, school, health or age care. After World War II the political system in Germany changed abruptly from collective hierarchy to individual democracy and the economy turned from state industry to a free social market. However, the new democratic, individual structures evolved only gradually after one or two generations in work as well as in church, family, health and age care. This is demonstrated by comparing US income distributions to German data (1950 to 1975). US data show a Boltzmann distribution, German data show a slow change from Gaussian to Boltzmann distribution. The German property distribution of 1993 shows a clear Boltzmann function. The same gradual change is taking place in all other subsystems, church, family, health and age care.

AKSOE 6 Sondersitzung: Verleihung des Young-Scientist Award for Socio- and Econophysics

Zeit: Dienstag 16:00–18:00

Raum: HSZ/04

Hauptvortrag

AKSOE 6.1 Di 16:00 HSZ/04

Physicists attempt to scale the ivory towers of finance — ●J. DOYNE FARMER — Santa Fe Institute, 1399 Hyde Park Rd., Santa Fe, NM

For some time now physicists have been employees of major investment banks. More recently, they have also become active in academic studies of financial markets. I will briefly review some of the striking statistical regularities of markets, and discuss possible explanations. I will argue that several aspects of markets may be explainable in terms of very simple hypotheses, e.g. that treat trading as an interaction between agents that is analogous to the collision of slightly intelligent ping-pong balls.

Time permitting, I will make some remarks about the role of the central hypotheses of arbitrage efficiency and expectational equilibrium, the similarities and differences to the analogous concepts in physics, and the problems and challenges for theories that might go beyond them.

AKSOE 6.2 Di 17:00 HSZ/04

Verleihung des Young-Scientist Award for Socio- and Econophysics — ● —

AKSOE 6.3 Di 17:15 HSZ/04

Vortrag der Preisträgerin / des Preisträgers — ● —

AKSOE 7 Makro-ökonomische Modelle und Wirtschaftswachstum II

Zeit: Mittwoch 14:00–15:30

Raum: BAR/205

AKSOE 7.1 Mi 14:00 BAR/205

Local Self-organisation in the Spatial Distribution of Industries — ●THOMAS BRENNER — Max-Planck-Institut zur Erforschung von Wirtschaftssystemen, Kahlaische Str. 10, 07745 Jena

Local clusters have attracted increasing attention in economics, geography and politics in recent years. However, the question of why they exist is rarely addressed theoretically. This paper develops such a theory on the basis of the very general assumption that firms benefit from their co-location. A self-organisation process results that is mathematically formulated and analysed. It results that there is either one stable state or a group of stable states. In the former case the stable state is characterised by a distribution of firms among regions that corresponds to the attractiveness of the regions. In the latter case the stable states are characterised by the existence of two types of regions: regions with a large number of firms and regions with a low number of firms. The latter case can be interpreted economically as a case in which local clusters exist. From these findings predictions about the spatial distribution of firms in an industry can be deduced. These predictions are tested empirically with the help of data for Germany. For half of the manufacturing industries it can be shown that local clusters exist in Germany. For all manufacturing industries the spatial distribution of firms is adequately described by the model developed on the basis of self-organisation.

AKSOE 7.2 Mi 14:30 BAR/205

The Ramsey-Problem — ●CHRISTIAN HIRTREITER¹ and JOHANNES SCHNEIDER^{2,3} — ¹Institut für Organische Chemie, Fakultät für Chemie und Pharmazie, Universität Regensburg, 93040 Regensburg, Germany — ²School of Engineering and Computer Science, The Hebrew University of Jerusalem, Givat Ram, Jerusalem 91904, Israel — ³Fachbereich Physik, Universität Mainz, Staudinger Weg 7, 55099 Mainz, Germany

An important problem in economics is determining the roles of the single parts of a national economy. Especially, the single parts have to be ordered hierarchically according to the perspective which of these parts are users and which are suppliers for the overall economy. This problem was already studied decades ago by Fred Ramsey [1]. He defined an interaction matrix D with $D(i, j)$ being the value of goods produced by the industry sector i and sold to the industry sector j . The task is to find a permutation σ of the N parts of the economy, such that $\sigma(1)$ is the largest user and $\sigma(N)$ is the largest supplier. This problem is also of special interest for physicists as it stands in between spin glass models and the Traveling Salesman Problem.

[1] F. L. Ramsey, D. A. Pierce, V. J. Bowman, Triangularization of Input-Output Matrices, Technical Report No. 16, Department of Statistics, Oregon State University

AKSOE 7.3 Mi 15:00 BAR/205

Modeling the German energy market — ●DIETER F. IHRIG — FH Suedwestfalen, Iserlohn, Germany

It would be helpful in political discussions to get quickly and transparent assessments of the consequences of political actions on the ener-

gy market of a national economy. For this reason a transparent model concerning the German energy market was written. The end energy consumption will be recorded in 4 sectors (households, low consumer, industries, traffic) and 4 service arrays (room heating, process heat, mechanical energy and light) specified for primary energy sources. To assess the primary energy requirement it is necessary to deal with more than 125 end primary energy consumption data each year. The model is based on data of the study-group of energy balances at the VDEW (Organization of

German energy supplier). The data sets of the years 1993, 1997, 2001 are available. It is possible to define over 40 years objectives on higher energy saving in the most service arrays of each end energy consumption sector. The effects on CO₂-emission of several strategies of energy saving will be calculated including commercial data and socioeconomic aspects (investment, foreign trade, energy prizes, jobs etc.). The model is build by 45 EXCEL files including more than 400 work sheets.

AKSOE 8 Urbane Systeme und Verkehrsdynamik

Zeit: Mittwoch 16:00–18:00

Raum: BAR/205

AKSOE 8.1 Mi 16:00 BAR/205

Employing the social force pedestrian model for simulating evacuation scenarios — ●TORSTEN WERNER — Dresden University of Technology, Mommsenstr. 13, D-01069 Dresden, Germany

The social force model by Helbing et. al. is currently the most advanced approach for simulating pedestrian motion. It solves NEWTON's equation for each individual and considers repulsion interaction, friction forces, dissipation and fluctuations—familiar quantities to every physicist.

That model can be successfully applied to simulate real world scenarios in pedestrian movement. In particular it has already been used for modeling ship evacuation and the annual pilgrim stream at the Jamarat area near Mekka which is well known for its high densities and regular fatal accidents resulting from those dangerous densities.

A simulation software has been implemented that can handle multiple floors in real 3-dimensional buildings and other nontrivial geometries, e. g. columns and angular walls. All parameters that influence pedestrian movement can be adjusted in a way that the simulation results match available empirical data.

There are plans to use such simulation for projecting and testing new ship geometries, planning stadiums for the soccer world championship in 2006 and prior reconstruction of the Jamarat bridge.

AKSOE 8.2 Mi 16:30 BAR/205

Probabilistic Description of Traffic Flow — ●REINHARD MAHNKE and RALF REMER — FB Physik, Univ. Rostock, 18051 Rostock

We present an application of a one-dimensional one-step stochastic process to describe the traffic breakdown phenomenon. We consider a traffic flow model on a one-lane circular road described by a stochastic master equation.

In traffic engineering one speaks about the traffic breakdown probability which is the inverse quantity of the average breakdown time during which a spontaneous jamming (clustering) of cars appears in an initially homogeneous metastable traffic flow.

We calculate the mean first passage time as characteristic time of breakdown at different overall vehicular densities showing the typical nucleation barrier.

[1] R. Mahnke, J. Kaupužs, *Networks and Spatial Economics* **1**, 103 (2001)

AKSOE 8.3 Mi 17:00 BAR/205

Explaining and Simulating Experimental Time-Gap Distributions and Flow Patterns of freeway traffic — ●MARTIN TREIBER and DIRK HELBING — Institut für Wirtschaft und Verkehr, TU Dresden

Based on the statistical evaluation of experimental single-vehicle data, we propose a quantitative explanation of the erratic scattering of flow-density data in synchronized traffic flows. A correlation analysis suggests that the observed scattering is well compatible with unique equilibrium velocity-distance relations for each driver and stems from the observed large variation of the individual netto time gaps in combination with positive correlations of the gaps between successive vehicles. Two-lane multi-class microsimulations with the *Intelligent-Driver Model* show that this correlation is caused by dynamical clustering effects

We also observe "frustration effects":

The most probable netto time gap in congested traffic flow upstream of a bottleneck is significantly increased compared to uncongested freeway sections.

A further increase, connected with a decreased outflow at the downstream boundary of the jam occurs for very extended congestions. We simulated all this by incorporating frustration effects in our model.

AKSOE 8.4 Mi 17:30 BAR/205

Truly Agent-Based Strategy Selection for Transportation Simulations — ●KAI NAGEL and BRYAN RANEY — Institute for Computational Science, ETH Zurich

Multi-agent transportation simulations represent travelers as individual "agents," who make independent decisions about their actions. We are implementing such a simulation for all of Switzerland, which is composed of modules that model those decisions for each agent, such as: (i) **Route planner:** Generates routes. (ii) **Micro-simulation:** Executes routes simultaneously; computes agent interactions, leading to congestion. (iii) **Feedback:** Iterates the above modules, resolving interdependencies. We discuss the operation of these modules, and focus on improvements made to the feedback system, such as an agent "memory" that allows agents to choose among previously used routes based on their past performance. We also show results of an implementation of a large scale scenario (more than 1 million agents) in Switzerland.

AKSOE 9 Soziale Systeme und Entscheidungsmodelle

Zeit: Donnerstag 09:30–12:30

Raum: BAR/205

Hauptvortrag

AKSOE 9.1 Do 09:30 BAR/205

Transitions to global culture from a statistical physics viewpoint — ●M. SAN MIGUEL, K. KLEMM, V. M. EGUILUZ, and R. TORAL — IMEDEA, Campus Universitat Illes Balears, E-07071 Palma de Mallorca, Spain

We study Axelrod's model for the dissemination of culture. The $T=0$ nonequilibrium phase transition between a culturally polarized and a culturally fragmented phase is shown to disappear when cultural drift (noise) is at work. We find that a noise induced transition to a culturally fragmented phase is fixed by the rate of the stochastic perturbations. The average size of the largest culturally homogeneous domain is a universal function of the product of system size and noise rate. These results can be understood in terms of an optimization dynamics in the $d=1$ version of the model.

We also analyze the $T=0$ transition in different social complex net-

works. In a small world network the transition is postponed by increasing the degree of disorder of the underlying network. In scale-free networks the transition only exists for finite size networks, but it persists in the thermodynamic limit of structured scale free networks which incorporate some degree of clustering.

References: Papers and presentations on this work can be found at http://www.imedeia.uib.es/physdept/research_topics/socio/culture.html

AKSOE 9.2 Do 10:15 BAR/205

Pause 10:15 – 10:30 — ● —

AKSOE 9.3 Do 10:30 BAR/205

Conflict Resolution, Management and Decision-Making for Sustainable Fisheries: A Qualitative Multi-Agent Approach to Viable Control — ●JÜRGEN KROPP, KLAUS EISENACK, and JÜRGEN SCHEFFRAN — Potsdam Institute for Climate Impact Research

The last decade has seen growing concern on the sustainable utilization of living marine resources. The absence or failure of adequate management has led to the situation that more than 70% of the world's fish resources are heavily exploited or overexploited.

In our paper we analyse fisheries, including their institutionalised management frameworks from a dynamic multi-agent perspective. To tackle this challenge our novel approach integrates dynamical evolving interactions between economic, environmental and political subsystems assessing viability and sustainability of management frameworks. The treatment of the systems parts is facilitated by means of qualitative differential equations, clustering state space into regions of qualitative change. In the model the economic sphere is represented by relevant agents (producers) which interfere with the natural environment (harvest). The human impact is a function of the state of the environment, human efforts and their efficiency which is shaped by technology (catch rate). The third sphere, describing political actors, can interfere via control and management strategies, but has taken lobby pressure into account. By use of dynamic game strategies, we study the impact of integrated approaches for viable and sustainable resource management on environmental conservation that minimizes control complexity via critical couplings, including legal and economic instruments, social and technical measures.

AKSOE 9.4 Do 11:00 BAR/205

Use of Hermitian matrices in the analysis of newsgroups — ●BETTINA HOSER and ANDREAS GEYER-SCHULZ — Lehrstuhl f. Informationsdienste u. elektron. Märkte; Universitaet Karlsruhe (TH); 76128 Karlsruhe

Classical network analysis uses adjacency matrices as one of the basic analysis tools. These non-symmetric, non-negative, quadratic matrices $A = a_{ij} \in R$ contain in their standard version only binary ($a_{ij} = 0$ no linkage, $a_{ij} = c; c \geq 0$ linkage) and thus very basic information about the relationship within the group. The implication is that the resulting eigensystem analysis is a mixture of 'signal' and 'noise' (random communication) which is difficult to interpret. Especially, identification of the relevant substructures (informal groups of newsgroup members) in the newsgroup becomes problematic. In this paper we present an enhanced way of describing a network, e.g. for a small newsgroup ($90 \leq N \leq 150$), by a Hermitian matrix. The approach is based on the assumption, that in a newsgroup not only the fact, but also the traffic size and traffic direction with which the members contact each other is essential when analysing the behaviour within the group. We propose a way to incorporate this directed two-way information into a complex, square adjacency matrix M (with $m_{kl} = i * m_{lk}^*$; $m_{kk} = 0$; $m_{kl} \in C$). After rotation by $-\frac{\pi}{4}$ the originally non-symmetric complex adjacency matrix becomes Hermitian. The resulting Eigensystem offers on the one hand an Eigenvalue ($\lambda_r \in R$) ranking based on the strength (amount of traffic) within a sub-

structure that is centered around a very busy center-person and on the other hand more information about its members.

AKSOE 9.5 Do 11:30 BAR/205

A metric to create and employ human capital in social systems — ●HANS G. DANIELMEYER — Japanisch-Deutsches Zentrum Berlin

I split human capital (h) from the national product, treat it like capital stock (k), and calibrate it with Germany's educational budget. The mean value for h turns out to be as large as that of k (presently USD 100,000 per capita). Its decay time is three times that of k . This calibrates also the Poisson-distribution of h for testing educational systems. There are significant national departures from the ideal dynamics of $h(t)$. PISA and OECD records reflect however primarily the system's ability to educate and lead its teachers and not how it is paid for. Then I use a matrix method to describe how individual h 's interact and change with success or failure (state vectors) in their schools or firms (process matrices). The method supplies an open metric for evaluating and comparing social systems and could help to improve them. Some examples are given, including social competence (by splitting the h 's into complex numbers) and exchange processes (by using operators for matrix elements).

AKSOE 9.6 Do 12:00 BAR/205

Immigration, Integration and Ghetto Formation — ●HILDEGARD MEYER-ORTMANN — School of Engineering and Science, International University Bremen, 28725 Bremen

We study ghetto formation in a population with natives and immigrants in the framework of the two-dimensional Ising model with Kawasaki-exchange dynamics. We show the conditions under which ghetto formation between natives and immigrants can be avoided. The conditions are determined by the immigration rate, the integration speed and last but not least by the phase structure of the Ising model.

AKSOE 9.7 Do 12:15 BAR/205

Interaction in networks with complete and incomplete information — ●BODO VOGT¹ and STEFAN REIMANN² — ¹Institut fuer Mathematische Wirtschaftsforschung, Universitaet Bielefeld, Postfach 100131, 33501 Bielefeld — ²Institut fuer Empirische Wirtschaftsforschung, Universitaet Zuerich, Bluemlisalpstrasse 10, Ch-8006 Zuerich

In economic models the local interaction structure is very often not modeled in detail. Recently for special settings and full information Bala and Goyal (2000) characterize Nash equilibria for the formation of networks. We consider more complicated forms of the interaction of agents and analyze stable configurations. We also do not make the assumption of full information of the agents and look at typical cases of networks which are obtained under incomplete information.

AKSOE 10 Finanzmärkte und Risikomanagement III

Zeit: Donnerstag 14:00–15:30

Raum: BAR/205

AKSOE 10.1 Do 14:00 BAR/205

Influence of supply and demand on stock price changes — ●PHILIPP WEBER and BERND ROSENOW — Institut für Theoretische Physik der Universität zu Köln, Zùlpicher Straße 77, 50937 Köln

We study the dependence of stock price changes on the difference between supply and demand in the stock market, which is measured by the difference between the volume of buy and sell orders (order imbalance). The functional relation between the order imbalance in a given time interval and the expected price change is the price impact function [1,2]. We determine the price impact function for the 100 most frequently traded US stocks in the year 1997 by using trade and quote information from the TAQ data base. Our special interest are the tails of the price impact function, relating large order imbalances and large price changes. We discuss different mechanisms generating the 1000 largest price changes in the data set. [1] V. Plerou et al., Phys. Rev. E 66, 027104 (2002) [2] B. Rosenow, Int. J. Mod. Phys. C, Vol. 13, No. 3 (2002) 1-7

AKSOE 10.2 Do 14:30 BAR/205

Exact Hurst exponent and crossover behavior in a limit order market model — ●RICHARD WILLMANN^{1,2}, GUNTER M. SCHÜTZ¹, and DAMIEN CHALLET³ — ¹Forschungszentrum Jülich, Germany — ²Weizmann Institute of Science, Israel — ³Oxford University, UK

An exclusion particle model is considered as a highly simplified model

of a limit order market. Its price behavior reproduces the well known crossover from over-diffusion (Hurst exponent $H > 1/2$) to diffusion ($H = 1/2$) when the time horizon is increased, provided that orders are allowed to be canceled. For early times a mapping to the totally asymmetric exclusion process yields the exact result $H = 2/3$ which is in good agreement with empirical data. The underlying universality class of the exclusion process suggests some robustness of the exponent with respect to changes in the trading rules. In the crossover regime the Hurst plot has a scaling property where the bulk deposition/cancellation rate is the critical parameter. Analytical results are fully supported by numerical simulations.

AKSOE 10.3 Do 15:00 BAR/205

Price formation under local market knowledge — ●MIGUEL A. SANTOS, KONO MASAHIRO, FRANK SCHWEITZER, and HEINZ MÜHLENBEIN — Fraunhofer Institute for Autonomous Intelligent Systems, Schloss Birlinghoven, 53754 Sankt Augustin, Germany

Recently, a modified version of the Sznajd model was proposed as a simple mechanism of price formation in financial markets. In contrast to usual Ising-like spin models, its local dynamics corresponds to a spread of opinions among traders. In common to usual models, one single rationalist with a global market knowledge is able to sustain the market in a state outside the regime of fundamentalism, where all traders want to sell or

all want to buy. In this work, we consider how this picture changes when several rationalist traders interact having only a local market knowledge.

AKSOE 11 Finanzmärkte und Risikomanagement IV

Zeit: Donnerstag 16:00–18:00

Raum: BAR/205

AKSOE 11.1 Do 16:00 BAR/205

Risk: From research to running systems — ●PETER BORRMANN — IBM BCS, Am Sandtorkai 73, 20457 Hamburg

In this talk we will give an overview of current problems in risk management of banks and other firms from the perspective of a scientist and practitioner.

We will present research level examples that the optimal - state of the art - solution is not always feasible and will define ways how to find the appropriate solution - depending on the clients budget, risk culture and capabilities.

“Understanding each other” is the key success factor!

AKSOE 11.2 Do 16:30 BAR/205

Introducing a Credit Portfolio Model: Theoretical Concepts and Practical Implementation — ●MATTHIAS KOLL, THOMAS REMPEL-OBEREM, RAINER KLINGELER, and PETER MARTIN — ifb AG, Neumarkt-Galerie, Neumarkt 2, D-50667 Köln

Since the New Basel Capital Accord has been widely discussed in the last years, the risk management for banking organizations has gained a lot of additional interest. The issue of managing the credit default risk plays an important role as the bankruptcy of a number of obligors in the bank's credit portfolio can lead to severe problems. A model to control and to manage these risks has been developed for a german bank with a portfolio of some 10,000 credits mostly for middle-sized enterprises in germany and europe [1]. Firstly, we will discuss our basic approach following the ideas of the CREDITRISK⁺ model [2]. In order to conveniently incorporate industry correlations and uncertainties concerning the default probabilities, we use a Monte-Carlo approach for the derivation of the loss distribution. Moreover, we intensively discuss the difficulties of the use of empirical economical data as input; we also focus on the practical needs of the bank and on the required model output which should enforce a reliable management of credit risk. Finally, we will present an outlook concerning our current research activities in this field.

(Ref.: [1] TH. REMPEL-OBEREM ET AL., “An Application of the CREDIT RISK⁺ Model”, in: *Wirtschaftswissenschaftliche Beiträge. Credit Risk: Measurement, Evaluation and Management*,

Physica-Verlag, in press; [2] CREDIT SUISSE FIRST BOSTON, see <http://www.csfb.com/creditrisk>)

AKSOE 11.3 Do 17:00 BAR/205

Die Qualität und Zuverlässigkeit von verfügbaren Finanz- und Wirtschaftsdaten — ●ANDREAS SCHAALÉ — Mulackstrasse 6, 10119 Berlin

Die experimentelle Basis von sozio-ökonomischen Modellen (Makro- und Mikroökonomie, Internettraffic etc.) bilden die am Markt verfügbaren Unternehmens- und Wirtschaftsdaten. Die Aussagefähigkeit dieser Daten ist kritisch zu sehen, da viele mit objektiven und subjektiven Fehlern behaftet sind. Es wird eine Übersicht gegeben, wie weit man diese Informationen als valide Grundlage für theoretische Modelle verwenden kann.

AKSOE 11.4 Do 17:30 BAR/205

Parallelisation and Vectorisation of Simulation Based Option Pricing Methods — ●JÜRGEN SCHUMACHER¹, UWE JAEKEL², and ACHIM BASERMANN² — ¹Institut für Informatik III, Uni Bonn — ²NEC Europe Ltd, Sankt Augustin

In the last years, an increasing demand for complex derivative products arose in financial markets. These new products have features which are adapted to the hedging goals of a specific investor or a small group of clients. Many of these products are dependent on a set of risk factors e.g. basket options, spread options or quantos. In order to price these products and hedge the comprised risks, methods have to be applied which can easily be adapted to different option types and which show a competitive convergence speed. Pricing methods based on Monte Carlo simulation in the case of European style options and the simulation-based stochastic mesh method developed by Broadie & Glasserman are the first choice for high dimensional pricing problems since their convergence rates are independent of the dimension of the underlying vector. We have parallelised and vectorised both pricing methods in order to speed up the computation of price estimates such that the time requirements of market participants are met. Our experimental results confirm that high speedup ratios are reached by these methods.

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