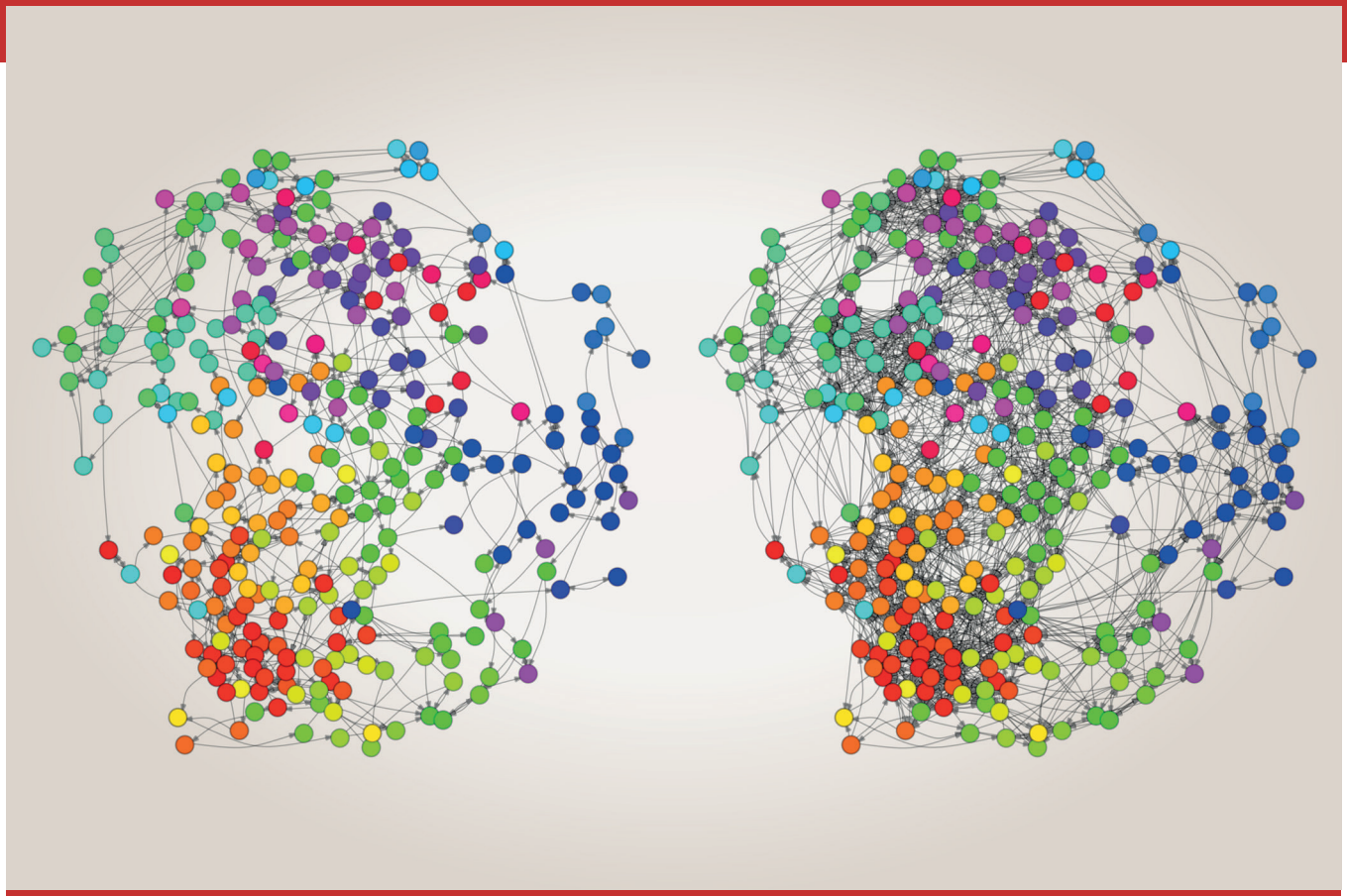
ETH zürich



Chair of Systems Design

Prof. Frank Schweitzer

Activity Report 2004 - 2014

Preface

In October 2004, I started to build up the newly founded Chair of Systems Design at ETH Zürich – at that time relying on only one former collaborator. Now, after ten years of efforts, our group consists of more than 15 collaborators with a broad range of research topics and externally funded projects.

This is a good reason to look back and to draw some conclusions: what happened to the ambitious goals of that time? In what direction did our research develop? How did we form scientific connections – within ETH, the Swiss research community, across Europe? But it is also a good reason to look ahead: where do we want to be in the next ten years? What is our research agenda in the long run?

In order to prepare for such a discussion, it is certainly helpful to realise in detail where exactly we spent our time and effort and what we achieved during the last ten years. This report was jointly prepared for this purpose. It reflects the *research profile* we had to develop from scratch when starting in the newly founded Department of Management, Technology, and Economics (D-MTEC) of ETH Zürich. It also gives information about our *teaching*, in particular about the courses we developed for our Master program. Much effort during these ten years was also spent on *events*, in order to reach some visibility. These include talks presented at conferences, workshops organised by us, colloquium talks of invited guests, etc. These activities are complemented by a broad range of *services* we provide to the scientific community, from running scientific journals, reviewing papers for conferences, to the development of free software to enhance our everyday tasks.

I very much hope that this overview of our activities may stimulate new ones – possibly involving a collaboration with you. Thus, we are looking forward to the next ten years of productive relationships.

10 November 2014 Frank Schweitzer

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1 Our Team

1.1 People

This report should start by acknowledging our most valuable resource: the collaborators who have worked, or are still working, in our team over the last ten years.

Building up a team rests on various premises which cannot be taken for granted. First of all, it needs a considerable budget to hire personal – and in this respect successful grant applications add to the basic funding from ETH, which is indispensable and greatly appreciated. But finding the right people is still another challenge. In October 2005 we started with only one team member (in addition to the professor), today we count between 15 to 20 people in our team (depending on the counting method). Our current team is a really interdisciplinary one: we have group members with a background in computer science, mathematics, physics, economics, engineering, social science. But it is also an international team with people from Switzerland, Germany, France, Italy, Spain, Kazakhstan, Turkey, Argentina, Bulgaria, Armenia, Greece, the Netherlands, Austria, China and Canada. A list of those who worked with us during the past ten years can be found below:

Professor

Schweitzer, Frank, Prof.	2004/10 – present

Senior Assistant

Battiston, Stefano, Dr.	2009/08 – 2013/09

Office Administration

Dulik, Rahel	2007/08 – present
Weis, Bettina	2007/01 – 2007/07
Siegfried, Carole	2004/11 – 2007/02

PostDocs

Tessone, Claudio J., Dr.	2007/03 – present
Garas, Antonios, Dr.	2010/08 – present
Scholtes, Ingo, Dr.	2011/09 – present
Garcia, David, Dr.	2012/11 – present
Perony, Nicolas, Dr.	2012/04 – present
Mavrodiev, Pavlin, Dr.	2014/11 – present
Leduc, Matt, Dr.	2014/10 – present
Tasca, Paolo, Dr.	2012/04 – 2013/09
Puliga, Michelangelo, Dr.	2010/11 – 2013/05
Lorenz, Jan, Dr.	2007/04 – 2013/04
Usseglio, Alessandro, Dr.	2012/02 – 2012/12
Richardson, Thomas, Dr.	2011/11 – 2012/10
Müller, Moritz, Dr.	2010/04 – 2012/04
Wanfeng, Yan, Dr.	2011/11 – 2012/01
Martignoni, Dirk, Dr.	2011/03 – 2011/09
König, Michael, Dr.	2008/04 – 2010/09
Pich, Christian, Dr.	2009/08 – 2010/09
Walter, Frank E., Dr.	2009/10 – 2010/09
Geipel, Markus M., Dr.	2009/10 – 2010/06
Hogan, Patrick, Dr.	2008/10 – 2009/09
Battiston, Stefano, Dr.	2005/07 – 2009/07
Press, Kerstin, Dr.	2006/04 – 2008/01
Napoletano, Mauro, Dr.	2006/04 – 2007/12
Feiler, Matthias, Dr.	2006/08 – 2007/08
Fent, Thomas, Dr.	2005/02 – 2006/01
Sousa, Adriano, Dr.	2005/06 – 2005/12

PhD. Students

Burkholz, Rebekka	2013/02 – present
Wider, Nicolas	2013/03 – present
Abisheva, Adiya	2013/07 – present
Schweighofer, Simon	2014/01 – present
Nanumyan, Vahan	2014/09 – present
Zhang, Yan	2014/09 – present
Mavrodiev, Pavlin	2010/12 – 2014/10

Tomasello, Mario	2011/03 – 2014/09
Pfitzner, René	2011/05 – 2014/08
Zanetti, Marcelo S.	2008/07 – 2013/12
Liechti, Jonas	2012/07 – 2013/09
Tanase, Dorian	2008/05 – 2012/09
Guerra, Beniamino	2010/10 – 2012/09
Garcia, David	2008/11 – 2012/08
Chandra, Joydeep	2011/10 – 2012/05
Perony, Nicolas	2008/08 – 2012/03
Tasca, Paolo	2010/10 – 2012/03
Birbaumer, Mirko	2008/08 – 2011/02
Glattfelder, James	2006/11 – 2010/09
Vitali, Stefania	2006/12 – 2010/03
Walter, Frank E.	2005/11 – 2009/09
Geipel, Markus M.	2006/06 – 2009/09
Groeber, Patrick	2006/04 – 2009/08
Knellwolf, Simon	2009/01 – 2009/05
Stark, Hans-Ulrich	2005/06 – 2008/08
Gerber, Daniel	2007/12 – 2008/06
König, Michael	2005/09 – 2008/03
Rodrigues, Joao	2005/07 – 2006/12
Mach, Robert	2004/10 – 2006/05
Baumann, Christiane	2005/05 – 2004/12

Scientific Assistants

Sarigöl, Emre	2012/03 – present
Kaushik, Rahul	2010/10 – 2013/04

Student Assistants

Casiraghi, Giona	2013/11 – present
van der Pol, Corneel Willem	2014/01 – present
Javet, Noé	2014/03 – present
Hahn, Florian	2014/10 – present
Klijnsma, Thomas	2014/10 – present

Trainees

Vedova, Nina	2014/08 – present
Brack, Romy	2014/02 – 2014/08
Mautone, Ivana	2013/02 – 2014/02
Felder, Nora	2012/08 – 2013/02
Graf, Nadine	2012/02 – 2012/08
Bachelor, Alexander-James	2011/02 – 2012/02
Zaugg, Tamara	2010/08 – 2011/02
Graf, Nadine	2009/08 – 2010/08

Figure 1.1: The team of the Chair of Systems Design in October 2014. The picture was taken by Ingo Scholtes on top of the WEV-building.

1.2 Theses

Habilitation

1. Claudio J. Tessone: *Agent-based modelling of socio-economic systems: Social influence and network interaction*
   - Habilitation. Defence 11/2014
   - Reviewers: Prof. F. von Wangenheim, Prof. G. Fagiolo, Prof. S. Fortunato, Prof. M. Milakovic

Dissertations

1. Pavlin Mavrodiev: *Decisions and Their Unintended Consequences*
   - Dissertation ETH Nº 22026, Defence: 06/2014
   - Supervisor/Examiner: Prof. Frank Schweitzer, Co-Examiner: Prof. Ryan Murphy
2. Marcelo Serrano Zanetti: *A Complex Systems Approach to Software Engineering*
   - Dissertation ETH Nº 21653, Defence: 12/2013
   - Supervisor/Examiner: Prof. Frank Schweitzer, Co-Examiner: Prof. Giuseppe Valetto
3. Dorian Tanase: *Social dynamics in Online product review communities*
   - Dissertation ETH Nº 20755, Defence: 10/2012
   - Supervisor/Examiner: Prof. Frank Schweitzer, Co-Examiner: Prof. Mike Thelwall
4. David Garcia: *Modeling collective emotions in online communities*
   - Dissertation ETH Nº 20699, Defence: 09/2012
   - Supervisor/Examiner: Prof. Frank Schweitzer, Co-Examiner: Prof. Johan Bollen
5. Paolo Tasca: *Diversification, Leverage and Systemic Risk*
   - Dissertation Advanced School of Economics, Ca'Foscari University of Venice (DEA XXIII Ciclo), Defence: 03/2012
   - Supervisor/Examiner: Prof. Paolo Pellizzari, Examiners: Prof. Michael Haliassos, Prof. Antonio Guarino, Prof. Fabrizio Lillo
6. Nicolas Perony: *Comparative Analysis of Social Interactions in Animal Groups*
   - Dissertation ETH Nº 20255, Defence: 02/2012
   - Supervisor/Examiner: Prof. Frank Schweitzer, Co-Examiner: Prof. Barbara König
   - The Thesis was awarded the **ETH Medaille**.
7. Hans-Ulrich Stark: *Social Influence and Strategical Decision Making in Models of Social Interaction*
   - Dissertation ETH Nº 19639, Defence: 05/2011
   - Supervisor/Examiner: Prof. Frank Schweitzer, Co-Examiner: Prof. Dirk Helbing

8. James B. Glattfelder: *Ownership Networks and Corporate Control: Mapping Economic Power in a Globalized World*
   - Dissertation ETH Nº 19274, Defence: 09/2010
   - Supervisor/Examiner: Prof. Frank Schweitzer, Co-Examiner: Prof. Guido Caldarelli
9. Stefania Vitali: *Industrial organization from a geographical and network perspective*
   - Dissertation ETH Nº 18974, Defence: 05/2010
   - Supervisor/Examiner: Prof. Frank Schweitzer, Co-Examiner: Prof. Thomas Brenner
   - The Thesis was awarded the **Zürich Dissertation Prize**.
10. Markus Michael Geipel: *Dynamics of Communities and Code in Open Source Software*
    - Dissertation ETH Nº 18480, Defence: 09/2009
    - Supervisor/Examiner: Prof. Frank Schweitzer, Co-Examiner: Prof. Georg von Krogh
11. Patrick Christian Groeber: *An Interdisciplinary Approach to the Emergence and Enforcement of Norms of Coordination and Cooperation*
    - Dissertation ETH Nº 18513, Defence: 09/2009
    - Supervisor/Examiner: Prof. Frank Schweitzer, Co-Examiner: Prof. Dirk Helbing
12. Frank E. Walter: *Designing Mechanisms for Trust-based Interaction in Social Networks*
    - Dissertation ETH Nº 18539, Defence: 09/2009
    - Supervisor/Examiner: Prof. Frank Schweitzer, Co-Examiner: Prof. Elgar Fleisch
13. Michael D. König: *Dynamic R&D Networks. The Efficiency and Evolution of Interfirm Collaboration Networks*
    - Dissertation ETH Nº 18182, Defence: 01/2009
    - Supervisor/Examiner: Prof. Frank Schweitzer, Co-Examiner: Prof. Francis Bloch
    - The thesis was awarded the **Zürich Dissertation Prize**.
14. J. Emeterio Navarro Barrientos: *Adaptive Investment Strategies for Different Scenarios*
    - Dissertation Humboldt University Berlin, Defence: 10/2008
    - Supervisor/Examiner: Prof. Hans-Dieter Burkhard, Supervisor/Co-Examiner: Prof. Frank Schweitzer, Co-Examiner: Prof. Kai Nagel

Diploma Theses

1. Victor Garcia Palencia: *Brownian Agents and Bacterial Motility*
   - Department of Physics, ETH Zürich
   - Supervisor: Prof. Frank Schweitzer, date of completion: 07/2008
2. Nils Brünggel: *Web Crawler for Recommender Systems*
   - Lucerne University of Applied Sciences and Arts (Advisor: Roland Portman)
   - Supervisor: Prof. Frank Schweitzer, date of completion: 07/2008

Master Theses

1. Vahan Nanumyan: *Master Equations for Heterogeneous Evolution of Interdependent Networks*
   - Department of Physics, ETH Zürich
   - Supervisor: Prof. Frank Schweitzer, date of completion: 05/2014
2. Linda Lötscher: *Analysis of Community Structures in Complex Networks of Knowledge Transfer*
   - Department of Mathematics, ETH Zürich
   - Supervisor: Prof. Frank Schweitzer, Dr. Martin Mächler, date of completion: 04/2014
3. Georgi Smilyanov: *Elementary model of social interactions in house mice*
   - Department of Management, Technology and Economics, ETH Zürich
   - Supervisor: Prof. Frank Schweitzer, date of completion: 04/2014
4. Frédéric Balmer: *Modeling migrating cancer cells as Brownian agents*
   - Department of Physics, ETH Zürich
   - Supervisor: Prof. Frank Schweitzer, Prof. Eshel-Ben Jacob (Tel Aviv University), date of completion: 02/2013
5. Alexander Grimm: *Resilience of Collective Dynamics in Fluctuating Network Environments*
   - Department of Physics, ETH Zürich
   - Supervisor: Prof. Frank Schweitzer, date of completion: 10/2012
6. Daniel Längle: *Systemic Risk in Financial Networks*
   - Department of Management, Technology, and Economics, ETH Zürich
   - Supervisor: Prof. Frank Schweitzer, Prof. Rodney J. Garratt (UCSB), date of completion: 09/2012
7. Xi Xia: *How does Open Source Software Community Grow? An Empirical Study of Developers and Projects on SourceForge.net*
   - Department of Management, Technology, and Economics, ETH Zürich
   - Supervisor: Prof. Frank Schweitzer, date of completion: 08/2012

8. Remo Sandro Storni: *A simple social vs economical capital trade-off model*
   - Department of Mathematics, ETH Zürich
   - Supervisor: Prof. Frank Schweitzer, date of completion: 05/2008
9. Stefan Frei: *Vulnerability Management*
   - Department of Management, Technology, and Economics
   - Supervisor: Prof. Frank Schweitzer, date of completion: 08/2007
10. Mahir Yildirim: *Towards a Unified Framework for Recommender Systems*
    - Department of Computer Sciences, University of Freiburg, Germany
    - Supervisor: Prof. Frank Schweitzer, Frank E. Walter, Dr. Stefano Battiston, date of completion: 02/2007

Bachelor Theses

1. Florian Künzler: *Collective emotional memory and positive thinking in written expression*
   - Department of Mechanical and Process Engineering, ETH Zürich
   - Supervisor: Prof. Frank Schweitzer, date of completion: 05/2014
2. Fabian Marbach: *The Emergence of Inequality in an Agent-Based Model*
   - Department of Mechanical and Process Engineering, ETH Zürich
   - Supervisor: Prof. Frank Schweitzer, Dr. Claudio Juan Tessone, date of completion: 09/2013
3. Philipp Egolf: *Wisdom of Crowds for an Unknow Potential*
   - Department of Mechanical and Process Engineering, ETH Zürich
   - Supervisor: Prof. Frank Schweitzer, Pavlin Mavrodiev date of completion: 07/2013
4. Krishna Murthy: *Modeling viral marketing through the voter model and polya process*
   - Department of Mechanical and Process Engineering, ETH Zürich
   - Supervisor: Prof. Frank Schweitzer, date of completion: 07/2009

Semester Theses

1. Giona Casiraghi: *About Coreness, Nestedness and Systemic Risk*
   - Department of Mechanical and Process Engineering, ETH Zürich
   - Supervisor: Prof. Frank Schweitzer, date of completion: 06/2014
2. Daniele Casati: *Analysis of Twitter Dataset*
   - Department of Mathematics, ETH Zürich
   - Supervisor: Prof. Frank Schweitzer, date of completion: 12/2013
3. Vahan Nanumyan: *Correlations in OTC Derivatives*
   - Department of Physics, ETH Zürich

- Supervisor: Prof. Frank Schweitzer, date of completion: 11/2013

4. Kalle Klimkewitz: *A Program for Cascading Processes in Multi-Layered Networks*
   - Department of Mathematics, ETH Zürich
   - Supervisor: Prof. Frank Schweitzer, date of completion: 11/2013
5. Sylvain Wenger: *Finite Size Effect in a spatial Iterated Prisoners Dilemma: The emergence of rare attractors*
   - Department of Mathematics, ETH Zürich
   - Supervisor: Prof. Frank Schweitzer, date of completion: 07/2012
6. Adiya Abisheva: *Successful and failed online social networks: a quantitative macroscopic case study*
   - Department of Computer Science, ETH Zürich
   - Supervisor: Prof. Frank Schweitzer, date of completion: 02/2012
7. Christian Burri: *Hierarchy characterization in communities of wild house mice*
   - Department of Physics, ETH Zürich
   - Supervisor: Prof. Frank Schweitzer, Nicolas Perony, date of completion: 01/2011
8. Nicolas Bürkler: *Dynamics of Companies: The Evolution of its Research*
   - Department of Mechanical and Process Engineering, ETH Zürich
   - Supervisor: Prof. Frank Schweitzer, date of completion: 07/2005

2 Research Topics

"Systems Design" has various meanings, for example, in computer science, where it refers to the architecture of computer systems. Engineering sciences also have their own version of systems design with particular emphasis on product development. None of these topics is really at the heart of our research agenda, although we cover some issues related to systems engineering in our courses.

Being part of the Department of Management, Technology, and Economics (D-MTEC) of ETH Zürich, the main focus of our research is on social and economic systems, for example, online communities with a large number of users, networks of firms and banks, or *organisations* in general. We are interested in a fundamental understanding of their structure and dynamics, to mitigate important societal problems, such as systemic risk or inefficient (suboptimal) solutions resulting from the dilemma between individual and collective utility maximization. Can we 'design' the structure and dynamics of socio-economic systems such that a desired outcome is obtained, for example, cooperation is enhanced, or knowledge is shared in a more efficient way? This implies that we should know more about the structure and the dynamics within these systems and about the way they are built up by their constituents, grow and adapt to changing outside conditions.

Our methodological approach can be best described as *data-driven modelling*. I.e. we use big data to detect statistical regularities in such systems. We build large-scale agent based models to simulate the interaction dynamics on the "micro" level, to obtain the system's dynamics on the "macro" level. We further use rigorous mathematical models to further understand such sytems. We have achieved our goal if the agent-based model, after being calibrated against real data, produces a macro dynamics that not only resembles, but matches the observed dynamics at the system's level.

Such a level of understanding, although hard to achieve, allows us to target the problem of systems design, as we see it: what mechanisms do we have to change on the agent's level, to obtain a more desirable outcome on the system's level: more reliability, more cooperation, better dissemination of information, faster adaptivity of a system to exogeneous and endogeneous changes.

The broad range of research questions we address can be loosely grouped into the following areas, each of which is described on a separate page with links to our relevant publications.

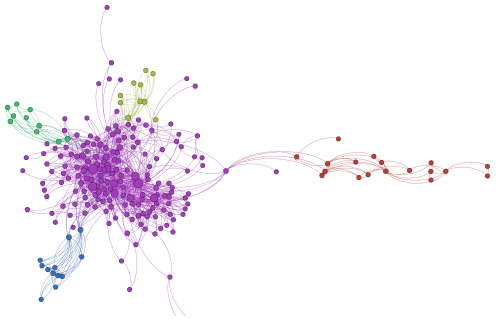


Figure 2.1: An example of our research: using clustering to refactor a Java classes database. In this manner, classes (circles) are put together in modules (colour) in order to decrease the inter-module links.

2.1 Fundamental Research

In general, our research is focused on questions and phenomena arising in different kinds of *socio-economic* and *socio-technical* systems. A first important task in addressing these questions is to understand *fundamental* aspects of these phenomena, which may or may not be related to the particular context in which they occur.

We systematically study this in our line of *fundamental research* which rests upon the methodological framework of *complex systems*. This framework has been developed over the last 40 years in different scientific disciplines, such as statistical physics, evolutionary biology, mathematical sociology, micro-economics, and computational sciences, before it merged into a commonly accepted approach to investigate various types of complex systems at large. In a nutshell, complex systems are comprised of a large number of strongly interacting subsystems – entities, processes, or so-called 'agents'. Their interactions result in the emergence of systemic features which cannot be easily inferred from the properties of the agents. Thus, the fundamental challenge of complex systems theory is to relate the properties of the agents and their interactions at the 'micro' level with the *collective* properties of the system as a whole at the 'macro' level.

A useful additional perspective to formalise these fundamental questions is provided by the *'complex networks'* approach, where agents are represented by nodes, and their interactions are represented by links. Both agents and links may change over time, often on different time scales. Hence, the dynamics of the system can be seen as a coevolution of the agents and their network. The complex networks approach allows us to utilise a wealth of methods which have been developed in different areas and which enable us to empirically investigate, for example, biological, social, technical or economic networks.

However, it is important to note that the research questions being addressed should neither be *motivated* nor *limited* by the capability of one particular methodological framework. This comment is particularly important since the development of network-based methods is still in its infancy. The majority of available methods is limited to single-layer, unweighted and time-aggregated networks. We want to overcome such limitations in order to study those systems which are of interest to us. Therefore, in our fundamental line of research we are actively involved in advancing the field of complex networks, developing novel methods for weighted, multi-layer, and temporal networks.

Hence, in our team we not only utilise existing methods, but also develop novel methods for the study of complex systems and complex networks. This is a crucial ingredient of our research approach which is driven by questions rather than available methods. It allows us to obtain fundamental insights about the structure and the dynamics of complex systems which is utilised subsequently to study specific socio-economic or socio-technical systems.

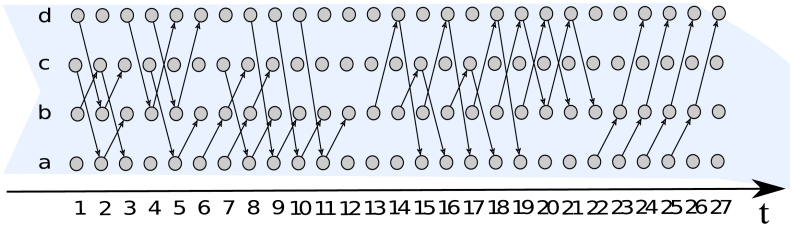


Figure 2.2: An example of our fundamental research: 'unfolding' of a temporal network.

2.1.1 Temporal Networks

The complex networks perspective has become an important methodological framework for both the modelling and analysis of complex systems. However, the vast majority of studies on complex networked systems is based on a *static network perspective*, in which links and nodes are assumed to exist at any point in time. At difference to this view, the availability of high-resolution time-stamped data on networked systems has recently validated the intuition that real complex systems are often highly dynamic, i.e. links are not active continuously but rather occur in specific temporal patterns. The fact that we currently lack a suitable methodological framework which integrates both the temporal and the topological dimension of complex systems severely limits of understanding of dynamic complex systems.

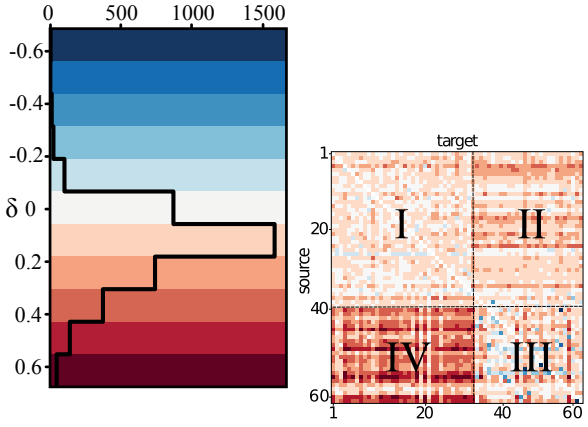


Figure 2.3: A visualisation of the non-trivial ways in which the ordering of interactions affects the length of time-respecting paths in a dynamic social network.

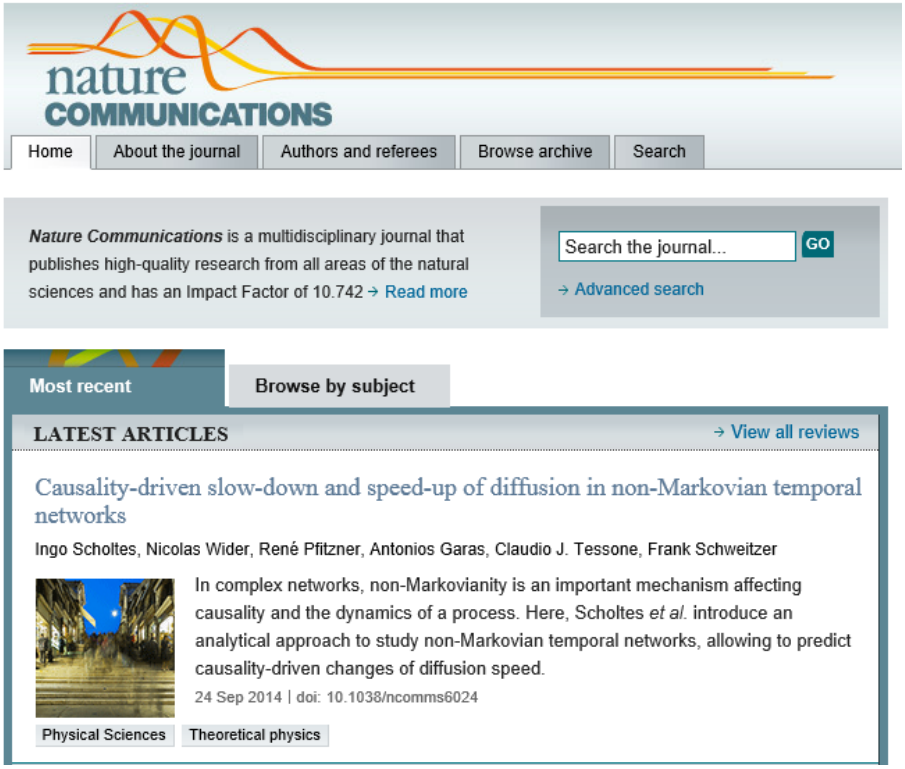
Motivated by this limitation, empirical studies of *temporal networks* with *time-varying topologies* enter the focus of a growing research community. The few existing studies on temporal networks occurring in social, economic and technological systems have generally highlighted the presence of statistical inhomogeneities in terms of broad distributions of the waiting times between consecutive node or link activities or the duration of individual contacts. Through our own research, we recently added an important additional perspective, namely that interactions in many complex systems occur in specific *temporal orders* and that this ordering is essential to understand dynamical processes on temporal networks. For example in communication processes, in order for an information to be transferred from node A via node B to node C, it is crucial that the interaction between A and B happens *before* the interaction between B and C.

To study effects that are due to the order in which interactions occur, in our most recent research we have investigated models that preserve *non-Markovian properties* of contact sequences, i.e. the fact that in many real-world systems the next interaction of a node is not independent of with whom the node has interacted shortly before. We have shown that such non-Markovian properties give rise to *effective interaction topologies* that significantly differ from what would be expected from a static network representation. We have further demonstrated that, due to these order correlations, extrapolating findings from time-aggregated networks to time-varying networks can lead to significantly wrong statements about dynamical processes like diffusion or information propagation, as well as about the importance of individual nodes. To quantify this discrepancy, we developed an information-theoretic measure which allows to quantify the presence and strength of "preferred contact sequences" in longitudinal network data and how this influences dynamical processes. We further demonstrated the usability of this novel measure in a number of real-world data sets from social, technical and biological contexts.

Most recently, we have developed a powerful framework for the modelling and analysis of temporal networks based on so-called "higher-order aggregate networks", which can be seen as a generalisation of the static abstraction commonly used in network analysis. This approach allows to study dynamical processes in temporal networks using standard techniques like, e.g., a dynamic analysis in terms of the eigenvalues of a modified Laplacian matrix, without losing information on the ordering of interactions which are hidden in the time dimension.

We are proud that our research on temporal networks has recently been featured in top-tier scientific journals like *Physical Re-*

view Letters and *Nature Communications*. Our unique approach not only allows us to quantitatively study a previously unexplored *temporal-topological* dimension of complexity in time-stamped network data. It also provides a methodological framework that offers broad perspectives for the development of new data mining and visualisation techniques which can significantly improve our ability to extract knowledge from dynamic networked systems. Apart from this fundamental research, we are also actively involved in the actual (technical) implementation of our methods in terms of software packages. In particular, we intend to maximise the outreach of our research through an open source framework for temporal network analysis publicly available at GITHUB [1] as well as through a dedicated third-party funded project targeting at making our research usable in industrial applications.



Selected Publications:

[14] Ingo Scholtes. *Force-Directed Layout of Non-Markovian Temporal Networks*. Tech. rep. 2014, pp. 1–11.

[16] Ingo Scholtes, Nicolas Wider, Rene Pfitzner, Antonios Garas, Claudio Juan Tessone, and Frank Schweitzer. "Causality-driven slow-down and speed-up of diffusion in non-Markovian temporal networks". *Nature Communications*, **5**, 5024 (2014).

[40] Rene Pfitzner, Ingo Scholtes, Antonios Garas, Claudio Juan Tessone, and Frank Schweitzer. "Betweenness preference: Quantifying correlations in the topological dynamics of temporal networks". *Physical Review Letters*, **110**, 198701 (2013).

[1] see `https://github.com/IngoScholtes/TemporalNetworks`

2.1.2 Multi-layered Networks

Multi-layered networks consist of layers of several networks, where nodes appear in at least one of these layers. The networks are both connected by intra-layer links (links in one layer) as well as inter-layer links (links between layers). This can be seen in social networks, where multiple types of social ties exist at the same time (private or professional). In real communication networks, such as a peer-to-peer network, one can draw a logical network (the connectedness of peers with each other) as well as a physical network (the way peers are connected through cables, hubs and data centers).

The research on single layer networks is mostly a simplification of the real-world: a social network is multi-layered since we have different networks based on the type of relation with other individuals. Although different layers of a network are mostly partly separated, it is interesting to estimate diffusion and failures propagation between nodes, based on the properties of intra-layer and inter-layer links.

Our chair is at the forefront of this research line and also participates in the large-scale collaboration project MULTIPLEX (see Section 5.4). We develop formal methods that capture the non-trivial dependencies of multi-layered networks. At the same time, we collect data about real-world multi-layer networks that shall be used to calibrate our models. Our vision is to generalise this multi-layered view to include information about the time dimension, this way utilizing our expertise in temporal networks (see Section 2.1.1).

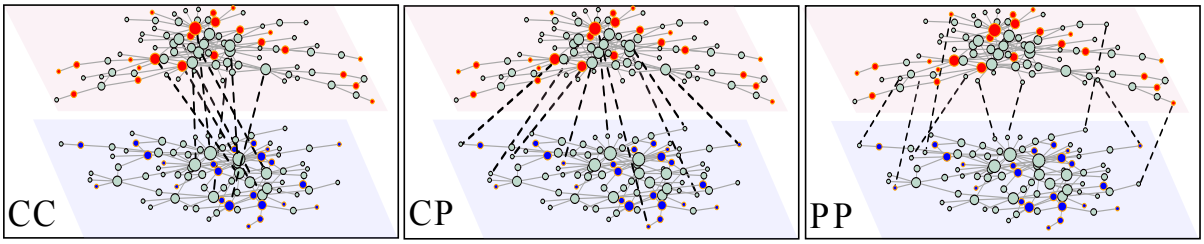


Figure 2.4: Illustration of two multi-layered networks connected by three different interconnectivity strategies. The CC strategy connects hub nodes from one network to hub nodes from the other network, the CP strategy connects hub nodes from one network to peripheral nodes in the other network, while the PP strategy connects hub nodes from one network to peripheral nodes in the other.

Selected Publications:

[4] Antonios Garas. “Reaction-Diffusion Processes on Interconnected Scale-Free Networks”. *arXiv:1407.6621* (2014).

[13] Emre Sarigöl, René Pfitzner, Ingo Scholtes, Antonios Garas, and Frank Schweitzer. “Predicting scientific success based on coauthorship networks”. *EPJ Data Science*, **3**, 9 (2014).

[20] Sven Tomforde, Jörg Hähner, Hella Seebach, Wolfgang Reif, Bernhard Sick, Arno Wacker, and Ingo Scholtes. “Engineering and Mastering Interwoven Systems”. In: *ARCS 2014 - 27th International Conference on Architecture of Computing Systems, Workshop Proceedings, February 25-28, 2014, Luebeck, Germany, University of Luebeck, Institute of Computer Engineering*. 2014, pp. 1–8.

[45] Ingo Scholtes, René Pfitzner, and Frank Schweitzer. “The Social Dimension of Information Ranking: A Discussion of Research Challenges and Approaches”. In: *Informatik 2013, 43. Jahrestagung der Gesellschaft für Informatik e.V. (GI), Informatik angepasst an Mensch, Organisation und Umwelt, 16.-20. September 2013, Koblenz*. 2013, pp. 1177–1179.

2.1.3 Analysis of Biological Systems

The complex systems toolbox provides a variety of methods adapted to the description and quantification of biological systems, at all scales. Collaborating with biologists from diverse fields, we have been working to shed light on the way these systems are organised, and their components dynamically interlinked.

This line of research is distinct from our work on the structure and dynamics of ***groups of social animals*** (Section 2.2.2). Many of these publications capture ***multi-agent models*** of collective behaviour observed at different levels of biological organisation, while some specifically focus on models of active biological motion and others on classification of phylogenetic and phenotypic variety.

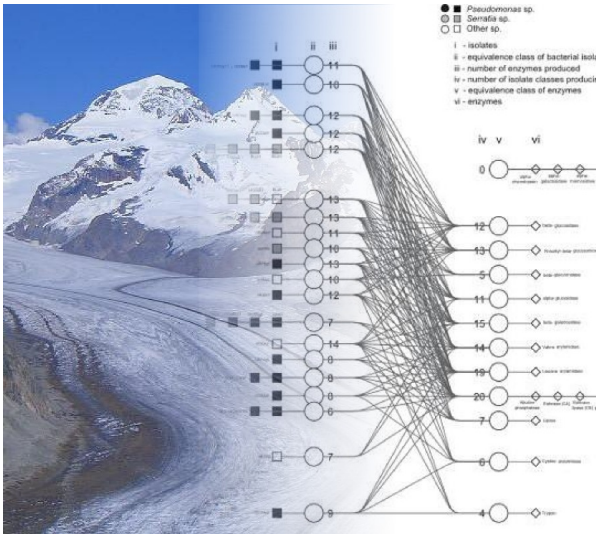


Figure 2.5: Phenotypically accurate clustering of bacterial strains from the Aletsch glacier.

Selected Publications for Models of Swarming Behaviour:

[168] Robert Mach and Frank Schweitzer. "Modeling vortex swarming in daphnia". *Bulletin of mathematical biology*, **69**, 539–562 (2007).

[188] Werner Ebeling and Frank Schweitzer. "Swarms of particle agents with harmonic interactions". *Theory in Biosciences*, **120**, 207–224 (2001).

[189] Frank Schweitzer, Werner Ebeling, and Benno Tilch. "Statistical mechanics of canonical-dissipative systems and applications to swarm dynamics". *Physical Review E*, **64**, 14 (2001).

Selected Publications for Models of Active Biological Motion:

[93] Mirko Birbaumer and Frank Schweitzer. "Agent-based modeling of intracellular transport". *European Physical Journal B*, **82**, 245–255 (2011).

[98] Victor Garcia, Mirko Birbaumer, and Frank Schweitzer. "Testing an agent-based model of bacterial cell motility: How nutrient concentration affects speed distribution". *European Physical Journal B*, **82**, 235–244 (2011).

[187] Werner Ebeling and Frank Schweitzer. "Self-Organization, Active Brownian Dynamics, and Biological Applications". *Nova Acta Leopoldina*, **88**, 169–188 (2003).

Selected Publications for Analyses of Phylogeny and Phenotypes:

[47] Miroslav Svercel, Manuela Filippini, Nicolas Perony, Valentina Rossetti, and Homayoun C. Bagheri. "Use of a four-tiered graph to parse the factors leading to phenotypic clustering in bacteria: a case study based on samples from the Aletsch Glacier". *PLOS ONE*, **8**, e65059 (2013).

[55] Marcelo Serrano Zanetti, Manuel Gil, Stefan Zoller, and Maria Anisimova. "Codonphyml: Fast maximum likelihood phylogeny estimation under codon substitution models". *Molecular Biology and Evolution*, **30**, 1270–1280 (2013).

[150] E Alejandro Herrada, Claudio Juan Tessone, Konstantin Klemm, Victor M. Eguiluz, Emilio Hernandez - Garcia, and Carlos M Duarte. "Universal scaling in the branching of the tree of life." *PLOS ONE*, **3**, e2757 (2008).

2.1.4 Models of Systemic Risk

The term '***systemic risk***' denotes the risk that a whole system consisting of many interacting agents fails. We see systemic risk as a macroscopic property that ***emerges from the nonlinear interactions of agents***. This differs from a conventional view that focuses on the probability of *single extreme events*, e.g. of earthquakes or big meteors hitting the earth, that seriously damage the system. It also differs from a perspective, e.g., used in finance, where a single agent is big enough to damage the whole system - which leads to the notion of *systemic importance*. In addition to all these ingredients, our systemic perspective emphasises the impact of individual failure exerted on other agents. I.e., the systemic failure can start with the ***failure of a few agents*** which is ***amplified*** both by interaction mechanisms and by systemic feedback. This can lead to ***failure cascades*** which span a significant part of the system.

We provide a ***general framework*** for modelling systemic risk which was first applied to fully connected networks and is being extended to networks with ***arbitrary degree distribution*** from a formal theoretical point of view. Since we also allow for nodes to have ***heterogeneous*** robustness, various applications and extensions of the existing models are possible. They include credit networks, supply networks or social online networks where cascades of leaving users may threaten the existence of the platform.

Our approach is based on the concept of complex networks, where agents are represented by nodes in a network, whereas their interactions are modelled by links between them. Both nodes and links can follow their own dynamics and influence each other by feedback effects. In order to understand the emergence of systemic risk, we have to model

(a) the internal dynamics of the agents, which is largely neglected in other approaches

(b) the interaction dynamics of the agents (in particular the network topology)

(c) macroscopic or systemic feedback, i.e. the impact of changing external conditions

(d) trend reinforcement, i.e. the fact that interactions are path dependent and depend on the history of previous interactions.

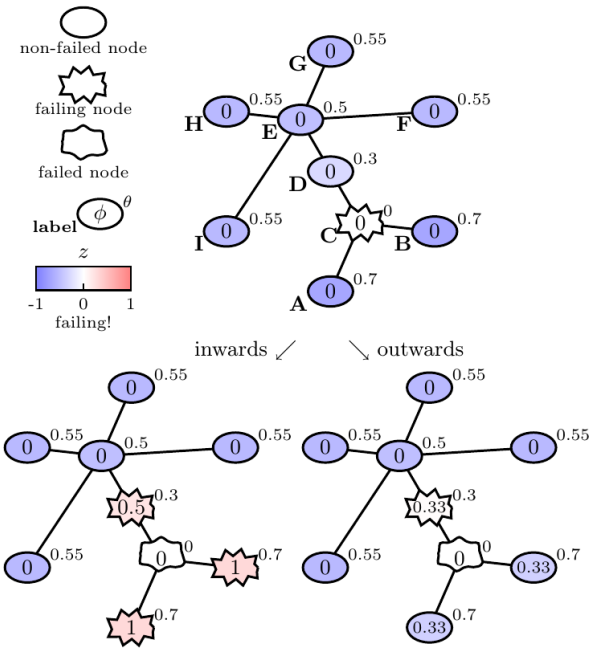


Figure 2.6: Illustration of the cascading dynamics for two different models described by our general framework.

Selected Publications:

[17] Paolo Tasca, Pavlin Mavrodiev, and Frank Schweitzer. "Quantifying the Impact of Leveraging and Diversification on Systemic Risk". *Journal of Financial Stability*, 29 (2014).

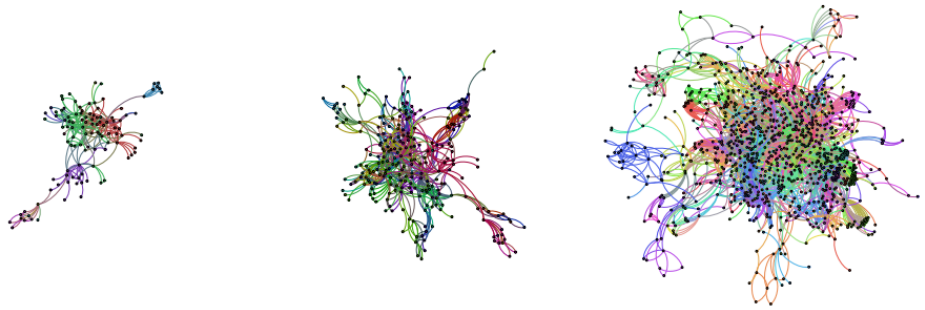
[50] Claudio Juan Tessone, Antonios Garas, Beniamino Guerra, and Frank Schweitzer. "How big is too big? Critical shocks for systemic failure cascades". *Journal of Statistical Physics*, **151**, 765–783 (2013).

[135] Jan Lorenz, Stefano Battiston, and Frank Schweitzer. "Systemic risk in a unifying framework for cascading processes on networks". *The European Physical Journal B*, **71**, 441–460 (2009).

2.1.5 Applications in Software Engineering

Examples for systems that are most commonly studied from a *complex systems* perspective can predominantly been found in the context of *biological* and *social* systems. However, it is important to realise that also man-made, engineered systems fall into this category. A particular class of complex engineered systems whose importance for society has increased tremendously over the last few years are *software systems*. Typical modern software systems consist of hundreds or even thousands of interdependent modules or subsystems, which are working together in complex ways and which mutually depend on each others' functionality. A proper understanding of the structure of such software systems, as well as of the evolution of these structures as their development progresses is fundamental for the design and management of secure, reliable and maintainable software. Naturally, such systems can be studied from a complex networks perspective, where *functions*, *classes*, or *packages* are represented by nodes and the interdependencies between them are modelled as links.

The application of network-analytic techniques allows us to study the *modularity* of software systems from a network perspective. Our most recent research in this area has shown not only that we can use such a network perspective to quantify the evolution of modularity in software systems. It has also proven to be useful for the development of *remodularisation algorithms*, which can be used to support developers in developing software structures that are easy to understand and thus to maintain. In addition to developing quantitative measures and algorithms for the remodularisation of software, we also use agent-based modelling techniques to study the *temporal evolution* of software systems. This interdisciplinary approach not only helps us to better understand *why* software systems evolve the way they do, it also allows us to identify which growth processes are *sustainable* in the sense that they lead to a software structure which can easily be maintained by engineers.



(a) 2003-10-01 (b) 2003-11-01 (c) 2004-06-01

(d) 2001-02-01 (e) 2001-10-01 (f) 2003-01-01

Figure 2.7: Evolution of modularity in a JAVA software project. Nodes represent classes, while links represent dependencies between them. The colouring of nodes represents the package assignment of classes.

Our research in this area is truly interdisciplinary, being published both in interdisciplinary journals like *Europhysics Letters* as well as in premium software engineering outlets like the *International Conference on Modularity* or *IEEE Transactions on Software Engineering*.

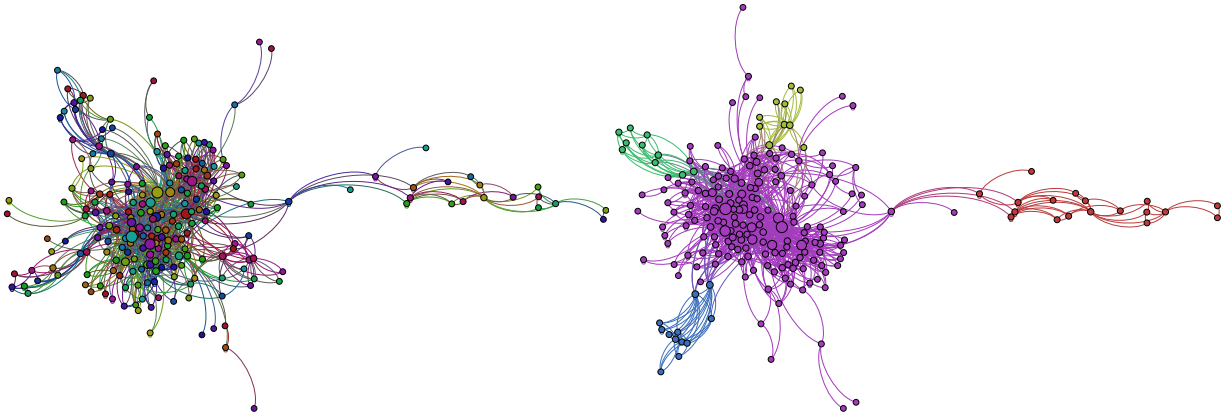


Figure 2.8: The dependency network of an actual JAVA software before (left) and after (right) applying the remodularisation proposed by our algorithm. Nodes represent classes, while links represent dependencies between them. The colouring of nodes represents the package assignment of classes.

Selected Publications:

[21] Marcelo Serrano Zanetti, Claudio Juan Tessone, Ingo Scholtes, and Frank Schweitzer. "Automated Software Remodularization Based on Move Refactoring". In: *In Proceedings of the 13th International Conference on Modularity 2014*. ACM, 2014.

[70] Markus Michael Geipel and Frank Schweitzer. "The Link between Dependency and Cochange: Empirical Evidence". *IEEE Transactions on Software Engineering*, **38**, 1432–1444 (2012).

[92] Marcelo Serrano Zanetti and Frank Schweitzer. "A network perspective on software modularity". In: *Architecture of Computing Systems (ARCS) Workshops 2012*. GI, IEEE, 2012, pp. 175–186.

[111] Claudio Juan Tessone, Markus Michael Geipel, and Frank Schweitzer. "Sustainable growth in complex networks". *Europhysics Letters*, **96**, 58005 (2011).

[128] Markus Michael Geipel and Frank Schweitzer. "Software change dynamics: Evidence from 35 Java projects". In: *Proceedings of the the 7th joint meeting of the European software engineering conference and the ACM SIGSOFT symposium on The foundations of software engineering*. New York, New York, USA: ACM Press, 2009, p. 269.

2.2 Social Organisations

Our fundamental line of research provides the basis for our *applied lines of research*, one of which addresses the study of *social organisations*. In line with our methodological approach summarised in Section 2.1, our emphasis is again on the emergence of *systemic properties* which are due to the interactions between agents in a particular social organisation. As one particular example, we study *opinion dynamics* in social systems, addressing the question when and how a macroscopically ordered state, or *consensus*, emerges due to the communication between agents with different opinions. Likewise, we investigate the spontaneous emergence of *social norms* in populations of agents with heterogeneous behaviour. A better understanding of such dynamics opens the possibility to design interaction mechanisms that, for example, foster desired collective behaviour, such as sustained cooperation or trust between agents.

While the questions above relate to rather formal and abstract models of social organisations, we also study problems that are more closely related to real applications in socio-economic and socio-technical systems. Examples include the design of (social) recommender systems, the management of software development teams, the design of mechanisms in online social networks, or the mitigation of risks in socio-economic systems. This requires us to employ a wide spectrum of methodologies and tools ranging from multi-agent computer simulations, data mining, (massively parallel) data processing and statistical data analysis, to machine learning, algorithm design and mathematical proofs.

Even if the social organisations mentioned above seem quite diverse, they can be described by a common methodology and also allow us to approach, from different sides, fundamental questions about the trade-off between the *robustness* and *adaptivity* of social organisations. While *robustness* seems to be a desired feature for social organisations, it may limit their *adaptivity*, i.e. their ability quickly adapt to a changing environment or to internal challenges. Successful organisations are both able to maintain a coherent structure that ensures their functionality and to adapt to innovations or threats instantaneously. In order to reveal the basic principles at work in successful social organisations, we have to rely on data from specific contexts, while at the same avoiding to narrow our perspective too much.

This is why we decided, for example, to study software development processes based on *Open Source Software* (OSS) communities: here we are able to obtain data not only about the structure of various OSS projects – i.e. the 'products', but also about the communication between developers and users – i.e. the 'producers'. We can thus trace how both the the product – i.e. the software – and the community of producers – i.e. the development team – change over time. We can see if and how robustness is maintained while maintaining an openness for gradual improvements as well as the adoption of innovations. Finally, we are able to quantitatively study how different dimensions of the success of a product (measured for instance in terms of adoption rate, software defects, or user satisfaction) is connected to the structure and dynamics of the community of 'producers'.

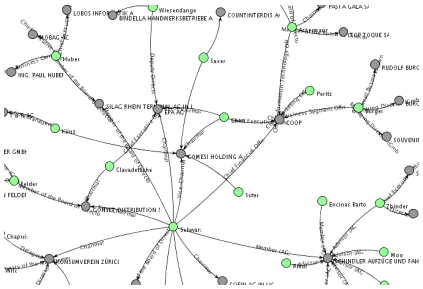


Figure 2.9: Snapshot of a network of managers in Swiss companies.

In addressing the questions laid out above, we carefully avoid the common 'sociophysics' pitfall of over-simplifying social systems. Keeping in mind the context in which social organisations operate, our studies emphasise the importance of 'domain knowledge' from sociology, economics, management science or software engineering. The success of this approach is documented by publications in interdisciplinary journals but also in highly-ranked disciplinary outlets covering areas such as software engineering, animal behaviour, socio-technical systems, mathematical sociology, economic behaviour, or organisational science.

2.2.1 Structure and Dynamics of Online Social Networks

Several online social networks have emerged in the past twenty years, each with a different purpose. Some networks are designed for the user to connect to real-life friends (Facebook, Google+, Qzone, Myspace, VKontakte); others serve as a distribution channel for news or blogs (Twitter, Livejournal) without real-life contact; or they are game-related (Habbo, Friendster); or, finally, their scope is to create and maintain professional relationships (LinkedIn).

Social online networks have changed the way how individuals and groups distribute knowledge and information. Some questions logically arise: how does information propagate throughout these networks? Moreover, what are the differences in information flow between several networks? How do these networks emerge and what are the conditions for being robust against failures or collapse of a network?

Such questions pose a number of challenges, since most online social networks are **temporal**, i.e. their composition continuously changes. In addition, the most popular networks are **enormous** (hundred of millions of users & links), thus making analytic measurements and calculations impossible with the typical computational power available nowadays. Moreover, most of these data are not **openly available**, as this would infringe privacy of participating users.

Our goal is to address these challenges and use time-averaged or snapshot techniques, numerical approximations or sampling to investigate the structure and dynamics of these networks. By means of our exhaustive empirical analyses, we are able to determine the causes for the rise and the decline of several online social networks.

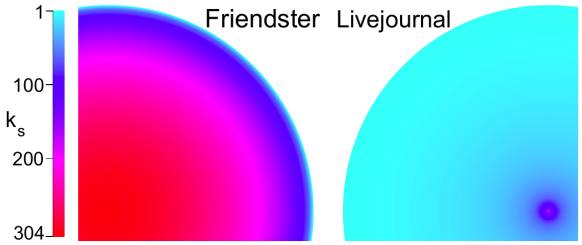


Figure 2.10: An analyis of two large online social networks, Friendster and Livejournal. Layers are coloured according to the k-core depth in the network, with areas proportional to the amount of nodes with such k-core depth.

Selected Publications:

[1] Adiya Abisheva, Venkata Rama Kiran Garimella, David Garcia, and Ingmar Weber. "Who watches (and shares) what on YouTube? And when? Using Twitter to understand YouTube viewership". In: *WSDM '14 Proceedings of the 7th ACM international conference on Web search and data mining*. New York, NY, USA, 2014, pp. 593–602.

[9] David Garcia, Ingmar Weber, and Rama Venkata Kiran Garimella. "Gender Asymmetries in Reality and Fiction : The Bechdel Test of Social Media". In: *International AAAI Conference on Weblogs and Social Media*. 2014, pp. 131–140.

[25] Valentin Burger, Tobias Hoßfeld, David Garcia, Michael Seufert, Ingo Scholtes, and David Hock. "Resilience in Enterprise Social Networks". In: *Informatik 2013, 43. Jahrestagung der Gesellschaft für Informatik e.V. (GI), Informatik angepasst an Mensch, Organisation und Umwelt, 16.-20. September 2013, Koblenz*. 2013, pp. 1165–1168.

[29] David Garcia, Pavlin Mavrodiev, and Frank Schweitzer. "Social resilience in online communities: The autopsy of Friendster". In: *1st ACM Conference in Online Social Networks (COSN'13)*. http://dx.doi.org/10.1145/2512938.2512946, 2013, pp. 39–50.

[86] Milovan Suvakov, David Garcia, Frank Schweitzer, and Bosiljka Tadic. "Agent-based simulations of emotion spreading in online social networks". *arXiv:1205.6278*, 21 (2012).

[125] Frank Schweitzer and David Garcia. "An agent-based model of collective emotions in online communities". *The European Physical Journal B*, **77**, 533–545 (2010).

2.2.2 Structure and Dynamics of Animal Groups

Why are we interested in animal groups? We see them as particular instances of social organisations, which share similar problems as the more socially complex primates that we are. Examples of these problems are: coordination of decisions, formation of hierarchies and leadership, coherent motion, social influence, collaboration, cooperation and conflict management. Thus, by studying such groups, we also learn about social organisations at large and how they solve the prevalent tension between adaptation and robustness.

Our focus is on social animal groups for which detailed individual data are available. This allows us to understand the relation between the individual behaviour and the collective dynamics. Our methodology encompasses several approaches, from the analysis of large-scale data sets to agent-based models of interacting individuals and mathematical investigations of the resulting structure and group dynamics. Whenever applicable, we benefit from a comparative approach between social animal species, and we try to contribute to the biological understanding of each species we study.

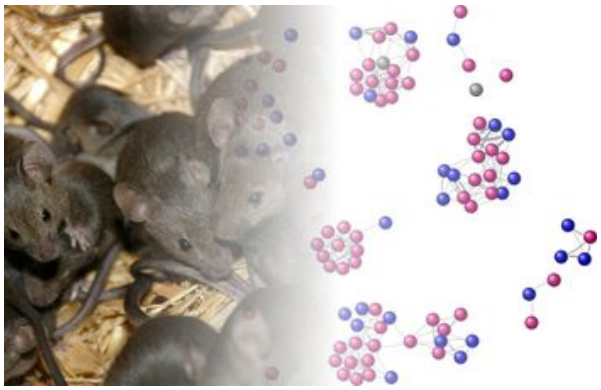


Figure 2.11: Illustration of the social network of wild house mice.

House mice We have analysed and modelled the behaviour of wild house mice, using data from a long-term field project headed by Prof. Barbara König, University of Zürich. Our focus was on reconstructing the spatial movement patterns of individual mice and their time-dependent network of interactions.

Meerkats We have helped collect, analysed and modelled positional and behavioural data on wild meerkat groups, coming from a long-term field project headed by Prof. Marta Manser (University of Zürich) and Prof. Tim Clutton-Brock (University of Cambridge). Our focus was on reconstructing the correlated spatial movement of the dominating individuals and its impact on the group's behaviour.

Bechstein's bats We have analysed and modelled the behaviour and social structure of wild Bechstein's bat colonies, working with Prof. Gerald Kerth (University of Greifswald) and his team on roosting data. Our focus was on reconstructing the long-term social network of bats and their collective decision dynamics in choosing common roost sites.

Selected Publications:

[11] Tom O. Richardson, Nicolas Perony, Claudio Juan Tessone, Christophe A.H. Bousquet, Marta B. Manser, and Frank Schweitzer. "A framework for extracting pairwise coupling information during collective animal motion". *arXiv:1311.1417* (2014).

[22] Anja Baigger, Nicolas Perony, Vera Leinert, Markus Melber, Stefanie Grunberger, Daniela Fleischmann, and Gerald Kerth. "Bechstein's bats maintain individual social links despite a complete reorganisation of their colony structure". *Naturwissenschaften*, **100**, 895–898 (2013).

[39] Nicolas Perony and Simon W. Townsend. "Why did the meerkat cross the road? Flexible adaptation of phylogenetically-old behavioural strategies to modern-day threats". *PLOS ONE*, **8**, (2013).

[79] Nicolas Perony, Claudio Juan Tessone, Barbara Koenig, and Frank Schweitzer. "How random is social behaviour? Disentangling social complexity through the study of a wild house mouse population". *PLOS Computational Biology*, **8**, e1002786 (2012).

[100] Gerald Kerth, Nicolas Perony, and Frank Schweitzer. "Bats are able to maintain long-term social relationships despite the high fission-fusion dynamics of their groups." *Proceedings of the Royal Society B: Biological Sciences*, **278**, 2761–2767 (2011).

2.2.3 Design and Analysis of Socio-technical Systems

The pervasive use of information and communication technologies across all fields of society results in an increasing interdependency between social and technical systems. Modern society depends on a multitude of technical systems and infrastructures, moreover many of those technical systems are influenced by the social systems into which they are embedded. Obvious examples for such systems include communication systems, collaboration tools, crowdsourcing platforms, social media or collaborative information systems, while less obvious examples include software engineering projects, search engines, traffic and power infrastructures or companies. Acknowledging the fact that the social and the technical layers of such systems are coupled inseparably, they are commonly referred to as *socio-technical systems*. The fact that their study necessitates models for both the social and the technical dimension has recently been acknowledged by a number of research communities and related research questions are addressed under the umbrella of *socio-technical*, *techno-social* or *cyber-physical systems*, *community informatics*, *social informatics*, *human-computer interaction* and *social computing*.

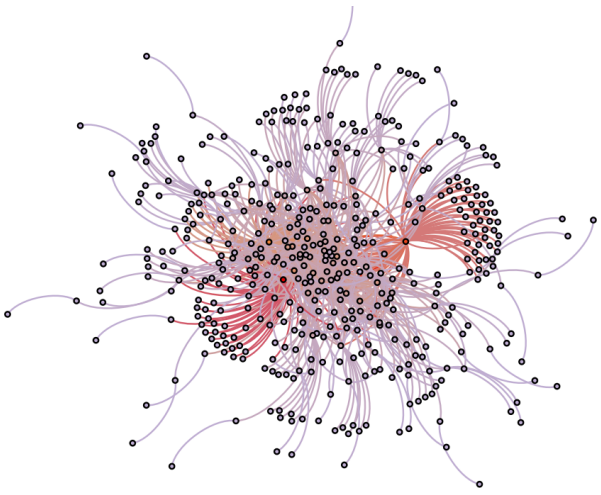


Figure 2.12: An example for a socio-technical system: Collaborations between users mediated via a collaboration tool used by a community of software developers.

Importantly, the ongoing convergence between social and technical systems implies that there is an increasing amount of data that can be used to quantitatively study socio-technical systems. Our focus is thus on data-driven research which allows us to analyse socio-technical systems in different contexts, typically addressing the question how they can be better designed and managed.

Studying the interplay between social structures and information networks found in scholarly publications, one important question that we study is how social structures influence our perception of what is important and how do they influence what we perceive and what else we ignore. In this line of research we have shown that scholarly citation structures are indeed highly correlated with the social network between authors. This correlation can be used to predict - solely based on the collaboration network of authors - whether their publications will be among the most highly cited in their respective field. This work not only provided interesting insights into citation patterns, it also suggests novel directions for the development of importance measures and ranking schemes which take into account the social dimension of information systems.

Interestingly for many of today's socio-technical systems, the proper "design" and "functioning" of the *social component* is as important as that of the technical component. In another line of research we thus study questions such as how technical systems can help us to monitor or even optimise the evolving social structures of teams or companies. We typically address this problem from the perspective of complex networks, which allows us to employ our competence in the modelling of evolving networks, the network-based analysis of collaboration structures, or the analysis of time-varying networks. Similarly, we are finally interested in novel approach which facilitate the design of socially-aware technical systems, i.e. technical systems that actively utilise the structure and dynamics of the social systems that they are coupled with in order to achieve their goals. Particular examples include trust-based systems which can be used in the context of peer-to-peer or social recommender systems.

Again, a particular asset of our research on the design and analysis of socio-technical systems is that it is truly interdisciplinary, combining the perspectives of social sciences, computer science and complex systems. The success of this approach is documented by the fact that our publications have been published in interdisciplinary journals like *EPJ Data Science*, in top-tier computer science venues like the *International Conference on Software Engineering* or *IEEE TrustCom*, as well as in publications which specifically address the interplay between social sciences and computer science.

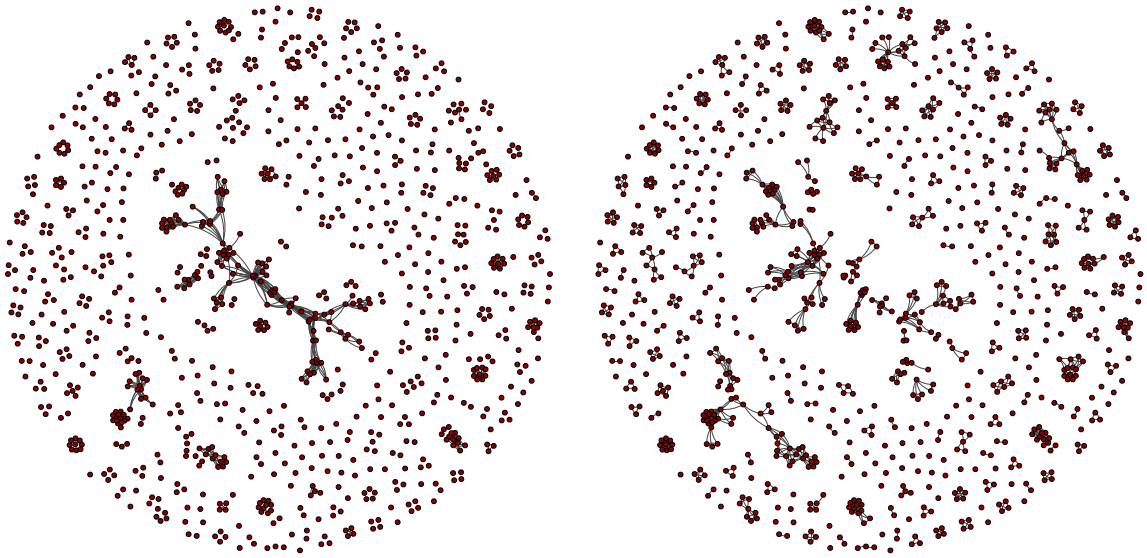


Figure 2.13: Citation (left) and collaboration (right) structures of a scientific community. Each node represents one author in the author-author citation network (left) and the coauthorship network (right)

Selected Publications:

[3] Valentin Burger, David Hock, Ingo Scholtes, Tobias Hoßfeld, David Garcia, and Michael Seufert. "Social Network Analysis in the Enterprise: Challenges and Opportunities". In: *Socioinformatics - The Social Impact of Interactions between Humans and IT*. Ed. by Katharina Zweig, Wolfgang Neuser, Volkmar Pipek, Markus Rohde, and Ingo Scholtes. Springer Proceedings in Complexity. Springer International Publishing, 2014, pp. 95–120.

[13] Emre Sarigöl, René Pfitzner, Ingo Scholtes, Antonios Garas, and Frank Schweitzer. "Predicting scientific success based on coauthorship networks". *EPJ Data Science*, **3**, 9 (2014).

[15] Ingo Scholtes, René Pfitzner, and Frank Schweitzer. "The Social Dimension of Information Ranking: A Discussion of Research Challenges and Approaches". In: *Socioinformatics - The Social Impact of Interactions between Humans and IT*. Ed. by Katharina Zweig, Wolfgang Neuser, Volkmar Pipek, Markus Rohde, and Ingo Scholtes. Springer Proceedings in Complexity. Springer International Publishing, 2014, pp. 45–61.

[82] Ingo Scholtes and Claudio Juan Tessone. "Organic design of massively distributed systems: A complex networks perspective". *Informatik Spektrum*, **35**, 1–12 (2012).

[147] Stefano Battiston, Domenico Delli Gatti, and Mauro Gallegati. "Trade Credit Networks and systemic risk". In: *Understanding Complex Systems*. 2008th ed. Vol. 2008. Understanding Complex Systems. Berlin, Heidelberg: Springer Berlin Heidelberg, 2008. Chap. Part IV, pp. 219–239.

2.2.4 Social Software Engineering

Besides being a problem that is challenging from a technical point of view, *software engineering processes* also comprise interesting *social aspects* that deserve to be studied scientifically. Representing a particularly interesting type of socio-technical system, we thus investigate the social structures and dynamics of collaborative software engineering processes. We are generally interested in the question how different ways to structure collaborations, or to distribute tasks and responsibilities in software development teams will positively or negatively affect the performance of the project. Our research methodology is data-driven, i.e. we analyse large-scale data sets capturing social dynamics in collaborative software engineering and make use of recent advances in the theory of complex systems, complex networks, machine learning and statistical analysis of big data. We commonly make use of available data on the community of developers and contributors to large-scale Open Source Software projects such as Eclipse, NetBeans, KDE, or Linux distributions such as Gentoo. Studying the evolution of the social organisation of these projects over periods of more than one decade, we can then link the performance of the projects to features of the underlying collaboration or communication networks.

Our research in this area has uncovered interesting relations between the topology of collaborations and both individual and collective performance in software development teams. Through a case study of the project Gentoo, we were able to find empirical evidence for that fact that a runaway *centralisation* of collaboration structures poses a severe risk to software projects, resulting in a severe and lasting drop in performance if one of the central collaborators leaves the project. Using data of evolving collaboration structures, we further showed that the presence of central collaborators results in a decreasing commitment of the remaining community, thus further driving centralisation.

Apart from empirical studies, we also used our complex networks competence to suggest concrete improvements of online collaboration tools. Using large-scale data sets on collaborative software engineering projects, we showed that the collaboration structures of software development communities can be used to automatically assess the quality of bug reports that contributors submit to the community. We not only highlight a statistically significant relation between the information provided in bug reports and features of the collaboration networks into which the reporting user is embedded. We also show how machine learning techniques can be used to develop a fully automatic classifier which can be directly used to mitigate the information overload present in many large-scale software engineering projects.

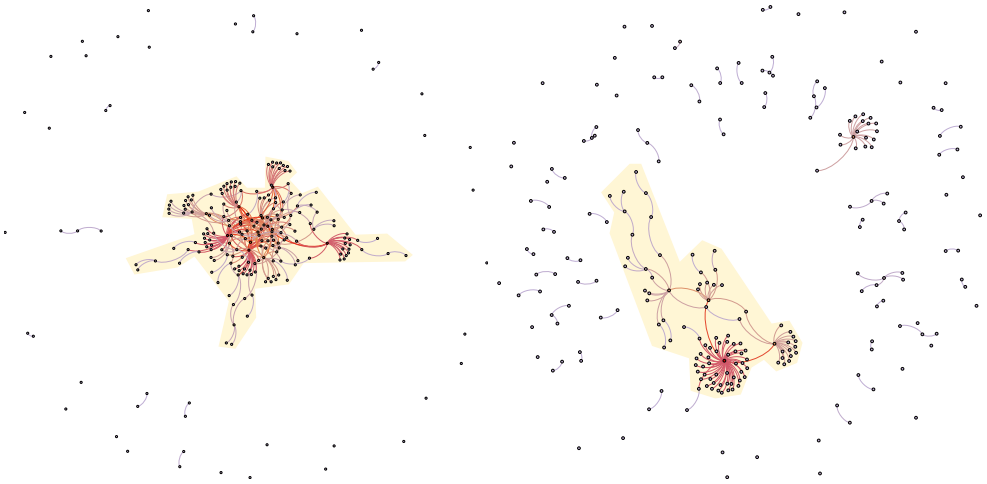


Figure 2.14: Collaboration structures of two software development communities. Nodes represent contributors to the project, links represent collaborations between them.

In our research on social software engineering, we particularly avoid to oversimplify complex engineering processes by integrating hands-on experience in software engineering with expertise in data mining and the modelling and analysis of complex systems. Through the unique combination of our competencies in computer science, statistical data analysis and complex networks theory present in our team, we were able to publish our results not only in interdisciplinary journals like *Advances in Complex Systems*, but also in premium software engineering venues such as the *International Conference on Software Engineering*. Apart from this scientific recognition, our research results have further attracted significant attention from industry, as documented by talk invitations from major software companies such as *Google*, *IBM* and *DATEV*.

Selected Publications:

[32] David Garcia, Marcelo Serrano Zanetti, and Frank Schweitzer. "The Role of Emotions in Contributors Activity: A Case Study of the Gentoo Community". In: *International Conference on Social Computing and Its Applications*. 2013.

[56] Marcelo Serrano Zanetti, Ingo Scholtes, Claudio Juan Tessone, and Frank Schweitzer. "Categorizing bugs with social networks: A case study on four open source software communities". In: *ICSE '13 Proceedings of the 35th International Conference on Software Engineering*. 2013, pp. 1032–1041.

[57] Marcelo Serrano Zanetti, Ingo Scholtes, Claudio Juan Tessone, and Frank Schweitzer. "The rise and fall of a central contributor: Dynamics of social organization and performance in the Gentoo community". In: *CHASE/ICSE '13 Proceedings of the 6th International Workshop on Cooperative and Human Aspects of Software Engineering*. 2013, pp. 49–56.

[85] Marcelo Serrano Zanetti. "The Co-evolution of Socio-technical Structures in Sustainable Software Development: Lessons from the Open Source Software Communities". In: *Proceedings of the 34th International Conference on Software Engineering*. ICSE '12. Zurich, Switzerland: IEEE Press, 2012, pp. 1587–1590.

[91] Marcelo Serrano Zanetti, Emre Sarigol, Ingo Scholtes, Claudio Juan Tessone, and Frank Schweitzer. "A quantitative study of social organisation in open source software communities". In: *OASIcs 2012 - Imperial College Computing Student Workshop 2012, Jones A.V. (Ed.)* Vol. 28. Schloss Dagstuhl, 2012, pp. 116–122.

2.2.5 Opinion Dynamics

How do agents change their opinions dependent on external influences or the opinion of others? At differences with strategies in game theory which are characterised by a payoff dependent on the strategic choice of the counterparty, opinions are assumed to have no intrinsic value. Hence, the emergence of *collective opinions* in a *multi-agent system* is the question of interest. In most cases, the formation of (partial) *consensus* among agents can lead to such collective opinions. Noticeably, different collective opinions can *coexist*, for example as opinions of a majority and a minority, or in different spatial domains. Studying formal multi-agent models, we are mostly interested in the interaction rules between agents which may foster the *emergence of consensus*. Two model classes are analysed based on either binary opinions (voter models), or continuous opinions (bounded confidence models). Interactions between agents are restricted either to their neighbourhood, or to agents with sufficiently similar opinions. We have proposed different mechanisms to enhance consensus formation, for example by considering the influence of the social network or other forms of local neighbourhoods, by nonlinear response to the opinion of others, or by considering the agents heterogeneity. Particular emphasis was on the role of *social influence*, where agents became subject to the opinons of others in different ways. While social influence not necessarily hampers the formation of consensus, it can lead to the convergence to opinions that are far from the true value as investigations of the *wisdom of crowds* show.

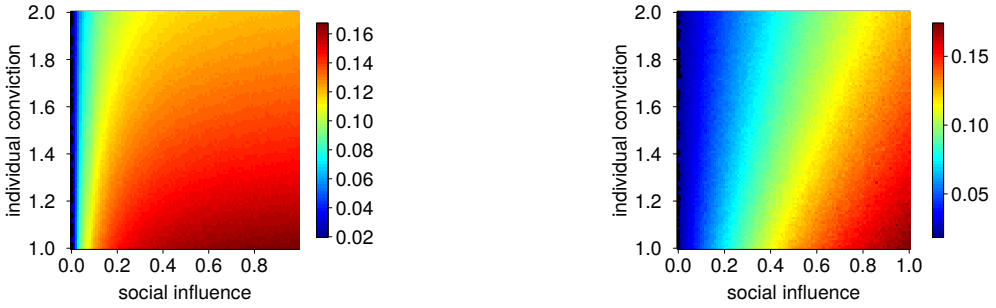


Figure 2.15: The collective error under social influence (in colour), of a population of decision-makers in a model of opinion formation. Depending on the initial configuration of the population, social influence can (i) lead to convergence away from the truth (left) (ii) be beneficial in moderate amounts (right) or (iii) always lead to convergence toward the truth (not shown).

Selected Publications:

[33] Patrick Groeber, Jan Lorenz, and Frank Schweitzer. "Dissonance minimization as a microfoundation of social influence in models of opinion formation". *Journal of Mathematical Sociology*, **38**, 147–174 (2013).

[36] Pavlin Mavrodiev, Claudio Juan Tessone, and Frank Schweitzer. "Quantifying the effects of social influence". *Scientific Reports*, **3**, (2013).

[77] Nicolas Perony, Rene Pfitzner, Ingo Scholtes, Frank Schweitzer, and Claudio Juan Tessone. "Hierarchical consensus formation reduces the influence of opinion bias". In: *ECMS 2012 - Proceedings of the 26th European Conference on Modelling and Simulation*. 2012, pp. 662–668.

[103] Jan Lorenz, Heiko Rauhut, Frank Schweitzer, and Dirk Helbing. "How social influence can undermine the wisdom of crowd effect". *Proceedings of the National Academy of Sciences (PNAS)*, **108**, 9020–9025 (2011).

[131] Patrick Groeber, Frank Schweitzer, and Kerstin Press. "How groups can foster consensus: The case of local cultures". *Journal of Aritifical Societies and Social Simulation*, **12**, 1–22 (2009).

2.2.6 Emotional Influence in Social Media

Online communication can be seen as a large-scale social experiment that constantly provides us with data about users' activities, interactions and emotions. While their online behaviour on the "micro" level is largely governed by individual traits, we find on the "macro" level remarkable statistical regularities. These can be reproduced by means of stochastic agent-based models that capture the nonlinear response to emotional information in different online communities. This research opens a vast field to combine big data analysis, nonlinear dynamics and statistical physics.

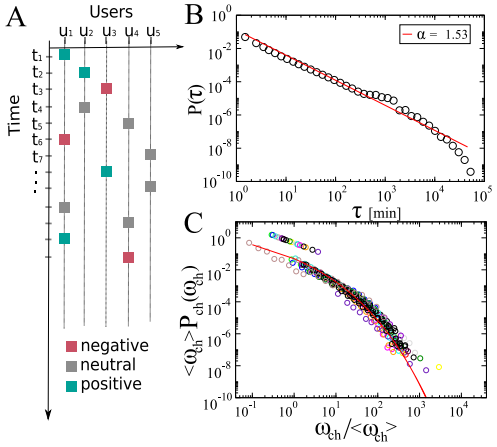


Figure 2.16: Communication activity over IRC channels, as described in [64].

Selected Publications:

[7] David Garcia, Antonios Garas, and Frank Schweitzer. "Modeling collective emotions in online social systems". In: *Collective Emotions*. Oxford University Press, 2014, pp. 389–406.

[31] David Garcia and Mike Thelwall. "Political alignment and emotional expression in Spanish Tweets". In: *Workshop on Sentiment Analysis at SEPLN*. 2013, pp. 151–159.

[41] Stefan Rank, Marcin Skowron, and David Garcia. "Dyads to Groups : Modeling Interactions with Affective Dialog Systems". *International Journal of Computational Linguistics Research*, **4**, 22–32 (2013).

[48] Dorian Tanase, David Garcia, Antonios Garas, and Frank Schweitzer. "Emotional reviews boost user visibility in social recommender systems". *Forthcoming* (2013).

[52] Mike Thelwall, Kevan Buckley, George Paltoglou, Marcin Skowron, David Garcia, Stephane Gobron, Junghyun Ahn, Arvid Kappas, Dennis Kuster, and A Janusz. "Damping sentiment analysis in online communication: Discussions, monologs and dialogs". In: *Computational Linguistics and Intelligent Text Processing(Lecture Notes in Computer Science)*. Vol. 7817. 2013, pp. 1–12.

[64] Antonios Garas, David Garcia, Marcin Skowron, and Frank Schweitzer. "Emotional persistence in online chatting communities". *Scientific Reports*, **2**, 402 (2012).

[66] David Garcia, Antonios Garas, and Frank Schweitzer. "Positive words carry less information than negative words". *EPJ Data Science*, **1**, 3 (2012).

[67] David Garcia, Arvid Kappas, Dennis Kuester, Mathias Theunis, Elena Tsankova, Antonios Garas, Peter Kuppens, and Frank Schweitzer. "Measuring the Dynamics of Individual Emotions Under Online Interaction Through Subjective and Physiological Responses". In: *SPR 52nd annual meeting*. 231323. New Orleans, Lousiana, 2012, pp. 1–2.

[69] David Garcia and Frank Schweitzer. "Modeling online collective emotions". In: *Proceedings of the 2012 workshop on Data-driven user behavioral modelling and mining from social media-DUBMMSM '12, CIKM2012*. New York, New York, USA: ACM Press, 2012, p. 37.

[80] Rene Pfitzner, Antonios Garas, and Frank Schweitzer. "Emotional divergence influences information spreading in Twitter". In: *The 6th International AAAI Conference on Weblogs and Social Media*. The AAAI Press, 2012, pp. 2–5.

[125] Frank Schweitzer and David Garcia. "An agent-based model of collective emotions in online communities". *The European Physical Journal B*, **77**, 533–545 (2010).

2.2.7 Outbreak of Cooperation

Cooperation is a widespread phenomenon in biological and social systems, but in most game-theoretical approaches ***defection*** should be the rational strategy to choose. In order to solve this paradox, a vast body of literature has investigated modifications to the classical approach.

Concentrating mainly on the Prisoner's Dilemma (PD) and the Iterated Prisoner's Dilemma (IPD), we have proposed different mechanisms that can be implemented into the interaction of agents, to facilitate the transition from defection to cooperation. Some of them are counterintuitive, such as providing less information, increasing individual diversity or allowing for migration. Their effect is analysed by means of multi-agent models, in which N-person games are decomposed into simultaneous 2-person games. As in evolutionary game theory, agents can adopt better strategies after each generation. These models are analysed by means of computer simulations and mathematical analyses.

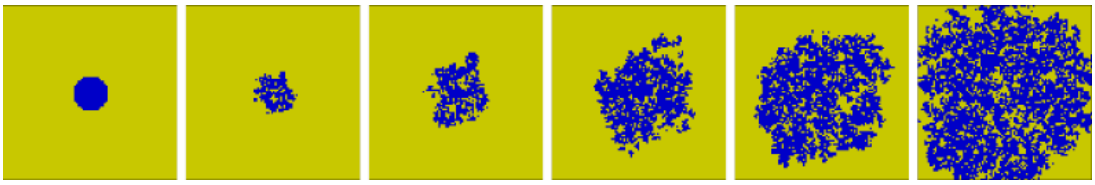


Figure 2.17: Time increases from left to right. Blue indicates cooperating nodes, yellow defecting nodes. As the time evolves, more nodes start to cooperate and finally global cooperation breaks out

Selected Publications:

[35] Jan Lorenz, Fabian Paetzel, and Frank Schweitzer. "Redistribution spurs growth by using a portfolio effect on risky human capital". *PLOS ONE*, **8**, e54904 (2013).

[46] Frank Schweitzer, Pavlin Mavrodiev, and Claudio Juan Tessone. "How can social herding enhance cooperation?" *Advances in Complex Systems (ACS)*, **16**, 22 (2013).

[51] Claudio Juan Tessone, Anxo Sanchez, and Frank Schweitzer. "Diversity-induced resonance in the response to social norms". *Physical Review E*, **87**, 022803 (2013).

[75] Pavlin Mavrodiev, Claudio Juan Tessone, and Frank Schweitzer. "Effects of social influence on the wisdom of crowds". In: *Proceedings of Collective Intelligence 2012*. 2012.

[83] Frank Schweitzer and Laxmidhar Behera. "Optimal migration promotes the outbreak of cooperation in heterogeneous populations". *Advances in Complex Systems (ACS)*, **15**, 1250059 (2012).

[127] Victor M. Eguiluz and Claudio Juan Tessone. "Critical behaviour in an evolutionary ultimatum game with social structure". *Advances in Complex Systems (ACS)*, **12**, 221–232 (2009).

2.3 Economic Networks

While the conceptual framework of 'complex networks' is one of the fundamental methods used in our research, its application to *economic systems* remains a challenging task. How can we reasonably represent economic systems consisting of agents with specific types of economic relations such as ownership, money borrowing and lending, or asset liabilities in terms complex networks? And what can learn from such a network representation? Can we use it to measure systemic risk in financial systems or even make substantiated statements about appropriate mitigation strategies?

The most common approach to study economic systems from a network perspective aggregates different types of economic relations in terms of undirected, unweighted links which do not change over time. While this already oversimplifies the problem at hand, nodes are moreover often assumed to be *equal*, even though in reality they represent for example firms or investors of different size, capital stock, etc., which in turn may affect their role in the network. Finally links between such agents are not established randomly, but are based on strategic decisions. Carefully considering these important aspects, in our research on *economic networks* we study how new systemic features, such as *systemic risk*, emerge in large economic systems which exceed the locally bounded views agents.

Our research on economic networks generally encompasses two different approaches: On the one hand, we take a *macroscopic perspective* on large economic networks which allows us to identify their structure with respect to different types of nodes as well as weighted, directed, and time-varying links. This has allowed us to study, for example, how networks of ownership relations change over time and what implications this network structure has for the distribution of power and control. On the other hand, we also take a *microscopic perspective* on 'individual' agents, modelling their strategies to increase their individual utility resulting, e.g., from a knowledge exchange with other agents or the diversification of risk. The latter approach allows us to understand the resulting structure of socio-economic systems, such as R&D networks, in a bottom-up fashion, while the former tells us more about the real structure of economic networks and the key players therein.

In this way, our approach comprises both an in-depth analysis of large data sets and the formal modelling of network dynamics in a mathematical framework, providing insights into collective phenomena emerging from the behaviour of economic agents.

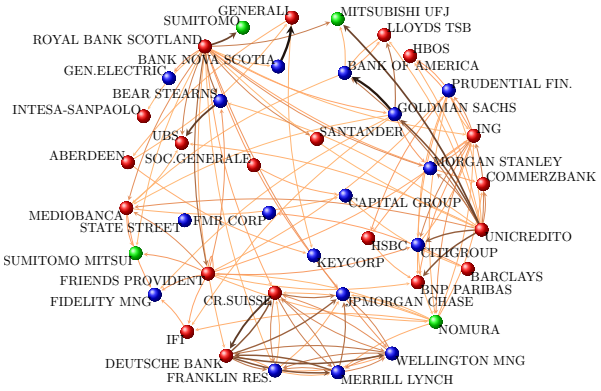


Figure 2.18: Subset of an international financial network. Nodes represent *major* financial institutions, links the strongest existing relations, node colors different geographic areas.

Selected Publications:

[140] Frank Schweitzer, Giorgio Fagiolo, Didier Sornette, Fernando Vega-Redondo, Alessandro Vespignani, and Douglas R. White. "Economic networks: The new challenges". *Science (New York, N.Y.)* **325**, 422–425 (2009).

[141] Frank Schweitzer, Giorgio Fagiolo, Didier Sornette, Fernando Vega-Redondo, and Douglas R. White. "Economic Networks: What do we know and what do we need to know?" *Advances in Complex Systems*, **12**, 407–422 (2009).

2.3.1 R&D Networks

Research and Development (R&D) networks are a specific instance of collaboration networks, one of our overarching research areas. Here, the nodes of the network represent firms and links represent their R&D collaborations, which are usually explicitly announced. Firms can enter or leave the network, and links only have a finite life time, during which firms exchange knowledge.

Within this line of research we address the full range of research questions from strategic network formation to large-scale temporal data analysis. Specifically, we investigate the conditions for stability (resulting from individual optimisation) and efficiency (resulting from aggregated optimisation).

Differently from simplistic models, we assume that firms strategically form and terminate links. On the aggregated level, R&D networks follow a characteristic life cycle dynamics, triggered by innovation booms in specific sectors (e.g. biotech, computer hardware) and their subsequent decline after a few years. Our models are able to predict such structural changes and map them with surprising precision to the conditions of the rise and fall of alliances, on the firm level.

Eventually, this research also enhances our activities on two other research topics, predicting success from dynamical interaction (here, success is measured by the number of patents) and mechanism design to enhance cooperation. In essence, firms in research alliances are not only collaborators, they are also cooperators in the first place. The chances of success of R&D alliances can be only improved, but not guaranteed.

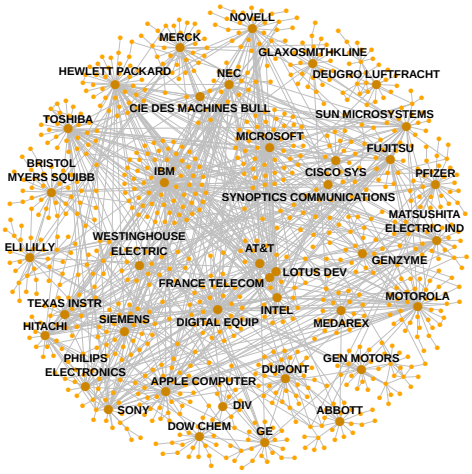


Figure 2.19: Visual representation of the global R&D network obtained from the Thomson Reuters SDC alliance data set. Every node represents a firm and every link an R&D alliance. We depict the 30 main firms and their respective circles of influence.

Selected Publications:

[5] Antonios Garas, Mario Vincenzo Tomasello, and Frank Schweitzer. "Selection rules in alliance formation: Strategic decisions or abundance of choice?" *arXiv:1403.3298* (2014).

[18] Mario Vincenzo Tomasello, Moritz Müller, and Frank Schweitzer. "Innovator Networks". In: *Encyclopedia of Social Network Analysis and Mining*. New York, NY: Springer New York, 2014, pp. 737–742.

[19] Mario Vincenzo Tomasello, Nicola Perra, Claudio Juan Tessone, Márton Karsai, and Frank Schweitzer. "The Role of Endogenous and Exogenous Mechanisms in the Formation of R&D Networks". *Scientific Reports*, **4**, 5679 (2014).

[53] Mario Vincenzo Tomasello, Mauro Napoletano, Antonios Garas, and Frank Schweitzer. "The Rise and Fall of R&D Networks". *arXiv:1304.3623*, 33 (2013).

[74] Michael D Konig, Stefano Battiston, Mauro Napoletano, and Frank Schweitzer. "The efficiency and stability of R&D networks". *Games and Economic Behavior*. 2nd ser., **75**, 694–713 (2012).

[101] Michael D Koenig, Stefano Battiston, Mauro Napoletano, and Frank Schweitzer. "Recombinant knowledge and the evolution of innovation networks". *Journal of Economic Behavior & Organization*, **79**, 145–164 (2011).

[133] Michael D Koenig, Stefano Battiston, and Frank Schweitzer. "Modeling evolving innovation networks". In: *Innovation Networks . New Approaches in Modelling and Analyzing*. Understanding Complex Systems. Berlin, Heidelberg: Springer Berlin Heidelberg, 2009. Chap. 8, pp. 187–267.

2.3.2 Financial Networks

After the economic downturn of 2008 the interest in research on financial networks vastly increased. Behaviour and stability of financial institutions are highly correlated and thus applying the complex networks perspective can give unique insights on financial networks.

Firms or stocks can be represented by nodes, economical behaviour is represented by links. Analysing network properties provides conclusions that other fields of research cannot provide. Moreover, the interdependence of stock prices can be easily modelled through agents having ties of different strength.

One of the outcomes of this research line is the definition of a novel centrality measure, the "Debt Rank". It is able to measure systemic impact in financial networks by combining financial and structural information about firms.

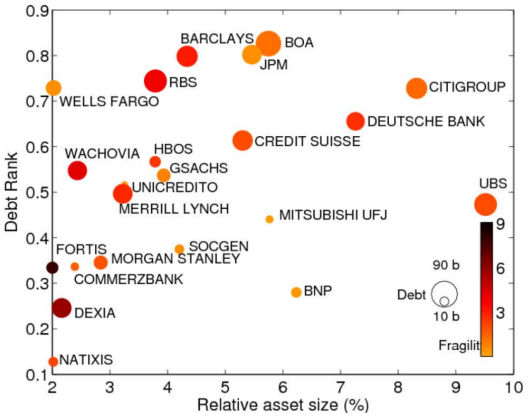


Figure 2.20: "Debt Rank" displayed as a function of the companies' asset size, measured as a fraction (in %) of the total asset size in the network. The size of each bubble is proportional to the outstanding debt of the institution while the color reflects its fragility, defined as the ratio of debt over market capitalisation.

Selected Publications:

[24] Stefano Battiston, Guido Caldarelli, Co - Pierre Georg, Robert May, and Joseph Stiglitz. "Complex derivatives". *Nature Physics*, **9**, 123–125 (2013).

[26] Guido Caldarelli, Alessandro Chessa, Fabio Pammolli, Andrea Gabrielli, and Michelangelo Puliga. "Reconstructing a credit network". *Nature Physics*, **9**, 125–126 (2013).

[27] Danilo Delpini, Stefano Battiston, Massimo Riccaboni, Giampaolo Gabbi, Fabio Pammolli, and Guido Caldarelli. "Evolution of controllability in interbank networks". *Scientific reports*, **3**, 1626 (2013).

[28] Marco Galbiati, Danilo Delpini, and Stefano Battiston. "The power to control". *Nature Physics*, **9**, 126–128 (2013).

[34] Rahul Kaushik and Stefano Battiston. "Credit default swaps drawup networks: Too interconnected to be stable?" *PloS one*, **8**, e61815 (2013).

[49] Paolo Tasca and Stefano Battiston. "On the Benefits of Risk Diversification: The Individual and Social Perspectives". *Submitted* (2013).

[61] Stefano Battiston, Michelangelo Puliga, Rahul Kaushik, Paolo Tasca, and Guido Caldarelli. "DebtRank: Too Central to Fail? Financial Networks, the FED and Systemic Risk". *Scientific Reports*, **2**, 541 (2012).

[63] S Cincotti, Didier Sornette, P Treleaven, Stefano Battiston, Guido Caldarelli, C Hommes, and A Kirman. "An economic and financial exploratory". *The European Physical Journal Special Topics*, **214**, 361–400 (2012).

[94] Ilaria Bordino, Stefano Battiston, Guido Caldarelli, Matthieu Cristelli, Antti Ukkonen, and Ingmar Weber. "Web search queries can predict stock market volumes". *PLOS-ONE*, **7**, e40014 (2011).

[99] James B. Glattfelder, A. Dupuis, and R. B. Olsen. "Patterns in high-frequency fx data : Discovery of 12 empirical scaling laws". *Quantitative Finance*, **11**, 599–614 (2011).

[116] Stefano Battiston, James B. Glattfelder, Diego Garlaschelli, F Lillo, and Guido Caldarelli. "The Structure of Financial Networks". *Network Science*, 131–163 (2010).

2.3.3 Ownership Networks

Ownership networks represent a special type of economic networks where directed links between agents represent possession, interest and eventually control. The nodes of the network are stakeholders or companies.

This field of research poses several challenges, since such ownership links stretch out internationally over the whole world, while available data is mostly limited to country-level. One of our goals is to map these links in a global manner, to accumulate global power based in nation-wide information.

In our investigation of the international ownership network we also compute the control accumulated by each global player. We find that transnational corporations form a giant bow-tie structure and that a large portion of control flows to a small tightly-knit core of financial institutions. This core can be seen as an economic "super-entity", the emergence of which raises important issues both for economists and policy makers.

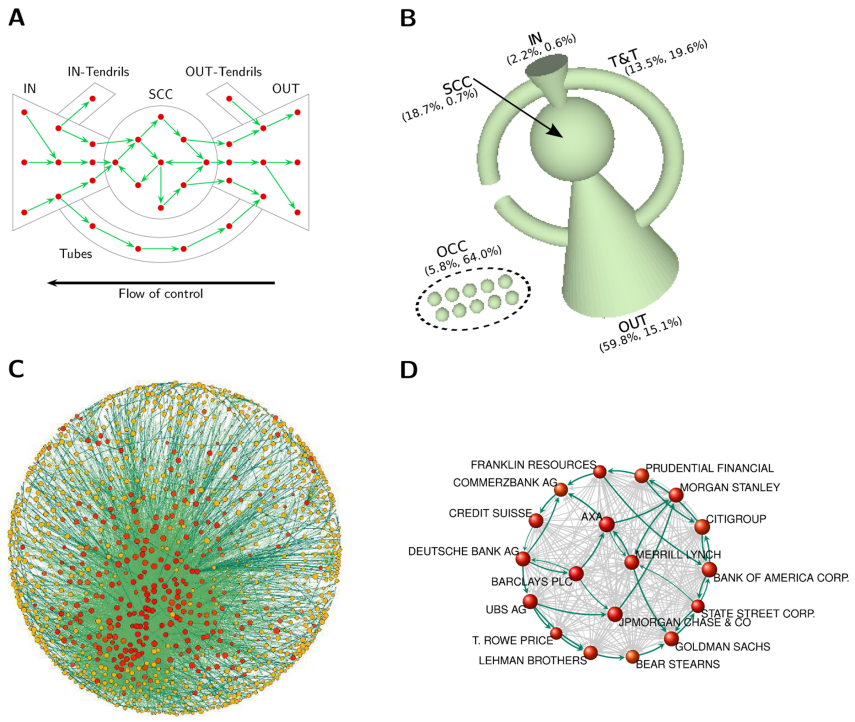


Figure 2.21: Representation of a typical bow-tie network architecture (A), and of the structure of a real ownership network (B). The complete empirical ownership network is depicted in (C), while the core nodes are highlighted in (D) together with some cycles.

Selected Publications:

[112] Stefania Vitali and Stefano Battiston. "Geography versus topology in the european ownership network". *New Journal of Physics*, **13**, 63021 (2011).

[113] Stefania Vitali, James B. Glattfelder, and Stefano Battiston. "The network of global corporate control". *PLoS-ONE*, **6**, 1–6 (2011).

[130] James B. Glattfelder and Stefano Battiston. "Backbone of complex networks of corporations: The flow of control". *Physical Review E*, **80**, 36104 (2009).

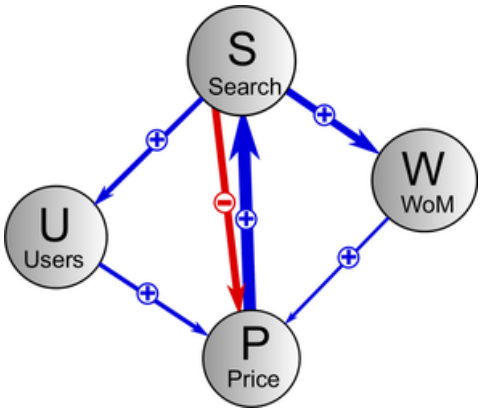
[162] Stefano Battiston, Joao F. Rodrigues, and Hamza Zeytinoglu. "The Network of Inter-regional Direct Investment Stocks across Europe". *Advances in Complex Systems (ACS)*, **10**, 29–51 (2007).

2.4 Response in Media

An evident sign of the importance of the research at the Chair of Systems Design is the response in the media. Outside scientific channels too, our papers find their way and the redistribution of our papers via these channels constitutes important feedback for us.

Response in media is sorted here by language, not country. The primary language is English, but since our chair is situated in the German-speaking part of Switzerland, German is also common, either for Swiss media or German media. French and Italian response also originates from the French- and Italian-speaking parts of Switzerland, not only from France and Italy.

The digital traces of bubbles: Feedback cycles between socio-economic signals in the Bitcoin economy
Garcia, David; Tessone, Claudio Juan; Mavrodiev, Pavlin; Perony, Nicolas Journal of the Royal Society Interface, pages: 20140623, volume: 11, number: 99, 2014



English	German
ETH News	ETH News
BBC News	Tages Anzeiger
Yahoo Finance	20 Minuten
Phys.org	Der Bund
Coindesk	
GigaOm	
Red Orbit	

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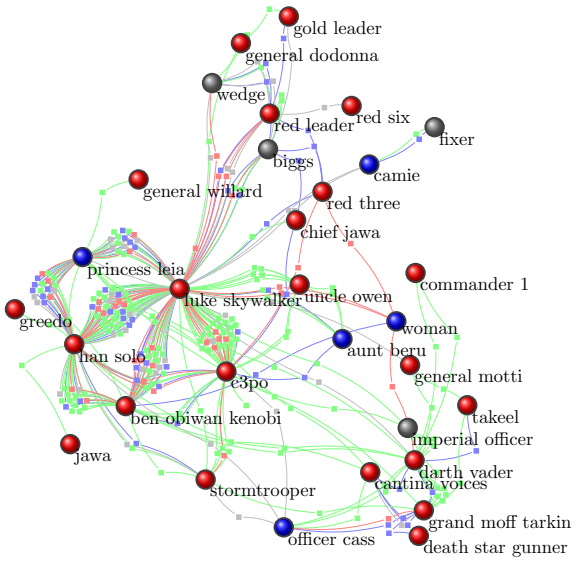
The Daily Dot	**Spanish**
Science Daily	Tendencias21
Science Codex	
Value Walk	**Dutch**
First Post	De Standaard
Computer Business Review	
New India Express	
GizBot	



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Netzwoche
Stuttgarter Zeitung
UZH News
Dradio Wissen
Hamburger Abendblatt
20 Minuten
ETH Life
SchweizerBauer
MyScience
BZ Berlin

Other
Scientias.nl (Dutch)
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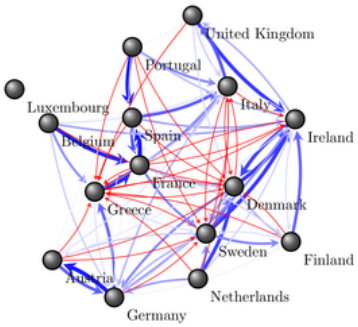
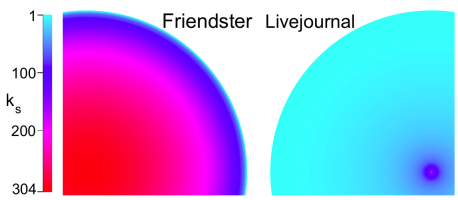


Social resilience in online communities: The autopsy of Friendster
Garcia, David; Mavrodiev, Pavlin; Schweitzer, Frank, 1st ACM Conference in Online Social Networks (COSN'13), 2013



English
ScienceNews
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Slate.com
The Connectivist
GIZMODO
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DW top story
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The Japan Times
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Sify
IndiaTalkies
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KnowlegeWorldCenter
Bukisa
ScienceBlog
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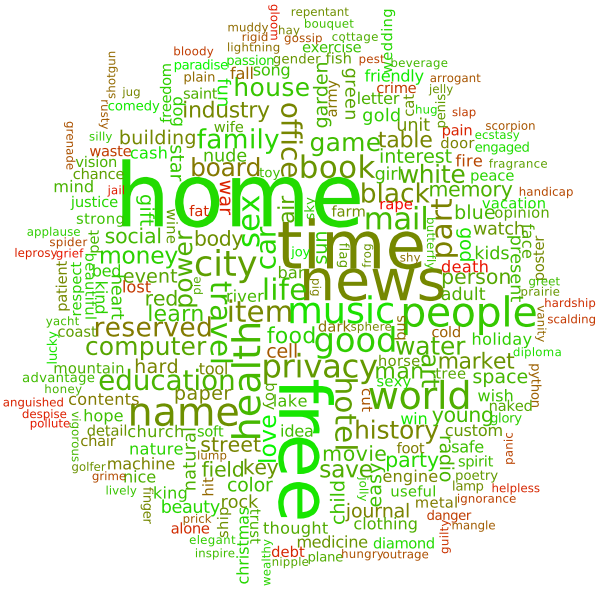

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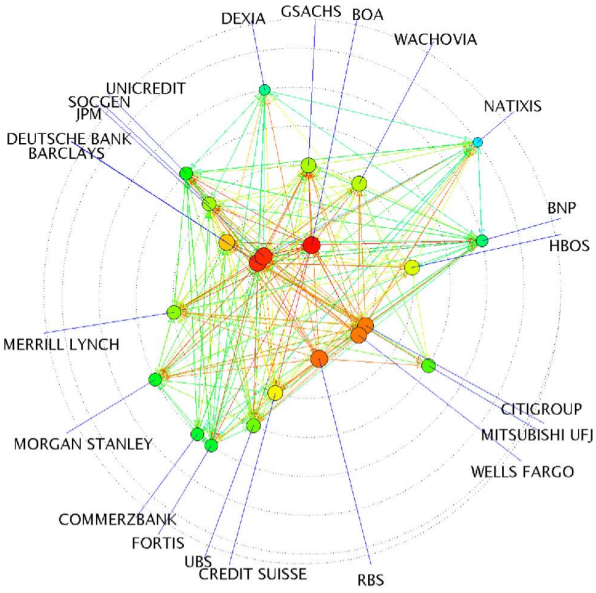

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Business Insider
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Ats
laRegioneTicino

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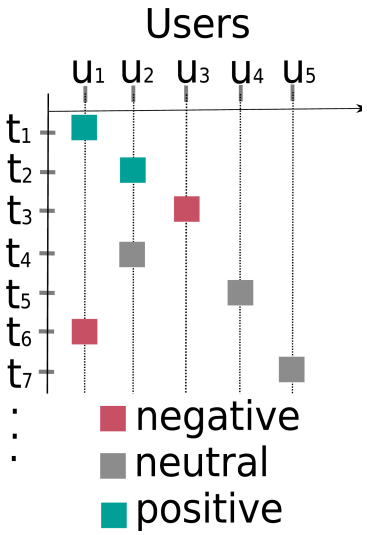
20minutes



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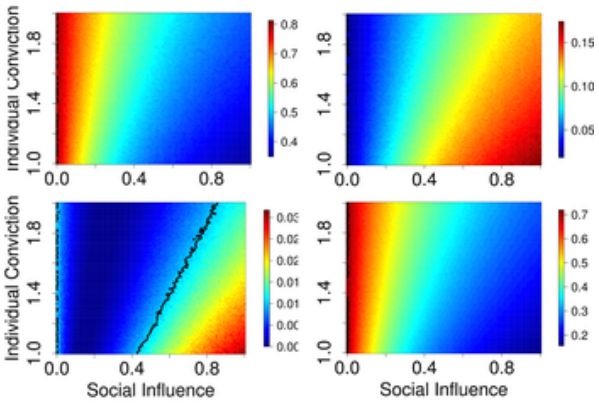

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The network of global corporate control
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The Huffington Post
The Daily Mail
RT
Leonardo TV
ScienceNews

German
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Badische Zeitung
Handelsblatt
The Intelligence
Der Sonntag
Tagesanzeiger
Welt Online
Frankfurter Rundschau
Südkurier

Italian
BancaFinanza
Repubblica
Il Fatto Quotidiano

Other
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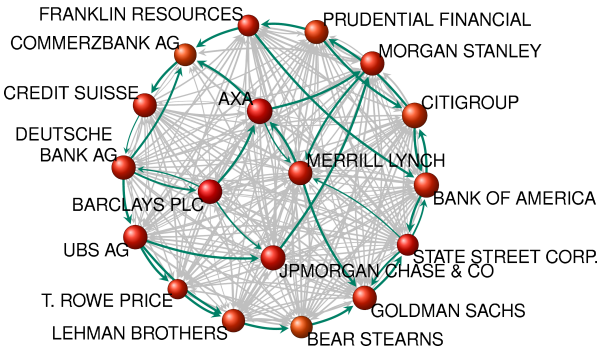
Vanguardia (Spanish)
Trud (Bulgarian)



3 Publications

Publications are probably the most important indicator of successful research activities – although not the only one. They could be judged in several ways, by quantity (sheer number of papers), by quality (rating of the journal), by impact (number of citations obtained). None of these figures provides an objective insight in the achievements of the past ten years. Because we started with a completely new research agenda rather than continuing previous activities, it is obvious that in early years the publications were quite sparse. It took some time before the first results were obtained, and even longer before they were developed towards a level that matches the quality standards of top journals. On another note, interdisciplinary research cannot be easily placed in major journals which sometimes have a rather narrow focus. In this respect, we first had to adapt to the standards of different scientific communities, ranging from economics and the social sciences to computer science, statistical physics and behavioural ecology.

As the list of publications below demonstrates, there is a broad spectrum of papers, mostly in reviewed journals and proceedings of competitive conferences, which encompasses our diverse research topics. The increasing number of publication shows that we are advancing in most of these areas.

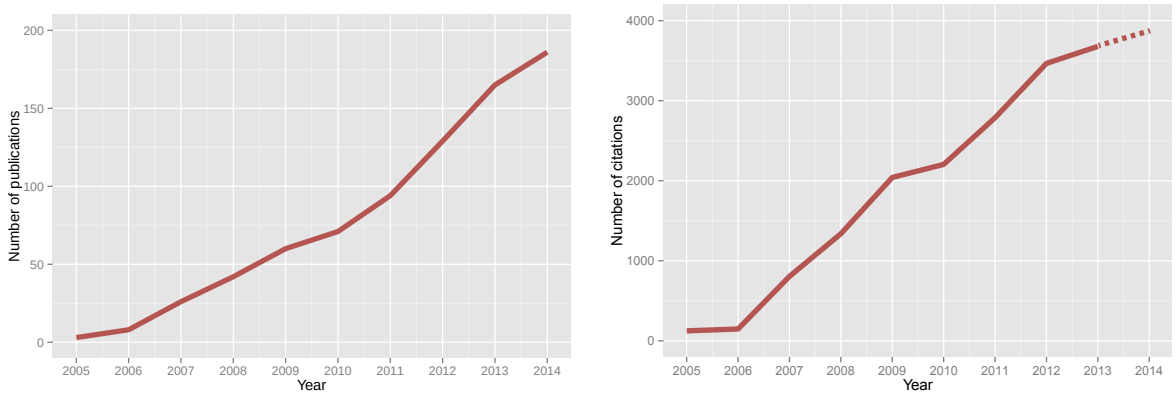


Figure 3.1: Left: Cumulative number of publications published by the Chair of Systems Design after 2005. Right: Cumulative number of citations that (only) these publications acquired after 2005.

List of Publications:

[1] Adiya Abisheva, Venkata Rama Kiran Garimella, David Garcia, and Ingmar Weber. "Who watches (and shares) what on YouTube? And when? Using Twitter to understand YouTube viewership". In: *WSDM '14 Proceedings of the 7th ACM international conference on Web search and data mining*. New York, NY, USA, 2014, pp. 593–602.

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4 Talks

In addition to publications, scientific presentations are an important way of disseminating our achievements. In fact, talks are quite an efficient way of promoting our research activities. Invited talks, in particular, and talks selected for highly competitive conferences reflect to what extent our research is recognised by the scientific community.

Looking back on the previous years, we find that the number of talks given has steadily increased. This indicates both that we have more results to disseminate and that our contributions are increasingly recognised by the scientific community.

This list does not include presentations given during internal research meeting. It is worth noting that the range of talks encompasses almost all of our research fields, and at various levels, from local seminar talks, to competitive conferences, to invited talks and keynote presentations at major conferences. So, we can see this as a good indicator that we have reached some public attention for our research.

Figure 4.1 shows that in the past 5 years, we have increased our activity in talks.

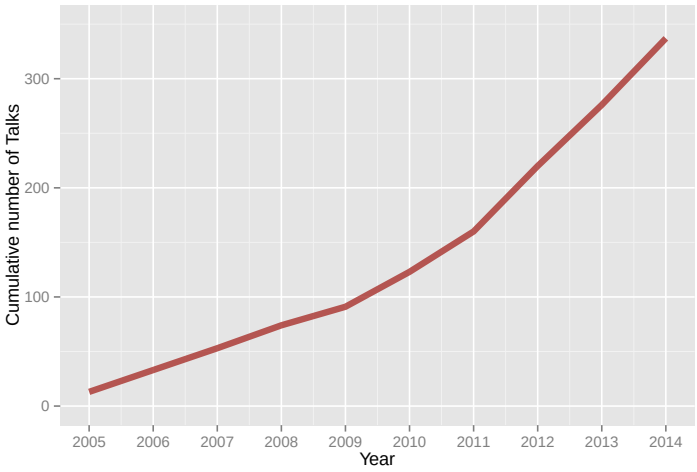


Figure 4.1: The activity of the chair in promoting our research activities through talks. For the year 2014, the number of talks was estimated.

2014

336. Schweitzer, Frank: **Modeling emotional agents: Data, Interaction, Simulation**, GESIS - Leibniz-Institut für Sozialwissenschaften Köln, December 01, 2014
335. Schweitzer, Frank: **How we collaborate - A complex network approach**, Second Annual KnowEscape Conference, Thessaloniki, Greece, November 24 – 26, 2014
334. Perony, Nicolas: **Reality mining of collective socio-spatial processes**, Social Computing Group, Idiap Research Institute, Martigny, Switzerland, November 07, 2014
333. Scholtes, Ingo: **Modeling Time-Varying Complex Networks: The Importance of Non-Markovianity**, Zürich Seminar on Applied Statistics, October 23, 2014
332. Perony, Nicolas: **Reality mining of collective socio-spatial processes**, Wearable Computing Lab, ETH Zürich, Zürich, Switzerland, October 20, 2014
331. Garcia, David: **Computational social science: Studying and modelling humans through their digital traces**, Bell Labs Dublin, October 03, 2014
330. Schweitzer, Frank: **Introduction to systems thinking and dynamics**, The Club of Rome, Impact Hub Zürich, October 02, 2014
329. Garcia, David: **Online Privacy as a Collective Phenomenon** , ACM Conference on Online Social Networks (COSN'14), October 01 – 02, 2014
328. Garcia, David: **Network polarization in online politics participatory media**, Internet, Policy & Politics Conference, University of Oxford, Oxford, UK, September 26, 2014
327. Garas, Antonios: **Cities and economic activities: a mutualistic dependence**, 3rd International Workshop on Citizen Networks - CitiNet 25th September 2014, Lucca Italy, September 25, 2014
326. Garas, Antonios: **Centrality-based career paths, success, and social influence**, Quantifying Success 2.0 at ECCS 2014, Lucca, Italy, September 24, 2014
325. Garas, Antonios: **Predicting Scientific Success Based on Co-authorship Networks**, ECCS 2014, Lucca, Italy, September 23, 2014
324. Wider, Nicolas: **Diffusion in Non-Markovian Temporal Networks: Slow-Down or Speed-Up?**, European Conference on Complex Systems (ECCS), Lucca, Italy, September 23, 2014
323. Wider, Nicolas: **The influence of interconnectivity on diffusion dynamics**, European Conference on Complex Systems (ECCS), Lucca, Italy, September 22, 2014
322. Scholtes, Ingo: **The Social Dimension of Information Ranking**, Big Data und Gesellschaft: interdisziplinäre Analysen, Stuttgart, Germany, September 22, 2014
321. Scholtes, Ingo: **Big Data and Socio-Technical Systems**, Keynote at SASOST Workshop, Imperial College London, UK, September 12, 2014
320. Scholtes, Ingo: **Complex Networks: A Tutorial**, Tutorial Lectures at IEEE SASO 2014, Imperial College London, UK, September 08, 2014
319. Garcia, David: **Political activity and network polarization in online participatory media**, GESIS, Cologne, September 08, 2014
318. Garas, Antonios: **Indicators for sustainable development in urban areas**, Invited talk at the EU-Japan Workshop 2014: "Exploring socioeconomic-technological-environmental systems across the boundary", Kyoto University, Japan, September 05, 2014
317. Perony, Nicolas: **Why Did the Meerkat Cross the Road? Adaptation of Phylogenetically-Old Behaviours to Modern Threats**, 51st Annual Conference of the Animal Behavior Society, Princeton University, Princeton NJ, USA, August 13, 2014

316. Perony, Nicolas: **Reality mining of collective socio-spatial processes**, MIT Media Lab, Cambridge MA, USA, August 07, 2014
315. Perony, Nicolas: **Bridging the gap between social and spatial complexity in the study of animal behaviour**, XVth Congress of the International Society for Behavioral Ecology (ISBE 2014), New York NY, USA, August 01, 2014
314. Tomasello, Mario Vincenzo: **The Rise and Fall of R&D Networks**, International Schumpeter Society Conference, Jena, Germany, July 30, 2014
313. Perony, Nicolas: **Reality mining of collective socio-spatial processes**, Leibniz Institute of Freshwater Ecology and Inland Fisheries, Berlin, Germany, June 24, 2014
312. Tomasello, Mario Vincenzo: **The Rise and Fall of R&D Networks**, DRUID Society Conference 2014 on entrepreneurship, organizationm innovation, Copenhagen, Denmark, June 17, 2014
311. Perony, Nicolas: **An integrated approach to dispersal in animal groups**, Laboratory of Movement Analysis and Measurement, EPF Lausanne, Lausanne, Switzerland, June 10, 2014
310. Tessone, Claudio Juan: **Bitcoins: the transition towards centralisation of a decentralised economy**, International School and Conference on Network Science (NetSci 2014), Berkeley, California CA, USA, June 06, 2014
309. Scholtes, Ingo: **Diffusion in Non-Markovian Temporal Networks: Slow-Down or Speed-Up?**, International School and Conference on Network Science (NetSci 2014), Berkeley, California CA, USA, June 06, 2014
308. Garcia, David: **Quantitative Analysis and Modeling of Collective Emotions in Online Communities**, Reading Emotions Conference, University Zürich, Zürich, Switzerland, June 06, 2014
307. Garas, Antonios: **Weighting the weights: k-shell decomposition and applications to weighted economic networks**, International School and Conference on Network Science (NetSci 2014), Berkeley, California CA, USA, June 05, 2014
306. Schweitzer, Frank: **How we collaborate - A complex network approach**, International School and Conference on Network Science (NetSci 2014), Berkeley, California CA, USA, June 04, 2014
305. Schweitzer, Frank: **Beyond aggregated networks - What we got wrong and will have to get right**, Satellite Workshop: Higher-Order Models in Network Science, NetSci 2014, Berkeley CA, USA, June 03, 2014
304. Scholtes, Ingo: **Higher-Order Aggregate Representations of Temporal Networks**, NetSci Satellite "Higher-Order Models in Network Science", Berkeley CA, USA, June 03, 2014
303. Schweitzer, Frank: **Analysing temporal bipartite social networks**, Satellite Workshop: Multiple Network Modeling, Analysis and Mining, NetSci 2014, Berkeley CA, USA, June 02, 2014
302. Tessone, Claudio Juan: **Collective behaviour induced by network volatility**, International School and Conference on Network Science (NetSci 2014), Berkeley, California CA, USA, June 02, 2014
301. Garcia, David: **Gender Asymmetries in Reality and Fiction: The Bechdel Test of Social Media**, 8th International Conference on Weblogs and Social Media (ICWSM '14), University of Michigan, Ann Arbor, USA, June 02, 2014
300. Scholtes, Ingo: **Complex Structures and Collective Dynamics in Networked Systems: Foundations for Self-Adaptation and Self-Organization**, Summer School, KTH Royal Institute, Stockholm, Sweden, June 01 – 01, 2014

299. Schweitzer, Frank: **Modeling user behavior in online social network**, AI Seminar, Information Science Institute, University of Southern California, Marina del Rey CA, USA, May 27, 2014
298. Perony, Nicolas: **Reality mining of collective behavioural processes**, Collective Motion 2014 Meeting, Open Innovation House, Helsinki, Finland, May 27, 2014
297. Garcia, David: **Gender Asymmetries in Reality and Fiction**, ETH Science Slam, ETH Zürich, Zürich, Switzerland, May 22, 2014
296. Abisheva, Adiya: **On Swiss multi-party political system and polarization in Politnetz**, SKIN3 workshop, Budapest, Hungary, May 22 – 23, 2014
295. Garcia, David: **Political activity and polarization in Politnetz and Twitter**, Hanse-Wissenschaftskolleg Delmenhorst, Bremen, Germany, May 10, 2014
294. Schweitzer, Frank: **Success and failure - A complex network approach**, Institute for Theoretical Physics, Wroclaw University, Wroclaw, Poland, May 09, 2014
293. Garas, Antonios: **Alliance formation in R&D networks, and the role of geography**, COST IS1104 workshop "The Geography of Financial Networks", Aix-Marseille Université, Aix en Provence, France, May 02, 2014
292. Tessone, Claudio Juan: **Bitcoin bubbles: From social signals to centralisation in a decentralised economy**, Workshop on Big Data and Marketing, University Zürich, Zürich, Switzerland, April 28, 2014
291. Garcia, David: **Análisis de polarización, desigualdad y resiliencia social a través de huellas digitales**, Universidad Autónoma de Madrid, Madrid, Spain, April 25, 2014
290. Scholtes, Ingo: **Automated Software Re-modularization Based on Move Refactoring**, 13th International Conference on Modularity 2014, Lugano, Switzerland, April 22 – 25, 2014
289. Garcia, David: **Gender Asymmetries in Reality and Fiction**, Euraxess Roadshow Science Slam, ETH Zürich, Zürich, Switzerland, April 09, 2014
288. Scholtes, Ingo: **When your social position predicts your success: lessons from Open Source communities and citations**, Lorentz Centre Workshop Simulating the Social Processes of Science, Leiden, The Netherlands, April 09, 2014
287. Perony, Nicolas: **Merging global geographic and local social information: biological reality mining of behavioural processes**, Geographic Information Science Centre, University of Zürich, Zürich, Switzerland, April 08, 2014
286. Schweitzer, Frank: **Beyond simulating science - What do we learn from data? And how do we verify our models?**, Lorentz Centre Workshop Simulating the Social Processes of Science, Leiden, The Netherlands, April 07, 2014
285. Garcia, David: **Understanding Collective Emotions in Online Communities Through Agent-Based Modelling**, Consortium of European Research on Emotion Conference 2014 (CERE 2014), Humboldt University Berlin, Berlin, Germany, March 27 – 28, 2014
284. Schweitzer, Frank: **Predicting systemic risk - Cascading processes in complex networks**, Physikalisches Kolloquium, University of Basel, Basel, Switzerland, March 21, 2014
283. Schweitzer, Frank: **Making better use of online media for marketing - Collective emotions and social influence in product reviews**, Seminar: IT for Marketing Management, Zürich, Switzerland, March 19, 2014
282. Tomasello, Mario Vincenzo: **The Role of Endogenous and Exogenous Mechanisms in the Formation of R&D Networks**, OFCE - SKEMA Business School, Nice, France, March 19, 2014

281. Scholtes, Ingo: **Categorizing Bugs with Social Networks: A Case Study on Four Open Source Software Communities**, Software Engineering Conference (SE 2014), Kiel, Germany, February 27, 2014

280. Scholtes, Ingo: **Challenges and Research Directions for Self-optimisation, Organic and Autonomic Computing**, 2nd International Workshop on Self-optimisation in Organic and Autonomic Computing Systems (SAOS 2014), Lübeck, Germany, February 25, 2014

279. Abisheva, Adiya: **Who Watches (and Shares) What on YouTube? And When? Using Twitter to Understand YouTube Viewership**, 7th ACM International Conference on Web Search and Data Mining (WSDM '14), New York City NY, USA, February 24 – 28, 2014

278. Perony, Nicolas: **Biological reality mining for the behavioural sciences**, Institut Pluridisciplinaire Hubert Curien, CNRS, Strasbourg, France, January 29, 2014

2013

277. Zanetti, Marcelo Serrano: **A Complex Systems Approach to Software Engineering**, Doctoral Defense, ETH Zürich, Switzerland, December 09, 2013

276. Schweitzer, Frank: **Utilizing Social Influence: Empirics and Modeling**, Research Seminar, Institute for Futures Studies, Stockholm, Sweden, December 06, 2013

275. Schweitzer, Frank: **Selbstorganisation und Evolution im Spiegel von Faust II**, Forschungskolloquium, Collegium Helveticum, Zürich, Switzerland, November 28, 2013

274. Schweitzer, Frank: **The Rise and Fall of collaborations: Insights from a large-scale analysis of R&D networks**, ESHIA Winter Workshop, Nanyang Technological University, Singapore, November 18 – 19, 2013

273. Scholtes, Ingo: **The Social Dimension of Collaborative Information Spaces**, First Annual KNOWeSCAPE Conference, Aalto University, Espoo, Finland, November 18 – 20, 2013

272. Schweitzer, Frank: **The Rise and Fall of collaborations: Insights from a large-scale analysis of R&D networks**, KAIST Globar Seminar, Department of Management Science, Korean Advanced Institute for Science and Technology (KAIST), Deajeon, Korea, November 14, 2013

271. Schweitzer, Frank: **Cascading process in complex networks: From systemic risk in banking networks to the collapse of Friendster**, Colloquium talk, Physics Department, Pohang University of Science and Technology (POSTECH), Pohang, Korea, November 13, 2013

270. Schweitzer, Frank: **Cascading process in complex networks: From systemic risk in banking networks to the collapse of Friendster**, Physics Department, Seoul National University, Seoul, Korea, November 11, 2013

269. Schweitzer, Frank: **Success and Failure: A Complex Network Perspective, Complexity Forum, Centre of Complexity Science**, University of Warwick, UK, October 23, 2013

268. Schweitzer, Frank: **Merging the Known and the Unknown - The Concept of Brownian Agents, Conference "Probabilistic Modeling in Science and Philosophy"**, Oeschger Centre for Climate Change Research, University of Bern, Switzerland, October 12 – 12, 2013

267. Garcia, David: **Measuring Social Resilience and Polarization Through Digital Traces: The Autopsy of Friendster and the Eurovision Crisis** , CCNR seminar, Northeastern University, Boston, October 09, 2013

266. Garcia, David: **Social resilience in online communities: The autopsy of Friendster** , 1st ACM Conference in Online Social Networks, Northeastern University, Boston, October 07, 2013
265. Garcia, David: **The Role of Emotions in Contributors Activity: A Case Study of the Gentoo Community**, Third International Conference on Social Computing and Its Applications, Karlsruhe, Germany, October 02, 2013
264. Perony, Nicolas: **The secret social lives of bats (and other interesting creatures)**, TEDxZürich 2013, Zürich, Switzerland, October 02, 2013
263. Scholtes, Ingo: **Force-based Layout of Non-Markovian Temporal Networks**, European Conference on Complex Systems (ECCS), Barcelona, Spain, September 20, 2013
262. Scholtes, Ingo: **Predicting success based on social network analysis**, Invited Talk at ECCS satellite workshop Quantifying Success, Barcelona, Spain, September 18, 2013
261. Garas, Antonios: **Betweenness Preference: Quantifying Correlations in the Topological Dynamics of Temporal Networks**, European Conference on Complex Systems (ECCS), Barcelona, Spain, September 17, 2013
260. Scholtes, Ingo: **The Social Dimension of Information Ranking**, Talk at Workshop Sozioinformatik 2013, University Koblenz-Landau, Koblenz, Germany, September 16, 2013
259. Scholtes, Ingo: **Complex Structures and Collective Dynamics in Networked Systems: Foundations for Self-Adaptation and Self-Organization**, Tutorial Lecture, IEEE International Conference on Self-Adaptive and Self-Organizing Systems (SASO 2013), Philadelphia, PA, USA, September 13, 2013
258. Schweitzer, Frank: **Success and Failure: A Complex Network Approach**, 2013 Chinese Conference 'Complex Networks', HangZhou, China, September 13 – 15, 2013
257. Scholtes, Ingo: **Self-Adaptation and Self-Organization in Socio-Technical Systems: A Tale of Two Layers**, Panel Talk at IEEE SASO 2013, Philadelphia, PA, USA, September 12, 2013
256. Scholtes, Ingo: **Topological and Temporal Complexity in Socio-Technical Systems**, Workshop on Self-Adaptive and Self-Organising in Socio-Technical Systems (SASO^{ST}) at IEEE SASO 2013, Philadelphia, PA, USA, September 09, 2013
255. Scholtes, Ingo: **Topological and Temporal Complexity in Socio-Technical Systems**, Invited Talk at University of Nebraska, Omaha, USA, September 05, 2013
254. Garcia, David: **The Digital Traces of Social Resilience**, Scientifica Zelt at Polyterrasse, Zürich, Switzerland, August 31, 2013
253. Perony, Nicolas: **Fission-fusion dynamics as a mechanism for group size regulation in Bechstein's bats**, Applied Zoology and Nature Conservation, University of Greifswald, Greifswald, Germany, August 30, 2013
252. Scholtes, Ingo: **Topological and Temporal Complexity in Socio-Technical Systems**, Invited Talk, Google Labs, Zürich, Switzerland, August 26, 2013
251. Perony, Nicolas: **At the crossroads between collective motion and social structure: What can we learn from a social perspective on movement ecology?**, Plenary talk, Max Planck Institute for Ornithology, Radolfzell, Germany, August 23, 2013
250. Battiston, Stefano: **Efficiency and Stability of R&D Networks**, Inside the Box of Technology, Santa Fe Institute, USA, August 07, 2013
249. Battiston, Stefano: **DebtRank: Too Central to Fail?**, Seminar - Central Bank of Austria, July 21, 2013
248. Scholtes, Ingo: **Modeling and Analysis of Complex Dynamic Networks: Why Should Computer Scientists Care?**, Invited Talk, Computer Science Colloquium, University of Augsburg, Germany, July 18, 2013

247. Battiston, Stefano: **DebtRank Analysis of Japanese Credit Network**, Financial Networks and Systemic Risk, Stat Phys Satellite Workshop 2013, Kyoto, Japan, July 17, 2013
246. Battiston, Stefano: **DebtRank, Systemic Risk and Future Challenges for the Social Scieces**, Horizons in Social Sciences 2013, IMT Lucca, Italy, July 11, 2013
245. Perony, Nicolas: **New telemetry tools for advanced studies of collective behaviour in the field**, Department of Zoology, University of Cambridge, Cambridge, UK, July 01, 2013
244. Schweitzer, Frank: **Predicting Success**, ISI Torino/CRT Foundation, Torino, Italy, June 28, 2013
243. Garcia, David: **Political Polarization in Participatory Media**, Non-Equilibrium Social Science Conference (NESS), ISCTE Lisbon University Institute, Lisbon, Portugal, June 11 – 12, 2013
242. Garcia, David: **Collective Emotions in the Internet Society**, Global Brain Institute - Vrije Universieit Brussel, Brussels, Belgium, June 07, 2013
241. Pfitzner, René: **Betweenness Preference: Quantifying Correlations in Temporal Networks**, The International Workshop and Conference on Network Science (NetSci), Copenhagen, Denmark, June 07, 2013
240. Scholtes, Ingo: **The Paths Not Taken: Aggregate Networks Considered Harmful!**, The International Workshop and Conference on Network Science (NetSci), Copenhagen, Denmark, June 07, 2013
239. Battiston, Stefano: **Introduction to Parallel Session on Financial Networks: Overview of FOC Activities**, The International Workshop and Conference on Network Science (NetSci), Copenhagen, Denmark, June 06, 2013
238. Scholtes, Ingo: **Social Dynamics in Open Source Communities: Research Methods, Applications and Perspectives**, The International Workshop and Conference on Network (NetSci) Science Satellite workshop Social Dynamics (SocialD), Copenhagen, Denmark, June 04, 2013
237. Scholtes, Ingo: **Modeling and Analysis of Complex Dynamic Networks: Why Should Computer Scientists Care?**, Invited Talk, The International Workshop and Conference on Network Science (NetSci) satellite workshop "Dynamic Information and Communication Networks", Copenhagen, Denmark, June 03, 2013
236. Garas, Antonios: **What do we lose when we aggregate temporal networks?**, The International Workshop and Conference on Network (NetSci) satellite workshop "Temporal and Dynamic Networks: From Data to Models", Copenhagen, Denmark, June 03, 2013
235. Zanetti, Marcelo Serrano: **The Rise and Fall of a central contributor: Dynamics of social organization and performance in the Gentoo community**, International Workshop on Cooperative and Human Aspects of Software Engineering (ICSE), CHASE, San Francisco, USA, May 25, 2013
234. Zanetti, Marcelo Serrano: **Categorizing Bugs with Social Networks: A Case Study on Four Open Source Software Communities**, International Conference on Software Engineering (ICSE) 2013, SEIP, San Franscico, USA, May 24, 2013
233. Perony, Nicolas: **Bridging the gap between social and spatial complexity in collective animal behaviour**, Invited seminar, CoSy seminar series, Department of Mathematics, Uppsala University, Uppsala, Sweden, May 15, 2013
232. Schweitzer, Frank: **Doppelte Botschaften - Wie Emotionen unsere Online-Mitteilungen beeinflussen**, Treffpunkt Science City: Kommunikation - Zeichen, Sprachen, Botschaften, Zürich, Switzerland, April 14, 2013

231. Scholtes, Ingo: **Structure and Dynamics of Collaborative Software Engineering: A Complex Networks Perspective**, Invited Talk at IBM Switzerland, Zürich, Switzerland, April 11, 2013
230. Schweitzer, Frank: **Modeling Systemic Risk**, Workshop on Complexity Models for Systemic Instabilities and Crises, Leiden, Netherlands, April 09, 2013
229. Pfitzner, René: **Temporal Networks and Information Spaces**, Data Archiving and Networked Services (DANS), The Hague, Netherlands, April 09, 2013
228. Tasca, Paolo: **Internal Seminar at Central Bank of Portugal: Systemic risk in Financial Networks**, Banco de Portugal, Lisbon, Portugal, March 30, 2013
227. Pfitzner, René: **Physics and the Information Society: Turning Big Data into Big Insight**, Topical Talk at Deutsche Physikalische Gesellschaft (DPG) Spring Meeting, Regensburg, Germany, March 14, 2013
226. Scholtes, Ingo: **Categorizing Bugs with Social Networks: A Case Study on Four Open Source Software Communities**, Invited Talk, Monte Verita Symposium "Augmenting Software Developer Support to Improve Productivity", Monte Verita, Ascona, Switzerland, March 11, 2013
225. Scholtes, Ingo: **Organic Computing: Research Perspectives**, Invited Talk at Organic Computing Perspectives Seminar, Hünfeld, Germany, March 06, 2013
224. Tomasello, Mario Vincenzo: **An activity-driven model for the growth of R&D networks**, Journal Club @ MOBS, Northeastern University, Boston, U.S.A., March 01, 2013
223. Battiston, Stefano: **DebtRank: Too Central to Fail?**, Deutsche Bundesbank Conference NetoNet, Frankfurt, February 13, 2013
222. Garcia, David: **A modelling framework for collective emotions in online communities**, Warsaw University of Technology, Warsaw, Poland, January 30, 2013
221. Schweitzer, Frank: **Collective Dynamics in Cyberspace: Chaos or Order?**, Physikalisches Kolloquium, University of Chemnitz, Chemnitz, Germany, January 09, 2013

2012

220. Perony, Nicolas: **Decoding social and spatial complexity in animal groups**, Invited seminar, Max Planck Institute for Ornithology, Radolfzell, Germany, December 07, 2012
219. Scholtes, Ingo: **Vom Programmierer zum Team, vom Team zur Community - Perspektiven des Social Software Engineering**, Invited Talk at DATEV TrendScout Workshop, Nürnberg, Germany, November 27, 2012
218. Schweitzer, Frank: **Model validation for multilevel economic networks**, Foundational Research on Multilevel Complex Networks and Systems (MULTIPLEX) Kickoff Meeting, Lucca, Italy, November 19, 2012
217. Zanetti, Marcelo Serrano: **Empirical Software Engineering: Complexity Matters**, IBM DeveloperWorks Day, IBM Forum, Zürich, Switzerland, November 14, 2012
216. Perony, Nicolas: **Leadership and information transfer in moving animal groups**, Invited lecture, Collective Motion 2012 meeting at the Center for Interdisciplinary Research, Bielefeld, Germany, November 09, 2012
215. Battiston, Stefano: **DebtRank: Too Central to Fail? Financial Networks, the FED and Systemic Risk**, 6th Annual Quant Invest Congress, Paris, France, November 06, 2012
214. Garcia, David: **Political Polarization and Popularity in Online Participatory Media: An Integrated Approach, Workshop on Politic, Elections, and Data**, 21st ACM International Conference on Information and Knowledge Management (CIKM'12), Maui, Hawaii, USA, November 02, 2012

213. Garcia, David: **Modeling Online Collective Emotions: Workshop on Data-driven User Behavioral Modelling and Mining from Social Media**, 21st ACM International Conference on Information and Knowledge Management (CIKM'12) Maui, Hawaii, USA, October 29, 2012
212. Battiston, Stefano: **The architecture of the global corporate control network, Workshop on the Crisis of Financialized Capital**, University of Toulouse, Toulouse, France, October 24 – 25, 2012
211. Zanetti, Marcelo Serrano: **A Quantitative Study of Social Organisation in Open Source Software Communities**, Imperial College Computing Student Workshop (ICCSW), London, United Kingdom, September 27, 2012
210. Battiston, Stefano: **DebtRank: Too Central to Fail? Financial Networks, the FED and Systemic Risk, Workshop on Global Systems and Networks of Networks**, Madrid, Spain, September 27, 2012
209. Garcia, David: **Measuring the dynamics of individual emotions under online interaction through subjective and physiological responses**, Society for Psychophysiological Research (SPR) 52nd annual meeting, New Orleans, Lousiana, USA, September 19 – 23, 2012
208. Pfitzner, René: **Quantifying Correlations in the Topological Dynamics of Temporal Networks**, Institute for Scientific Interchange (ISI), Torino, Italy, September 18, 2012
207. Perony, Nicolas: **On the interface between movement and sociality in animal behaviour (and what lies on either side)**, Invited seminar, Santa Fe Institute, Santa Fe NM, USA, September 13, 2012
206. Guerra, Beniamino: **How Big is too big? Critical Shocks for Systemic Failure Cascades**, Latsis Symposium, ETH Zürich, Zürich, Switzerland, September 11 – 14, 2012
205. Tomasello, Mario Vincenzo: **Network dynamics and the creation of knowledge in R&D networks**, Latsis Symposium, ETH Zürich, Zürich, Switzerland, September 11 – 14, 2012
204. Tasca, Paolo: **The Matrix of Market Procyclicality and Systemic Risk**, Latsis Symposium, ETH Zürich, Zürich, Switzerland, September 11 – 14, 2012
203. Tomasello, Mario Vincenzo: **The Rise and Fall of R&D networks across industries**, Latsis Symposium, ETH Zürich, Zürich, Switzerland, September 11 – 14, 2012
202. Garcia, David: **Information content and emotional expression: positive words carry less information**, European Conference on Complex Systems (ECCS'12), Brussels, Belgium, September 07, 2012
201. Tomasello, Mario Vincenzo: **The evolution of R&D networks across industries**, European Conference on Complex Systems (ECCS'12), Brussels, Belgium, September 06, 2012
200. Perony, Nicolas: **A quantitative look at social structure and group decision making in Bechstein's bats**, Applied Zoology and Nature Conservation, University of Greifswald, Greifswald, Germany, September 05, 2012
199. Garcia, David: **Analysing cultural affinity through the Eurovision Song Contest. Workshop in Cultural and opinion dynamics: Modeling, Experiments and Challenges for the future**, European Conference on Complex Systems (ECCS'12), Brussels, Belgium, September 05, 2012
198. Mavrodiev, Pavlin: **Quantitative analysis of roosting decisions in bats**, Applied Zoology and Nature Conservation, University of Greifswald, Greifswald, Germany, September 05, 2012

197. Zanetti, Marcelo Serrano: **Sustainable Network Growth Based on Modular Structures**, European Conference on Complex Systems (ECCS'12), Brussels, Belgium, September 04, 2012
196. Tomasello, Mario Vincenzo: **Network dynamics and the creation of knowledge in R&D networks** , European Conference on Complex Systems (ECCS'12), Brussels, Belgium, September 03, 2012
195. Perony, Nicolas: **On fission-fusion dynamics and the establishment of complex social structures**, International Behavioral Ecology Congress (ISBE 2012), Lund University, Lund, Sweden, August 16, 2012
194. Perony, Nicolas: **"Take me to your leader!": Inferring leadership in animal groups on the move**, Artificial Life 13, Michigan State University, East Lansing MI, USA, July 20, 2012
193. Schweitzer, Frank: **Systemic Risk in Economic and Financial Networks**, COST MP0801 Annual Meeting, National University of Ireland, Galway, Ireland, July 11 – 13, 2012
192. Schweitzer, Frank: **Can we design social herding to enhance cooperation?**, ETH Zürich, Zürich, Switzerland, July 02 – 04, 2012
191. Perony, Nicolas: **Different approaches to leadership in meerkat groups**, Department of Zoology, University of Cambridge, Cambridge, UK, July 02, 2012
190. Scholtes, Ingo: **A Tunable Mechanism for Identifying Trusted Nodes in Large Scale Distributed Networks**, 11th IEEE International Conference on Trust, Security and Privacy in Computing and Communications (TrustCom-2012), Liverpool, UK, June 25 – 27, 2012
189. Tomasello, Mario Vincenzo: **Evolution of R&D networks across industries**, SKEMA Business School, Sophia Antipolis, France, June 25 – 30, 2012
188. Schweitzer, Frank: **The next level of modeling social interaction: How to detect, quantify and utilize emotional influence**, Aalto Complexity Networks Factory, Sannäs, Finland, June 05, 2012
187. Schweitzer, Frank: **Systemic Risk in Economic and Financial Networks** , Aalto Systems Forum, Aalto School of Economics, Aalto University, Helsinki, Finland, June 05, 2012
186. Zanetti, Marcelo Serrano: **The Co-Evolution of Socio-Technical Structures in Sustainable Software Development: Lessons from the Open Source Software Communities**, International Conference on Software Engineering (ICSE), Doctoral Symposium, Zürich, Switzerland, June 04, 2012
185. Perony, Nicolas: **Hierarchical Consensus Formation Reduces the Influence of Opinion Bias**, 26th European Conference on Modelling and Simulation, University of Koblenz and Landau, Koblenz, Germany, May 30, 2012
184. Battiston, Stefano: **DebtRank: Too Central to Fail? Financial Networks, the FED and Systemic Risk, Workshop on Global Systems and Networks of Networks** , Florence, Italy, May 16, 2012
183. Schweitzer, Frank: **Systemic risk, Risk Center Seminar Series**, ETH Zürich, Zürich, Switzerland, April 24, 2012
182. Perony, Nicolas: **On the link between collective movement and the emergence of sociality**, Invited talk, Laboratory of Insect Social Evolution, The Rockefeller University, New York NY, USA, April 23, 2012
181. Scholtes, Ingo: **Designing adaptive distributed systems: A complex networks perspective**, Invited talk at research seminar of Professor Vincent D. Blondel, Catholic University of Louvain-La-Neuve, Belgium, April 20, 2012

180. Perony, Nicolas: **Quantitative analysis of animal social networks**, Invited seminar, Human Nature Lab, Harvard University, Cambridge MA, USA, April 19, 2012

179. Perony, Nicolas: **From Social Dynamics to Collective Motion (and back)**, Invited talk, Couzin Lab, Department of Ecology and Evolutionary Biology, Princeton University, Princeton NJ, USA, April 17, 2012

178. Scholtes, Ingo: **Statistical Mechanics of Networks: Applications in Future Information Systems**, Lecture Series at Summer School "Modeling and Analysis of Novel Mechanisms in Future Internet Applications", University of Würzburg, Germany, March 27 – April 03, 2012

177. Garas, Antonios: **k-shells on weighted networks**, Deutsche Physikalische Gesellschaft (DPG) Annual Conference, Berlin, Germany, March 25 – 30, 2012

176. Schweitzer, Frank: **Response to social norms enhancement by heterogeneous populations**, Deutsche Physikalische Gesellschaft (DPG) Annual Conference, Berlin, Germany, March 25 – 30, 2012

175. Pfitzner, René: **Sentiment Classification in Social Media - an exemplar study in the micro-blogging platform Twitter**, Deutsche Physikalische Gesellschaft (DPG) Annual Conference, Berlin, Germany, March 25 – 30, 2012

174. Pfitzner, René: **The Central Limit Theorem in Hierarchical Structures**, Deutsche Physikalische Gesellschaft (DPG) Annual Conference, Berlin, Germany, March 25 – 30, 2012

173. Garas, Antonios: **The role of emotions in on-line communication**, Deutsche Physikalische Gesellschaft (DPG) Annual Conference, Berlin, Germany, March 25 – 30, 2012

172. Schweitzer, Frank: **The Wisdom of Crowds Effect at Work: The Good, The Bad, and The Ugly**, Deutsche Physikalische Gesellschaft (DPG) Annual Conference, Berlin, Germany, March 25 – 30, 2012

171. Schweitzer, Frank: **When it pays off to pay tax: Insights from coupled multiplicative stochastic processes**, Deutsche Physikalische Gesellschaft (DPG) Annual Conference, Berlin, Germany, March 25 – 30, 2012

170. Schweitzer, Frank: **Sociophysics models of emotions in blog debates, newsgroups, and MySpace discussions**, Review Meeting "Cyberemotions", Brussels, Belgium, March 16, 2012

169. Zanetti, Marcelo Serrano: **A Network Perspective on Software Modularity**, International Workshop on Complex Sciences in the Engineering of Computing Systems (ARCS), CSECS, 2012, Munich, Germany, February 28, 2012

168. Tessone, Claudio Juan: **Effects of volatility in real-world networks: modeling based on monogamous networks**, First International Workshop on Complex Sciences in the Engineering of Computing Systems (CSECS), held at ARCS 2012, Munich, Germany, February 28, 2012

167. Scholtes, Ingo: **Organic Distributed Systems: A Complex Networks Perspective**, First International Workshop on Complex Sciences in the Engineering of Computing Systems (CSECS), held at ARCS 2012, Munich, Germany, February 28, 2012

166. Perony, Nicolas: **Simplifying social complexity: a quantitative approach to social interactions in animal groups**, Invited seminar, Seminar of the Research Center on Animal Cognition, Paul Sabatier University, Toulouse, France, February 28, 2012

165. Perony, Nicolas: **Comparative analysis of social interactions in animal groups**, Animal Behaviour Seminar, Institute of Evolutionary Biology and Environmental Studies, University of Zürich, Zürich, Switzerland, February 22, 2012

164. Battiston, Stefano: **Emergence of Systemic Risk in Financial Networks**, European Center for Advanced Research in Economics and Statistics (ECARES), Université Libre de Bruxelles, Brussels, Belgium, February 09, 2012
163. Garcia, David: **WP5 Research Update**, The Austrian Research Institute for Artificial Intelligence (OFAI) Cyberemotions Workshop, Vienna, Austria, January 18, 2012

2011

162. Schweitzer, Frank: **The surprising power of social influence in the digital age**, U.S.-Swiss Dialogue, NYU Stern School of Business, New York University, New York NY, USA, December 01, 2011
161. Schweitzer, Frank: **Our Friends, our beliefs, our emotions: How computational social science reads our digital traces**, ETH Alumni NEC & Swissnex, Boston MA, USA, November 29, 2011
160. Battiston, Stefano: **Systemic risk in financial networks**, Risk Center Seminar Series, ETH Zürich, Switzerland, November 29, 2011
159. Battiston, Stefano: **Systemic risk in financial networks** , Scuola Sant'Anna, Pisa, Italy, November 22, 2011
158. Schweitzer, Frank: **The next level of modeling social interaction: How to detect, quantify and utilize emotional influence**, Laboratory for Information and Decision Systems Seminar, MIT, Cambridge MA, USA, November 22, 2011
157. Schweitzer, Frank: **Collective Emotions on the Internet - How to quantify and model emotional influence**, The School of Informatics and Computing Colloquium Series, Indiana University, Bloomington IL, USA, November 18, 2011
156. Schweitzer, Frank: **Systemic risk in economic and financial networks**, School of Industrial Engineering Seminar, Purdue University, West Lafayette IN, USA, November 17, 2011
155. Schweitzer, Frank: **The next level of modeling social interaction: How to detect, quantify and utilize emotional influence** , Northwestern Institute on Complex Systems Seminars, Northwestern University, Evanston IL, USA, November 16, 2011
154. Battiston, Stefano: **Lectures on Financial Networks**, FOC School, Livorno, Italy, November 13 – 16, 2011
153. Battiston, Stefano: **Systemic risk in financial networks** , Korea Advanced Institute of Science and Technology (KAIST), Daejeon, Korea, November 02, 2011
152. Schweitzer, Frank: **Systemic risk in economic and financial networks** , Special Seminar, Laboratory for Information and Decision Systems, MIT, Cambridge MA, USA, October 21, 2011
151. Schweitzer, Frank: **The next level of modeling social interaction: How to detect, quantify and utilize emotional influence** , Center for Complex Network Research & Barabasi Lab Seminar, Northeastern University, Boston MA, USA, October 17, 2011
150. Perony, Nicolas: **Uncomplicated social complexity: descriptive and mechanistic approaches to animal social behaviour**, Invited lecture, Lecture Series in Behavioural and Evolutionary Ecology, University of Bern, Bern, Switzerland, October 12, 2011
149. Schweitzer, Frank: **Open source software as a complex network**, Center for the Study of Complex Systems Seminar Series, University of Michigan, Ann Arbor MI, USA, October 04, 2011
148. Schweitzer, Frank: **SocioAware Agents – Better Agents?**, Distinguished Lecture, 1st International Workshop on Socio-Aware Networked Computing Systems, 5th IEEE International Conference on Self-Adaptive and Self-Organizing Systems, Ann Arbor MI, USA, October 03 – 07, 2011

147. Perony, Nicolas: **The emergence of hierarchy through competition in social organisations**, "Hierarchy: From the Definition to the Characterization of Complex Systems", Satellite Meeting of European Conference on Complex Systems (ECCS), University of Vienna, Vienna, Austria, September 15, 2011

146. Perony, Nicolas: **From individual energy to collective social behaviour in animal populations**, "Social Energy: A Useful Notion for Analysing Complex Socio-ecological Systems?", Satellite Meeting of European Conference on Complex Systems (ECCS), University of Vienna, Vienna, Austria, September 14, 2011

145. Perony, Nicolas: **How random is social behaviour?**, European Conference on Complex Systems (ECCS), Vienna, Austria, September 13, 2011

144. Schweitzer, Frank: **Open source software as a complex network** , Division of Computer Science, Nanyang Technological University, Singapore, August 11, 2011

143. Schweitzer, Frank: **Systemic risk in economic networks**, Singapore Economic Review Conference, Singapore, August 04 – 06, 2011

142. Scholtes, Ingo: **Modeling of Emerging Internet Services: Social Networks and Crowdsourcing**, Invited Talk at EuroView 2011, University of Würzburg, Germany, August 01, 2011

141. Garcia, David: **Emotional communication patterns in online chat communities**, Plenary meeting of the International Society for Research on Emotion, Kyoto, Japan, July 26 – 29, 2011

140. Pfitzner, René: **Statistical Classification of Cascading Failures in Power Grids**, 2011 IEEE Power & Energy Society General Meeting, Detroit, USA, July 24 – 29, 2011

139. Battiston, Stefano: **Systemically important nodes in complex financial networks**, International Workshop 'Coping with Crises in Complex Socio-Economic Systems', Zürich, Switzerland, June 23, 2011

138. Tasca, Paolo: **Diversification and Financial Stability**, International Workshop on Coping with Crises in Complex Socio-Economic Systems, June 20 – 25, 2011

137. Schweitzer, Frank: **The risk to fail**, International Workshop 'Coping with Crises in Complex Socio-Economic Systems', Zürich, Switzerland, June 20 – 23, 2011

136. Battiston, Stefano: **Systemically Important Nodes in Complex Networks**, International Conference on Network Science and Its Applications, Budapest, Hungary, June 09, 2011

135. Schweitzer, Frank: **An Agent-based Model of Collective Emotions in Online Communities**, Department of Biological Physics, Eötvös Loránd University, Budapest, Hungary, May 03, 2011

134. Perony, Nicolas: **From Social dynamics to Collective motion (and back)**, Invited talk, Eötvös Loránd University, Budapest, Hungary, May 03, 2011

133. Battiston, Stefano: **Risk diversification and default cascades in financial networks**, Complex Networks Seminar, LIP6 lab Université Pierre et Marie Curie, Paris, France, April 28, 2011

132. Perony, Nicolas: **Animal Interactions in the social and physical spaces**, University of Zürich, Zürich, Switzerland, April 15, 2011

131. Battiston, Stefano: **Liaisons Dangereuses: Systemic Risk in Financial Networks**, GRETHA Université Montesquieu, Bordeaux, France, April 08, 2011

130. Schweitzer, Frank: **Sociophysics models of collective emotions in online communities**, Review Meeting "Cyberemotions", Brussels, Belgium, March 21, 2011

129. Battiston, Stefano: **Liaisons Dangereuses: Systemic Risk in Financial Networks** , Observatoire Français des Conjonctures Economiques (OFCE), Sophia-Antipolis, France, March 17, 2011

128. Schweitzer, Frank: **An Agent-Based Model of Collective Emotions in Online Communities**, Deutsche Physikalische Gesellschaft (DPG) Annual Conference, Dresden, Germany, March 13 – 18, 2011

127. Schweitzer, Frank: **Collective Dynamics of Firms: A Statistical Physics Approach, Tutorial**, Deutsche Physikalische Gesellschaft (DPG) Annual Conference, Dresden, Germany, March 13 – 18, 2011

126. Garcia, David: **Product Reviews and IRC Channel Analysis**, Project Workshop "Cyberemotions", Ljubljana, Slovenia, January 20, 2011

2010

125. Schweitzer, Frank: **Systemic Risk in Economic Networks**, ESF SCSS Exploratory Workshop: Information and Behaviour in Networks, Oxford, UK, December 08 – 10, 2010
124. Garcia, David: **Modeling Collective Emotions in Online Communities**, Institute Jozef Stefan, Ljubljana, Slovenia, November 26, 2010
123. Schweitzer, Frank: **Modeling Collective Emotions: A Stochastic Approach Based on Brownian Agents**, COST MP0801 Workshop "Complex Stochastic Dynamics", Vienna, Austria, November 26 – 28, 2010
122. Schweitzer, Frank: **Public Lecture: Complex Networks**, Department of Physics, University of Vienna, Vienna, Austria, November 26, 2010
121. Schweitzer, Frank: **Modeling Collective Emotions in Online Communities** , CCSS Seminar "Modeling Complex Socio-Economic Systems and Crises", ETH Zürich, Zürich, Switzerland, November 09, 2010
120. Garcia, David: **Modeling Collective Emotions in Online Communities** , Universidad Carlos III Madrid, Madrid, Spain, October 29, 2010
119. Perony, Nicolas: **Social structure and long-term community evolution in the association network of a wild house mouse population**, Animal Behaviour Seminar, University Zürich, Zürich, Switzerland, October 13, 2010
118. Schweitzer, Frank: **Research on Systemic Risk: Contributions of ETH Zürich to FOC**, FOC Kickoff Meeting, Rome, Italy, October 12 – 13, 2010
117. Schweitzer, Frank: **Special Lectures: Collective Dynamics of Firms**, Graduate School of System Design and Management, Keio University, Yokohama, Japan, October 04, 2010
116. Schweitzer, Frank: **The Hidden Complexity of Open Source Software**, Business School, University of Science and Technology, Shanghai, China, September 30, 2010
115. Schweitzer, Frank: **Brownian Motion Scaled Up: Einstein's Theory and the Collective Dynamics of Brownian Agents**, The Nobel Lectures at the 'Albert Einstein' Exhibition, China Science and Technology Museum Nº5, Beijing, China, September 29, 2010
114. Perony, Nicolas: **The dynamical social network of a wild house mice population**, Data driven dynamical networks Workshop, Les Houches, France, September 27, 2010
113. Battiston, Stefano: **Liaisons Dangereuses: Increasing Connectivity, Risk Sharing, and Systemic Risk**, MAFIN: Managing Financial Instability in Capitalistic Economies, Reykjavik, Iceland, September 23 – 25, 2010
112. Perony, Nicolas: **An agent-based approach to sociality in wild house mice**, Dynamics On and Of Complex Networks IV Workshop, Lisbon, Portugal, September 16, 2010
111. Perony, Nicolas: **Long-term community evolution in an animal society**, Science of Complex Networks Workshop, Lisbon, Portugal, September 15, 2010
110. Perony, Nicolas: **A stochastic model of social interaction in wild house mice**, European Conference on Complex Systems, Lisbon, Portugal, September 14, 2010
109. Battiston, Stefano: **Liaisons Dangereuses: Increasing Connectivity, Risk Sharing, and Systemic Risk** , Workshop on Counterparty Risk and Systemic Risk, Institute Louis Bachelier, Paris, France, September 02, 2010
108. Battiston, Stefano: **Liaisons Dangereuses: Increasing Connectivity, Risk Sharing, and Systemic Risk** , Conference of European Economic Association, University of Glasgow, Glasgow, UK, August 23 – 28, 2010

107. Tasca, Paolo: **Financial Fragility Dynamics**, WISE of the Advance School of Economics (SSE), Venice, Italy, July 08, 2010
106. Schweitzer, Frank: **Personalized and Dynamic Trust in Social Networks**, Sunbelt XXX Social Networks Conference, Riva del Garda, Italy, June 29 – July 04, 2010
105. Tasca, Paolo: **Financial Fragility Dynamics** , IX Swiss Doctoral Workshop in Finance, Gerzensee, Switzerland, June 21 – 22, 2010
104. Battiston, Stefano: **Liaisons Dangereuses: Increasing Connectivity, Risk Sharing, and Systemic Risk** , 2dn Conference on Financial Stability, University of Tilburg, Tilburg, Netherlands, June 04, 2010
103. Schweitzer, Frank: **Open Source Software as a Complex Network**, COST MP 0801 Second Annual Meeting, Sunny Beach, Bulgaria, May 26 – 28, 2010
102. Schweitzer, Frank: **Open Source Software: Networks of Social and Functional Dependencies**, The International Workshop and Conference on Network Science (NetSci) School and Conference, Boston, USA, May 10 – 14, 2010
101. Battiston, Stefano: **Liaisons Dangereuses: Increasing Connectivity, Risk Sharing, and Systemic Risk** , 2dn Conference on Financial Stability, Institut Louis Bachelier, Paris, France, March 25, 2010
100. Tessone, Claudio Juan: **Evolution based on centrality: bistability between hierarchical and destructured networks**, Deutsche Physikalische Gesellschaft (DPG) conference, Regensburg, Germany, March 21 – 26, 2010
99. Schweitzer, Frank: **The hidden complexity of open source software** , Deutsche Physikalische Gesellschaft (DPG) conference, Regensburg, Germany, March 21 – 26, 2010
98. Schweitzer, Frank: **OSS Projects - Software Structure, Dynamics, Communivation**, Workshop Mining Software Archives, Ascona, Switzerland, March 14 – 19, 2010
97. Schweitzer, Frank: **Economic Networks: Micro and Macro Perspectives**, Interdisciplinary Colloquium, Jacobs University Bremen, Bremen, Germany, March 08, 2010
96. Battiston, Stefano: **Efficiency and Stability of R&D Networks**, COST Action MP0801 Workshop on Evolution and Co-evolution, Valencia, Spain, February 24 – 26, 2010
95. Battiston, Stefano: **Systemic Risk in Complex Financial Networks**, The VI National Congress of the Institute for Biocomputation and Physics of Complex Systems (BIFI), Zaragoza, Spain, February 02 – 06, 2010
94. Schweitzer, Frank: **Modeling Collective Emotions in Cyberspace**, Project Workshop Cyberemotions, Wolverhampton, UK, January 21 – 23, 2010

2009

93. Schweitzer, Frank: **Modeling collective interactions in social systems**, Workshop 'Simulating Complex Organizations', Center for Advanced Studies, Ludwig-Maximilian University Munich, Munich, Germany, November 30, 2009
92. Schweitzer, Frank: **Predicting Systemic Risk: The role of contagion and cascades**, Complex'09 – The 9th Asia-Pacific Complex Systems Conference, Tokyo, Japan, November 4 – 7, 2009 (invited talk)
91. von Ledebur, Sidonia: **Patent collaboration of German inventors - did the distance increase over time?**, EAEPE Conference, Amsterdam, Netherlands, November 6 – 8, 2009
90. Walter, Frank E.: **Personalised and Dynamic Trust in Social Networks**, 3rd ACM Conference on Recommender Systems, New York City, New York, USA, October 22 – 25, 2009

89. Vitali, Stefania: **The Network of global corporate control.** Research seminar. Colloquium of CCSS Center of Competence, ETH Zürich, Zürich, Switzerland, October 20, 2009
88. Battiston, Stefano: **Liaisons Dangeureuses: Individual Risk Diversification and Systemic Risk**, International Workshop: Financial risk, market complexity and regulation, Collegium Budapest, Budapest, Hungary, October 8 – 10, 2009
87. Schweitzer, Frank: **Economic Networks: Mirco and Macro Perspectives**, Symposium: Frontiers in Network Science, Berlin, Germany, September 28 – 30, 2009
86. Pich, Christian: **More Flexible Radial Layout**, Graph Drawing 2009, Chicago IL, USA, September 22 – 25, 2009
85. Pich, Christian: **Drawing Directed Graphs Clockwise**, Graph Drawing 2009, Chicago IL, USA, September 22 – 25, 2009
84. König, Michael: **Games of Dynamic Network Formation**, HSC Video Conference, UCSD, San Diego, CA, USA, September 21, 2009
83. Tessone, Claudio J.: **Social network evolution based on agent centrality**, European Social Simulation Association Conference, University of Surrey, Guildford, UK, September 16, 2009
82. Schweitzer, Frank: **Mechanisms of systemic risk: Contagion, reinforcement, redistribution**, Conference: Complexity, Mathematics and Socio-Economic Problems, Bielefeld, Germany, August 31 – September 12, 2009
81. Tessone, Claudio J.: **From networks evolving by centrality to rank-based dynamics**, International Centre For Theoretical Physics "Abdus Salam", Trieste, Italy, August 21, 2009
80. Lorenz, Jan: **A model of emotion dynamics in cyberspace**, CyberEmotions Workshop, Jacobs University of Bremen, Germany, July 1, 2009
79. Battiston, Stefano: **Risk Diversification and Systemic Risk**, NetSci 2009 - International Workshop and Conference on Complex Networks and their Applications, Venice, Italy, June 29 – July 3, 2009
78. Vitali, Stefania: **The Map of Global Corporate Control**, NetSci 2009 - International Workshop and Conference on Complex Networks and their Applications, Venice, Italy, June 29 – July 3, 2009
77. Schweitzer, Frank: **Economic Networks: Micro and Macro Perspectives**, NetSci 2009 - International Workshop and Conference on Complex Networks and their Applications, Venice, Italy, June 29 – July 3, 2009
76. Lorenz, Jan: **Continuous opinion dynamics and bounded confidence: A model to explain the formation of parties**, University of Oldenburg, Germany, June 30, 2009
75. Battiston, Stefano: **Efficiency and Evolution of R&D Networks**, DIME International Conference on the Formation of Social and Economic Networks. Paris, June 27, 2009
74. König, Michael: **Games of Dynamic Network Formation**, DIME International Conference on the Formation and the Evolution of Social and Economic Networks, Paris, France, June 25, 2009
73. König, Michael: **Dynamic Network Formation and Centrality Measures**, Department of Computer & Information Science, University of Konstanz, Konstanz, Germany, June 18, 2009
72. Glattfelder, James B.: **The Network of Global Corporate Control**, International Workshop "Coping with Crises in Complex Socio-Economic Systems", Zürich, Switzerland, June 8 – 12, 2009

71. Battiston, Stefano: **Risk Diversification and Systemic Risk**, International Workshop "Coping with Crises in Complex Socio-Economic Systems", Zürich, Switzerland, June 8 – 12, 2009
70. Schweitzer, Frank: **Mechanisms of Systemic Risk: Contagion, Reinforcement, Redistribution**, NET 2009: Evolution of Complexity & COST MP0801 Meeting, Rome, Italy, May 28 – 30, 2009
69. Lorenz, Jan: **Universality in Continuous Opinion Dynamics: An Empirical Study of Movie Rating Distributions**, NET 2009: Evolution of Complexity & COST MP0801 Meeting, Rome, Italy, May 28 – 30, 2009
68. Tasca, Paolo: **Information Mirages and Systemic Risks in Financial Markets**. Research Seminar. Colloquium of CCSS Center of Competence, ETH Zürich, Zürich, Switzerland, April 21, 2009
67. König, Michael: **Games of Dynamic Network Formation**, Research Institute of Industrial Economics (IFN), Stockholm, Sweden, March 24, 2009
66. Perony, Nicolas: **From Animal Societies to Complex Systems: The case study of roosting associations in Bechstein's bats**, ETH Zürich Interaction Seminar for Ecology, Zürich, Switzerland, March 2, 2009
65. Schweitzer, Frank: **Mechanisms of Systemic Risk: Contagion, Reinforcement, Redistribution**, Complex'2009 – The First International Conference on Complex Sciences: Theory and Applications, Shanghai, China, February 23 – 25, 2009
64. Schweitzer, Frank: **Modeling Collective Interactions in Social Systems**, Cyberemotions Kickoff Meeting, Warsaw, Poland, February 12 – 14, 2009
63. Tasca, Paolo: **Exploring Information Mirages in a Simulated Multi-Agent Stock Market**, X Intern. Workshop on Quantitative Finance, PoliMi, Milan, Italy, January 29 – 30, 2009
62. König, Michael: **Efficiency and Stability of Dynamic Innovation Networks**, North American Winter Meeting of the Econometric Society, San Francisco, CA, USA, January 3 – 5, 2009

The remaining 61 talks are given before 2009 and are accessible on the website or in the previous report.

5 Funded Projects

The basic budget of our chair certainly allows us to fulfill our research and teaching commitments. However, given the broad range of research topics, it needs additional funding to reach a sufficient level of activity in all of these areas.

Applying for external funding has several positive aspects. First of all, it is a very competitive process. Hence, if a proposal is granted after rounds of external evaluation, this should be seen as an additional confirmation of the quality of the research proposed (and done so far). Secondly, as most funded research projects are based on collaborations, they allow us to develop our scientific network inside Switzerland, but also in Europe and worldwide. Thirdly, being partners in multinational research projects, we are able to efficiently disseminate our competencies, while contributing to the frontiers in scientific research, internationally.

Consequently, grant proposals played an important role in our scientific activities over the last ten years. Certainly, not all of our applications turned out to be successful, at the end. However, we are proud to have received **external funds of about 4.69 million CHF** for our chair, as of today. Noteworthy, except for rather small projects, funds from joint projects with the industry are rare – they come mostly from Swiss governmental institutions and from the European commission.

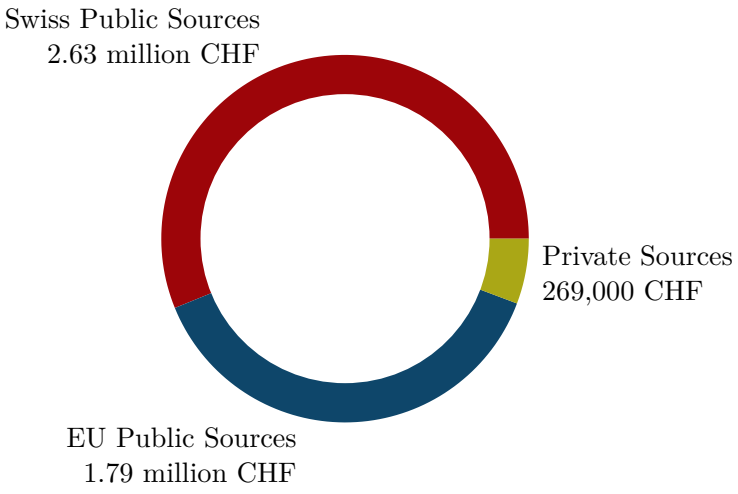


Figure 5.1: The funding for our projects, divided by geographical location and public or private origin.

5.1 Structure and Dynamics of Collaborative Information Spaces

Duration 36 months (May 2015 – April 2018)

Funding program COST-TD1210 action, Swiss State Secretariat for Education and Research SERI (Project C14.0036)

Total budget 181,592 CHF

Benefit for the Chair 181,592 CHF

This project is related to our research topics **Temporal Networks** (Section 2.1.1), and **Design and Analysis of Socio-Technical Systems** (Section 2.2.3).

The convergence of social and technical systems raises a number of important and novel issues. Knowledge spaces like, e.g., the WWW are created, organised and consumed in an increasingly collaborative fashion by groups of humans interacting on short time scales, a process commonly subsumed under the umbrella of *social computing* or *social information processing*.

As such, the question how pieces of information are linked to each other, ranked and filtered not only affects the ability of individuals or organisations to access information in a timely, objective and transparent manner. It is also of prime importance for society as a whole since notions of relevance in networks of linked information a) are increasingly influenced by social processes and b) can be an important driver of social dynamics themselves. The resulting feedback between the social and the semantic layer of collaborative knowledge spaces questions to what extent current network-based information ranking measures - even though they are computed by algorithms - can actually be seen as objective. Although the social and the information layer of collaborative knowledge spaces are coupled inseparably, the question how knowledge orders and social dynamics influence each other has been addressed only partially so far. A systems perspective that integrates both layers is still missing.

In this project, we close this gap by studying social feedback phenomena in information networks from the perspective of multiplex and dynamic networks. By taking a multiplex network perspective, we consider both the social and the information layer of collaborative knowledge spaces, and quantify their properties as well as mutual dependence.

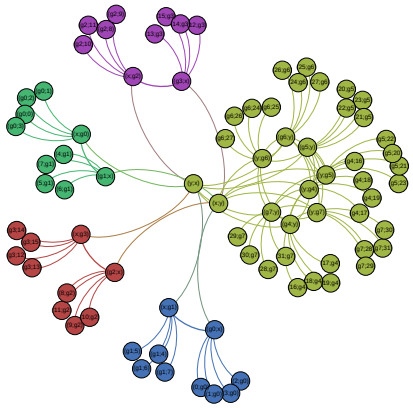


Figure 5.2: In this project, we will explore the possibility to utilise second-order time-aggregated representations (see above) of human navigation behaviour for the ranking of information.

Complementary, by employing our competence in temporal network theory, we quantify the navigation behaviour of users within information spaces from a complex networks perspective. We study how the retrievability of content and its ranking, in terms of predominant measures of relevance, is influenced by the structure and dynamics of the social systems that create it. We consider this question to be of particular interest and significance due to the recent trend towards "socially influenced" information retrieval systems, like e.g. "social search" or collaborative filtering techniques. We further address the question how increasingly accessible data on the social dimension of collaborative knowledge spaces can be used to augment existing relevance ranking mechanisms.

5.2 The Influence of Interaction Patterns on Success in Socio-Technical Systems

Duration 36 months (January 2014 – December 2015)

Funding program MTEC Foundation – Stiftung zur Förderung der Forschung und Ausbildung in Unternehmenswissenschaften an der ETH Zürich

Total budget 40,000 CHF

Benefit for the Chair 40,000 CHF

This project is related to our research topics **Temporal Networks** (Section 2.1.1), and **Design and Analysis of Socio-Technical Systems** (Section 2.2.3).

Increasingly, information and communication technologies (ICT) are being used to mediate, represent and record interactions and collaborations between humans. Examples for such systems not only include online social networks, but also information systems or collaborative software designed to help people organise themselves and collectively achieve a common goal. The use of these ICT systems gives rise to socio-technical systems in which technical infrastructures are coupled to complex social systems. A particular effect of their wide-spread adoption is that large-scale data sets on social structures and dynamics are increasingly becoming available.

This has led to a massive surge of interest in the quantitative analysis of socio-technical systems not only in academia but also in industry. In this research, investigating how social interactions influence success both at the level of individuals as well as organisations is becoming particularly popular. Apart from arousing significant interests in industry, these studies also bear a huge potential to identify risk factors associated with the social capital of organisations. As such, this research contributes to an optimised design of the socio-technical systems that increasingly shape our society.

Going beyond previous studies of how social structures influence the success of individuals and organisations, in this research project we will study the influence of dynamic interaction patterns in socio-technical systems. In particular, this project will close the gap between a) theoretical studies of time-varying (social) networks and b) the application of network analysis techniques in the study of success factors for social organisations. Based on an existing theoretical framework for the study of time-varying complex networks that has been developed at the Chair of Systems Design, we will

a) develop novel measures for the importance of actors in time-varying social networks,

b) combine these novel measures with standard machine learning algorithms to predict success in data sets on socio-technical systems that are available at our chair, and

c) develop a package for the statistics software R that allows researchers within and outside the MTEC department, as well as interested partners in the industry to apply our findings when studying social aspects of success and failure in socio-technical systems.

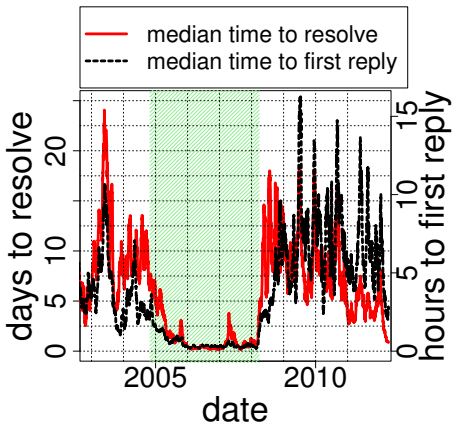


Figure 5.3: Quantitative success indicator for a software development team. In this project, we will study how changes in individual and collective success are related to the temporal dynamics of network structures.

5.3 The Role of Emotional Interactions in the Polarization of Opinions in Participatory Media

Duration 36 months (May 2013 – April 2016)

Funding source Swiss National Science Foundation (GrantCR21I1_146499 / 1)

Total budget 462,260 CHF

Benefit for the Chair 462,260 CHF

This project is related to our research topics **Emotional Influence in Social Media** (Section 2.2.6), and **Structure and Dynamics of Online Social Networks** (Section 2.2.1).

This project is one of the first steps in studying political science from online data. Internet made it possible not only to obtain and share information but also to *produce* it with speed and ease. This development resulted in a proliferation of online participatory media, such as social networking sites, blogs and online fora, which turned Internet users from simple information consumers to active contributors of online content.

Figure 5.4: Visualisation of network layers of *supports*, *likes* and *comments* in the Swiss online platform for mediating communication between politicans and voters - *Politnetz.ch*. Colours represent self-reported party affiliations. The figure shows that different networks vary in their degree of polarization.

On one hand, such real-time communication increases people's engagement in discussions on various political and social issues; on the other hand, such exchange of opinions - under certain conditions - can lead to polarisation of opinions to such degree that it is often hard to reconcile opposing sides. Polarisation provides a confrontation of opinions which is a cornerstone of a functional democratic society. At the same time it influences not only social media but also affects the culture of political discourse. In this interdisciplinary research project we will explore the conditions under which positive an negative emotions in online discussions can amplify polarisation in online participatory media.

The project aims at exploring and providing insights onto the following questions:

- How and when does public opposition emerge?
- How emotional interactions can amplify the polarisation of collective opinions?
- Are there universal properties of user behaviour in online participatory media?
- How online behaviour of users can help understand the role of politics in society?
- How does the usage of online media change political activity?
- How does user behaviour in online media change dependent on user emotions? Does it have any impact on voter behaviour or on better designing voting platforms?
- How do online opinion leaders emerge (especially relevant for e-democracy)?

5.4 MULTIPLEX: Foundational Research on Multilevel Complex Networks and Systems

Duration 48 months (November 2012 – October 2016)

Funding program EU 7th Framework Programme, FET Proactive IP Project number 317532. 2012-2016.

Project partners IMT Alti Studi Lucca (Italy), Universidad de Aveiro (Portugal), Bar-Ilan University (Israel), Universitat Rovira I Virgili (Spain), London Institute for Math. Sciences (UK), Central European University (Hungary), CNRS (France), ETH Zürich (Switzerland), Aalto University (Finland), ISI Torino (Italy), Paderborn University (Germany), Medical Institute of Wien (Austria), Computer Technology Institute & Press Diophantus (Greece), University Sapienza (Italy), University of Zaragoza (Spain), University of Warsaw (Poland), University of Wien (Austria), Aristotle University of Thessaloniki (Greece), University of Lausanne (Switzerland), Jozef Štefan Institute (Slovenia), Ruder Boskovic Institute (Croatia), Leiden University (Netherlands).

Total budget 6,000,000 EUR

Benefit for the Chair 450,000 CHF

This project is related to our research topic **Multi-layered networks** (Section 2.1.2).

A better understanding of multi-level systems is essential for future Information and Communication Technologies (ICT's) and for improving life quality and security in an increasingly interconnected and interdependent world. Indeed, multi-level dependencies may amplify cascade failures or make more sudden the collapse of the entire system. Recent large-scale blackouts resulting from cascades in the power-grid coupled to the control communication system witness this point very clearly.

Complex networks science is particularly suited to shed new light on the structural and dynamical interrelations between infrastructure and communication networks and between techno-social and socio-economic networks. MULTIPLEX proposes a mathematical, computational and algorithmic framework for multi-level complex networks. Firstly, this will lead to a significant progress in the understanding and the prediction of complex multi-level systems. Secondly, it will enable a better control, and optimization of their dynamics. Combining these modelling approaches with the analysis of massive heterogeneous data sets will lead to profound insights into the topology, dynamical organisation and evolution of multi-level complex networks.

Figure 5.5: The logo of the MULTIPLEX Project

5.5 Systemic Risks, Systemic Solutions

Duration 36 months (September 2012 – August 2015)

Funding source ETH Grant (ETH48)

Project partners (all from ETH Zürich): Chair of Forest Engineering (Prof. Hans Rudolf Heinimann), Chair of Systems Design (Prof. Frank Schweitzer), Chair of Entrepreneurial Risks (Prof. Didier Sornette), Chair of International Conflict Research (Prof. Lars-Erik Cederman), Chair of Integrative Risk Management and Economics (Prof. Antoine Bommier), Chair of Macroeconomics: Innovation and Policy (Prof. Hans Gersbach), Chair of Sociology, in particular of Modeling and Simulation (Prof. Dirk Helbing), Chair of Mathematical Finance (Prof. Paul Embrechts), Chair of Computational Physics (Prof. Hans Herrmann), Institute for Transport Planning and Systems (Prof. Kay Axhausen), Chair of Decision Theory (Prof. Ryan Murphy)

Total budget 1,500,00 CHF

Benefit for the Chair 160,000 CHF

This project is related to our research topics **Systemic Risk** (Section 2.1.4) and **Financial networks** (Section 2.3.2).

The collaborative project consists of three work packages (WP):

In **WP 1: Systemic Risk as an Emerging Phenomenon**, coordinated by F. Schweitzer, we link modern probabilistic and statistical methods, Extreme Value Theory in particular, with complexity science (complex network theory, agent-based modelling) to improve our understanding of systemic risk phenomena, such as sudden regime shifts, cascading effects, or slow emerging risks. In **WP 2: Financial Crisis**, coordinated by D. Sornette, we improve our understanding of the emergence and the spread of financial crisis and explore novel, cost-effective, more robust institutional arrangements that consider decision biases of agents. In **WP 3: Resources, Energy and Political Instability**, coordinated by L. E. Cederman, we explore interdependencies between macro-systems, particularly resource extraction, energy production, and political stability, to improve our understanding of cross-system links.

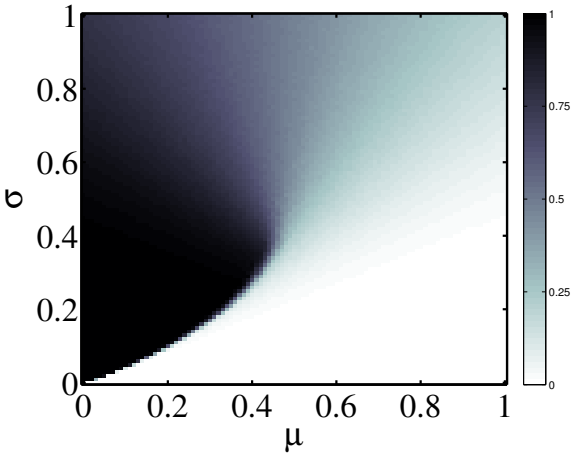


Figure 5.6: Systemic risk as the fraction of failed nodes $X^\star$ on a fully connected graph with $n = 1000$ nodes for different parameters of Normally distributed thresholds.

Systemic risk as an emerging phenomenon WP1 aims at developing models of complex adaptive systems in which systemic risks is an emergent feature, and to merge these with recent insights about the occurence of extreme events. Complex interactions e.g. in networks, nested feedback loops, or cascading effects are not fully implemented in such a description. In particular, the relation to risk and the interplay between the risk of (single) system's elements and the risk for the system as a whole is yet to be understood. WP1 tries to identify the underlying mechanisms of systemic risk. This requires to develop tools that detect precursors of systemic risk and, in turn, to explore measures to improve system resilience.

5.6 Payoffs of Local and Global Network Structures: Reproductive Career Paths in Wild House Mice

Duration 36 months (May 2012 – April 2015)

Funding program Swiss National Science Foundation (Grant CR31I1_140644 / 1)

Project partners Barbara König, University of Zürich (until November 2013)

Total budget 492,111 CHF

Benefit for the Chair 362,022 CHF

This project is related to our research topics **Structure and dynamics of animal groups** (Section 2.2.2), and **Design and analysis of socio-technical systems** (Section 2.2.3).

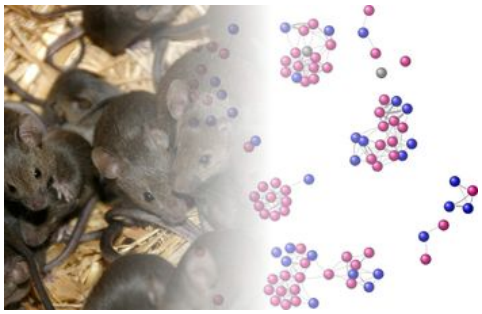


Figure 5.7: Modelling the social behaviour of wild house mice.

Why do individuals establish social bonds? To answer that question we focus our data-driven modelling approach on social interactions in animal societies and humans. Specifically, in the first part of the project we analyse data obtained from a wild population of house mice in their natural environment. In the second part, we extend our studies to analyse also collaboration networks of scientists and software developers. The project is really interdisciplinary, as it combines methods from different domains (social network analysis, machine learning, agent-based modelling) to analyse longitudinal and panel data from various systems.

We aim at a comprehensive understanding why individuals invest in the formation of social networks, by revealing the hidden principles underlying their decisions. Our goal is to expose the relation between success and social interaction strategies, both at the individual level and at the level of larger groups. For these, different measures of success apply, e.g. the number of offsprings in animals, the number of citations in scientific publications, the number of bugs fixed by developers. Fine-grained data about the social interactions of the actors, e.g. the co-location or inheritance network of mice, the co-authorship network of scientists and the assignments between developers, allow us to relate success and strategic behaviour in a statistical manner, for which we particularly apply machine learning approaches.

The project makes an important contribution, both theoretically and empirically, in identifying the incentive mechanisms that lead to the formation and the change of social networks. Our results shed new light on the relations between the individual effort invested in social bonding, the resulting individual payoff, as well as the position and role of individuals in a network.

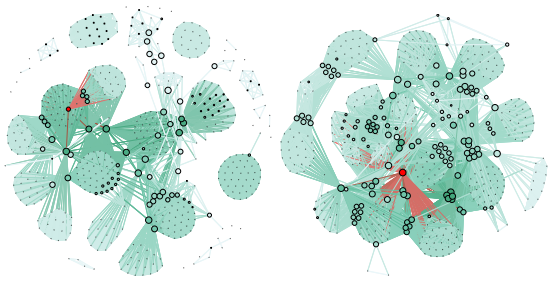


Figure 5.8: Career path of a scientist (red) in the collaboration network of a scientific community.

5.7 Topology Adaptation for Trust-based Search in Peer-to-Peer Networks

Duration 8 months (October 2011 - May 2012)

Funding program Indo Swiss Joint Research Programme

Project partners Prof. Niloy Ganguly, Indian Institute of Technology Kharagpur, India

Total budget 17,500 CHF

Benefit for the Chair 17,500 CHF

This project is related to our research topic **Design and analysis of socio-technical systems** (Section 2.2.3).

Peer-to-Peer (P2P) networks have enabled easy content sharing over the web through the users personal computers and hence have become hugely popular. However, side by side, content download from unauthentic sources has led to a surge in fake content and malware that are disseminated through these files. This motivates the need to design sophisticated search mechanisms in P2P networks that will not only guarantee low search latency and low bandwidth consumption but also ensure trustworthy sources, i.e. that are known to provide authentic files.

One way of designing such technique is to suitably organise the topology of the overlay network which interconnects peers. In this line, we aim at developing a suitable topology adaptation mechanism in P2P networks so that peers providing authentic content of a particular category such as music, movies, ebooks etc. can be grouped together to form a community, i.e. highly trusted peers in a community will be densely connected. This implies that the search queries can be disseminated quickly to these highly trusted peers.

Although this broad picture looks simple, to achieve these objectives, we need to address several issues. P2P networks are subject to heavy churn with peers continuously leaving and joining the systems, thus making the overlay unstable. Content is constantly updated by the users, making the discovery of content itself a challenging problem. However, the most important component needed to ensure the success of such algorithms is the choice of suitable trust ranking metrics that a node can use to rate the trust of its neighbours.

At the Chair of Systems Design, which is the host group of this project, we have been actively engaged in developing distributed trust management mechanisms for trust-based networks. In particular, we proposed an elegant trust ranking mechanism for web-based recommender systems. The principal task of this project is to customise the trust metric in such a way that it can be used in dynamic P2P networks. The research group at IIT, Kharagpur is actively involved in P2P research that involves enhancing the performance of P2P systems in terms of search latency, network coverage and traffic reduction. The results of this research have been published in top-tier conferences and journals.

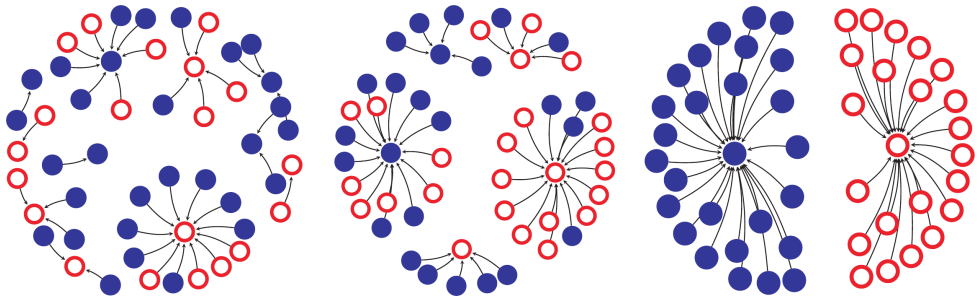


Figure 5.9: Different stages of a coalition process following a trust-based approach. Nodes only connect with each other after having established a sufficient level of trust.

5.8 FOC: Forecasting Financial Crises

Duration 42 months (September 2010 – February 2014)

Funding program FP7 European Commission FET Open Work Programme: ICT-2009.8.0 (STREP)

Project partners IMT Institute for Advanced Studies Lucca (Italy), ETH Zürich (Switzerland), Università Politecnica delle Marche (Italy), City University (UK), Oxford University (UK), Fundaciò Barcelona Medialab (Spain), European Central Bank, Jožef Stefan Institute (Slovenia), Ruder Boskovic Institute (Croatia), Eötvös Loránd University (Hungary), Boston University (US), Kyoto University (Japan), National Research Council of (Italy), Parmenides Foundation (Germany)

Total budget 2,500,000 EUR

Benefit for the Chair 420,000 CHF

This project is related to our research topics **Systemic Risk** (Section 2.1.4) and **Financial networks** (Section 2.3.2).

In this project an interdisciplinary consortium aims at understanding and forecasting systemic risk and global financial instabilities. By leveraging on expertise in Economics, Mathematics, Statistical Physics and Computer Science, we provide a novel integrated and network-oriented approach to the issue. On one hand, we develop a theoretical framework to measure systemic risk in global financial market and financial networks. On the other hand, we deliver an ICT collaborative platform for monitoring systemic fragility and the propagation of financial distress across institutions and markets around the world. Using our deliverables, experts are able to evaluate algorithms and models to forecast financial crises as well as visualise interactively possible future scenarios.

Figure 5.10: The logo of the FOC project.

5.9 OTC Derivatives and Systemic Risk in Financial Networks

Duration 38 months (August 2010 – July 2013)

Funding source Swiss National Science Foundation (Grant CR12I1-127000/1)

Total budget 476,277 CHF

Benefit for the Chair 476,277 CHF

This project is related to our research topics **Systemic Risk** (Section 2.1.4) and **Financial networks** (Section 2.3.2).

OTC derivatives are financial instruments that are traded outside of regulated markets (OTC = over the counter). Formally, derivatives are specified as contracts between two parties. Thus, in the absense of a clearing house, counterparty risk, i.e. the risk that a counterparty fails, is the main source of risk. The main goal of this project is to contribute to the understanding of the relation between the presence and structure of OTC networks and systemic risk.

The lack of **theoretical frameworks** to deal with distress in financial networks in the presence of OTC derivatives has motivated our project. While models exist to describe the distress of institutions in isolation, new problems arise when balance sheets of institutions become interdependent, this way forming a network of risk between institutions. During the whole project, we have developed several models to deal with default probabilities of financial institutions in a network context where links represent credit relations and OTC derivatives. Our models show two major effects: On the one hand, even if at individual level OTC contracts can be used to mitigate risk, at a system level they increase the interdependence between institutions and the uncertainty about the probability of systemic events. On the other hand, in the presence of a network of credit and a network of OTC contracts, a tail emerges in the distribution of losses, even when the underlying distribution of shocks on the assets held by the institutions is Gaussian. This means in practice that OTC tend to amplify the uncertainty of systemic events.

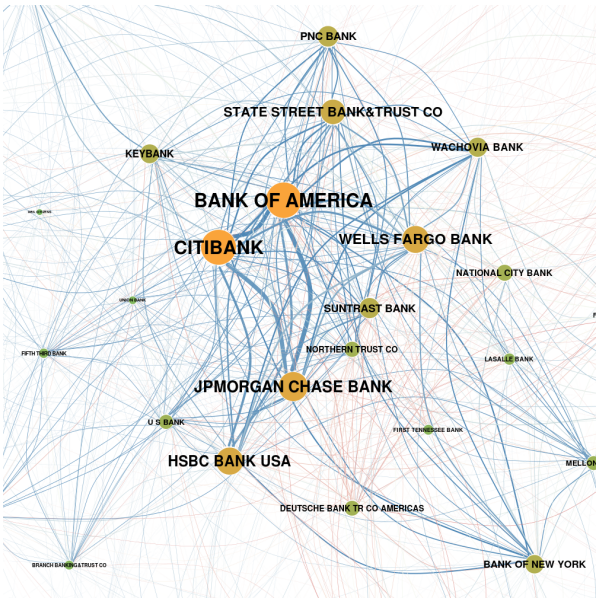


Figure 5.11: The core of the aggregated weighted temporal network, based on the activity of financial institutions in trading OTC derivatives.

On the **empirical side**, it is a challenge that OTC data are extremely difficult to access and, even then, hard to handle. We have coped with this difficulty by resorting to the technique of inferring proxies of network structures from time series of Credit Default Swaps, a popular type of OTC contract. But we have been able to access data about the network of OTC contracts in Germany and in the USA. To our knowledge, we have contributed some of the first empirical analyses of a real derivative network among a large number of banks, which allows to draw some insights on the structure of real OTC networks.

5.10 R&D Network Life Cycles

Duration 30 months (May 2010 – October 2012)

Funding source Swiss National Science Foundation (Grant 100014_126865)

Total budget 192,891 CHF

Benefit for the Chair 192,891 CHF

This project is related to our research topic **R&D networks** (Section 2.3.1).

It is widely agreed that research and development (R&D), with its subsequent technological innovations, is the driving force in economic growth. The project aims at understanding the rise and fall of collaboration networks in R&D intensive industries. Different from many other projects on economic networks, this one does not just focus on network growth, but also on the decline. Together with repeated collaborations over a longer period of time, this may result in life cycles of R&D networks, as we report in Fig. 5.12.

This phenomenon is interesting not just from a scientific perspective, where empirical and theoretical investigations are still rare. It is also important for national economies such as Switzerland, which remarkably rely on technological innovation. Hence, from a policy perspective, it is important to know the driving forces behind firms' decision to start, or to drop, R&D alliances.

With our project, we address both the theoretical and the empirical investigation of R&D life cycles. The former resulted in developing agent-based models to explain structural features of real R&D networks. The latter allowed us to reveal such features in large-scale data sets of firm interactions, and to identify the specific characteristics of successful firms.

Among the major deliverables, there are several publications, talks at scientific conferences, and the creation of an integrated data set, including both *alliance* and *patent* data, that can be further used in subsequent research on R&D networks.

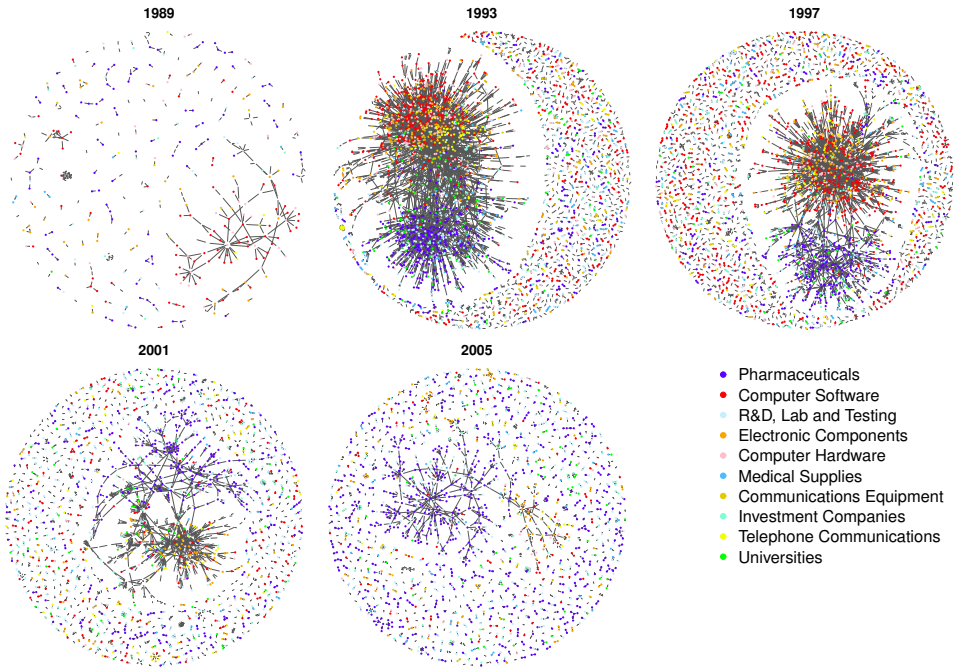


Figure 5.12: Time evolution of the global R&D network extracted from the Thomson Reuters SDC alliance data set. We depict in different colours the ten largest industrial sectors.

5.11 On the Interplay between Social Interactions and Software Architecture in Open Source Software

Duration 36 months (October 2009 – September 2012)

Funding program Swiss National Science Foundation (Grant CR12I1_125298)

Total budget 202,050 CHF

Benefit for the Chair 202,050 CHF

This project is related to our research topics **Social Software Engineering** (Section 2.2.4), **Design and analysis of socio-technical systems** (Section 2.2.3) and **Applications in Software Engineering** (Section 2.1.5)

Open Source Software refers to software developed by voluntary contributors and distributed under specific licensing terms which enable users to study the code and alter it at will. The popularity of Open Source is reflected by the fact that it led to several category-killers: products that quickly took over significant market-share. For example, the Apache web server holds around 50% of the world-wide server market and Mozilla's Firefox holds around 30% of the browser market.

Consequently, several scientific disciplines took up research on Open Source. Physicists use the new developments in network science to study both the architecture of Open Source solutions as well as the social networks of the developer communities. In Computer Science, software engineering research studies the efficiency of collaboration and coordination practices employed by Open Source Software communities. Management Science centers on the motivation of developers, the competitive dynamics between Open Source and proprietary software solutions as well as the determinants of success.

The aim of this project is to bring together these scientific disciplines, to harvest the synergies between them, and to advance the understanding of the complex socio-technological dynamics underlying Open Source Software beyond the scope of one particular discipline. We focus on the statistical laws governing the evolution of the software architecture, its link to project organisation, and the resulting social dynamics.

The project contributes both to science and practice. With its explicit multi-disciplinary setup, it establishes a holistic picture of the phenomenon of Open Source and fosters cross fertilisation between physics, computer science and management. We suppose that this insight will yield results which will be also relevant to practitioners. Understanding the statistical laws of software evolution may help developers to steer development towards favorable architectures. Understanding the link between architecture and project organisation may enable new management principles or provide tools for smoothing the interface between software, developers, and users.

Figure 5.13: Different collaboration structures in three Open Source projects.

5.12 Evolving Networks of Agents Competing for Centrality

Duration 36 months (October 2009 – September 2012)

Funding program Swiss State Secretariat for Education and Research SER (Project C09.0055)

Total budget 170,000 CHF

Benefit for the Chair 170,000 CHF

This project is related to our research topic **R&D networks** (Section 2.3.1).

This project is related to the EU COST Action MP0801 *"Physics of Competition, Cooperation and Conflicts"*. It takes the "bigger challenge" by aiming at social systems at large, to accomplish a new quantitative understanding of competition and conflicts. Because of the inherent complexity of socio-economic interaction, the outcome of such a global dynamics is (i) hard to predict, and (ii) difficult to control or to design. New theoretical approaches are thus needed to achieve this goal.

In our project, we develop a general theoretical model of agents competing in social and economic networks. In particular, we identify potential sources of conflict that arise when agents do not internalise in their decisions the effects they cause on other agents. We test the networks generated by the model against the general empirical patterns found in real-world networks, such as R&D networks. Moreover, we evaluate the efficiency of certain network structures, to derive incentive mechanisms to optimise the interaction outcome. This shall mitigate the potential conflicts in presence of nonaligned utility functions.

The figure below shows computer simulations that assume that agents prefer to connect to the neighbours of their neighbours that have a higher centrality, which creates local shortcuts. Network efficiency is measured on the basis of the aggregate centrality of agents. Environmental volatility measures the risk that if any single agent is exposed to an exogenous shock, it will force the deletion of one link. If the loss of links pushes the network efficiency down and environmental volatility up past some critical level, the strongly homogeneous network structure will break down into a sparse, hierarchical structure, similar to a core-periphery structure and is accompanied with a breakdown in network efficiency.

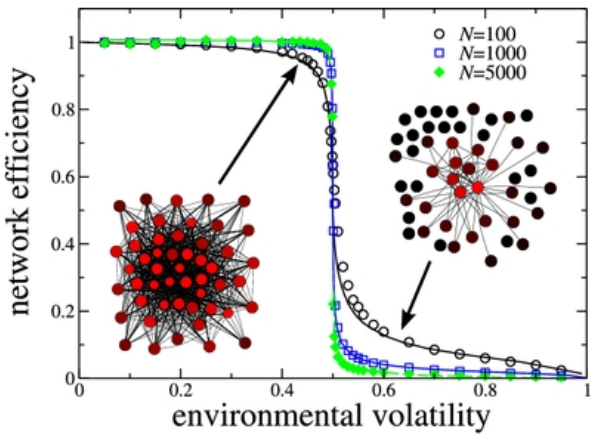


Figure 5.14: Computer simulations of network efficiency versus environmental volatility, highlighting the critical region described in the text above.

5.13 CYBEREMOTIONS: Collective Emotions in Cyberspace

Duration 52 months (February 2009 – January 2013)

Funding program EU 7th Framework Programme. Theme 3: Science of complex systems for socially intelligent ICT.

Project partners Warsaw University of Technology (Poland), École Polytechnique Fédérale de Lausanne (Switzerland), University of Wolverhampton (UK), Österreichissche Studiengesellschaft für Kybernetik (Austria), ETH Zürich (Switzerland), Jozef Stefan Institute Ljubljana (Slovenia), Jacobs University Bremen (Germany), Technical University Berlin (Germany), Gemius SA (Poland).

Total budget 3,600,000 EUR

Benefit for the Chair 543,000 CHF

This project is related to our research topics **Emotional Influence in Social Media** (Section 2.2.6), and **Structure and Dynamics of Online Social Networks** (Section 2.2.1).

CYBEREMOTIONS

The project **Cyberemotions** studied the role of collective emotions in creating, forming and breaking-up of e-communities. Understanding these phenomena is important in view of the growing role of ICT-mediated social interactions and specific features of e-communities. The challenge of this interdisciplinary project is to combine both psychological models of emotional interactions and algorithmic methods for detection and classification of human emotions in the Internet. The latter uses probabilistic models of complex systems and data driven simulations based on heterogeneous emotionally reacting agents. Our theoretical foundations mainly apply statistical physics approaches of emergent properties in multi-agent systems and methods developed to model self-organizing networks. On the empirical side, we concentrate on how to support and maintain emotional climates of security, trust, hope, and freedom in future techno-social communities and how to prevent and resolve conflicts in them.

At the **Chair of Systems Design**, we focus on agent-based models of collective emotions. We collaborate with Jacobs University Bremen on psychological experiments, analyzing emotion dynamics when people read or interact in the web. The Unversity of Wolverhampton and the OFAI in Vienna provided datasets and tools for emotional text classification, which we used for the analysis of large datasets from Twitter, product reviews, and IRC chat discussions. These results and data helped us to develop theoretical models for the emergence of collective emotions in cyberspace in collaboration with the groups in the Technichal Unversity of Warsaw and the Jozef Stefan Institute in Ljubljana. The partners in OFAI, EPFL, and the Technichal University of Berlin build on these models to develop the next generation of **emotion-aware ICT technologies**, using the emotion dynamics of our models to simulate emotions in virtual humans and dialog systems.

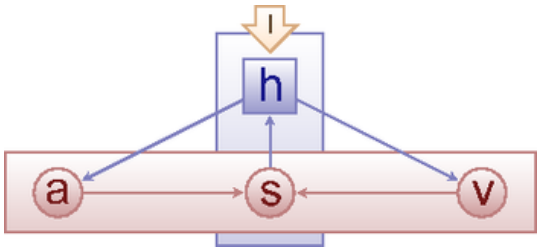


Figure 5.15: Causal relations among the components used in a general modelling framework for online emotional expression. Agents have internal emotional states composed by valence v and arousal a. These determine the agent's expression s, which is reflected to the communication field h that can influence the emotions of other agents.

5.14 Coping with Crises in Complex Socio-economic Systems

Duration 36 months (September 2008 – August 2011)

Funding source ETH Research Grant (CHIRP I)

Research partners Six chairs from three different departments of ETH Zürich: Prof. Kay Axhausen (D-BAUG), Prof. Lars-Erik Cederman (D-GESS), Prof. Dirk Helbing (D-GESS), Prof. Hans J. Herrmann (D-BAUG), Prof. Frank Schweitzer (D-MTEC), Prof. Didier Sornette (D-MTEC).

Total budget 650,000 CHF

Benefit for the Chair 108,000 CHF

This project is related to our research topics **Systemic Risk** (Section 2.1.4) and **Financial networks** (Section 2.3.2).

The research grant further supports the activities of our ETH Competence Center 'Coping with Crises in Complex Socio-Economic Systems' (CCSS), which started in September 2008 (see also `http://www.ccss.ethz.ch`). By means of theoretical and empirical analysis, CCSS aims at understanding the causes of and cures to crises in selected problem areas, for example in financial markets, in societal infrastructure, or crises involving political violence. While these different crises may have their own time scale and evolution, they can be seen as the unintentional result of the interaction among millions of social actors. In this project, we look at these crises as emergent phenomena in complex systems and we investigate the feedback mechanisms that generate them as well as the possible strategies to prevent or mitigate them.

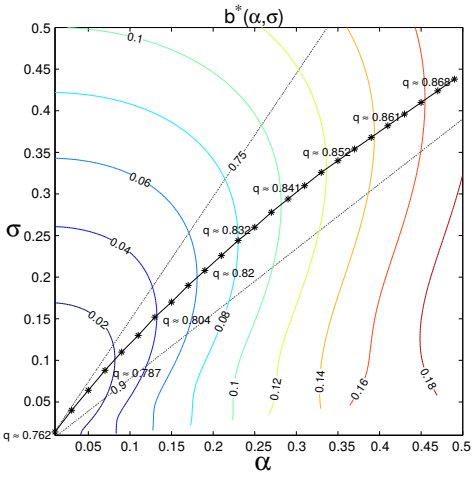


Figure 5.16: Contour plot for the systemic default probability $b^*(\alpha, \sigma)$. The solid black line denotes the optimal value of the shocks level, σ, regarding a fixed shock strength α.

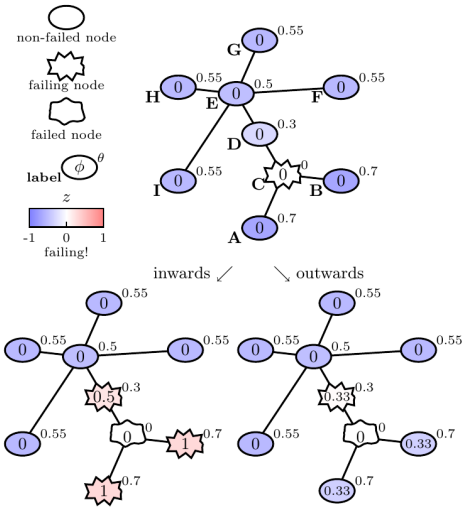


Figure 5.17: Illustration of a model for cascading failures in socio-economic systems.

Overall, the project consists of 3 working packages and our contribution is mainly in the first package: "Crises in Markets". Our scientific goal is to investigate possible mechanisms for the control of systemic risk and for the mitigation of crises. We have started developing a dynamic model of financial fragility that is based on the literature on liability networks in financial economics. We are able to analytically investigate the relation between individual risk diversification and emerging systemic risk, in the presence of financial acceleration. Understanding this relation is a first important step towards the possible control of systemic risk. On-going work focuses on extending the model to more complex situations and network structures.

5.15 Proof-of-Concept of a Trust-based Recommender System

Duration 18 months (May 2008 – October 2009)

Funding source MTEC Foundation, Stiftung zur Förderung der Forschung und Ausbildung in Unternehmenswissenschaften an der ETH Zürich

Total budget 70,000 CHF

Benefit for the Chair 70,000 CHF

This project is related to our research topic **Design and analysis of socio-technical systems** (Section 2.2.3).

Recommender Systems (RS) are applications that enable users of a particular online platform, e.g. Amazon, Last.FM, etc., to retrieve information on products and services offered. This information can be provided at different levels of personalisation and filtering. Thus, RS can be seen as tools to support the decision-making of consumers; because of this, they have become more and more widespread in all economic sectors. This project extends a novel type of electronic RS, developed at our chair, towards a real-world application. Differently from existing RS, the proposed system leverages the fact that users are part of a real social network and that they trust each other to different extents depending on the context. The main benefit of this approach is that it offers personalisation i.e. the recommendations is tailored to each individual user.

The main objective of the project is to prove the feasibility of a trust-based recommender system using social networks. We achieved this goal by developing a Knowledge Sharing Playground (KSP) which is, at a glance, a web application where users can share knowledge with other users. The framework implements the trust algorithms presented in [159] and extended in [144].

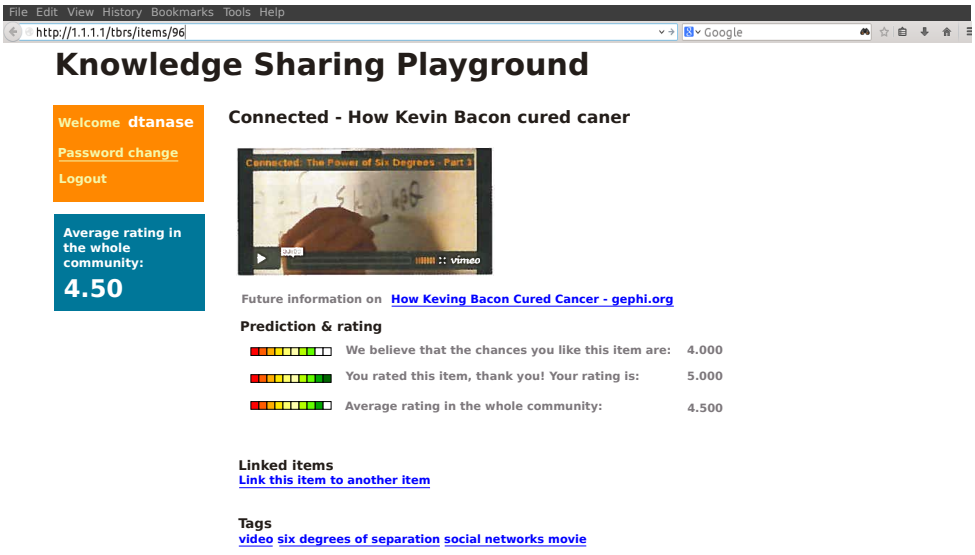


Figure 5.18: Screen capture of Knowledge Sharing Playground

5.16 Ownership Networks and Corporate Control

Duration 47 months (November 2006 – September 2010)

Funding source Olsen Ltd., Zürich (Switzerland).

Total budget 158,708 CHF

Benefit for the Chair 158,708 CHF

This project is related to our research topics **Ownership Networks** (Section 2.3.3) and **Systemic Risk** (Section 2.1.4).

This project addresses the following challenging research questions: Who holds the most control in our globalised world? How is economic control distributed globally? To what degree are the top economic actors interconnected with each other? The project analyses such questions at various levels. First of all, we develop a formal model that serves as framework to tackle issues pertaining to real-world systems. We present a methodology to extract the backbone of complex networks based on the weight and direction of links, as well as on non-topological properties of nodes. The next level consists in the validation of such model on actual data sets. Remarkably, we show how the methodology can be applied in general to networks in which mass or energy is flowing along the links.

Our cross-country investigation of ownership networks – focusing on the stock markets of 48 countries around the world – confirms the results reported in the literature on corporate control, namely, that in Anglo-Saxon countries control tends to be dispersed among numerous shareholders. On the other hand, it also reveals that in the same countries, control is found to be highly concentrated at the global level, i.e. lying in the hands of very few important shareholders. Interestingly, the exact opposite is observed for European countries.

In addition, we observe that the global network of corporations displays a peculiar topology, reflects the flow of control across agents: the "bow-tie". We find that the most powerful actors are interconnected in a tightly-knit group, thus aligning their interests and behaving as a single economic *super-entity*, with implications for market competition and financial systemic risk. We also develop models of network evolution that are able to reproduce the emergence of bow-tie topologies and the economic "super entity", by allowing the economic agents to maximise their level of control.

Among the major deliverables of the project, there are several publications and talks, press coverage, and the graduation of one doctoral candidate.

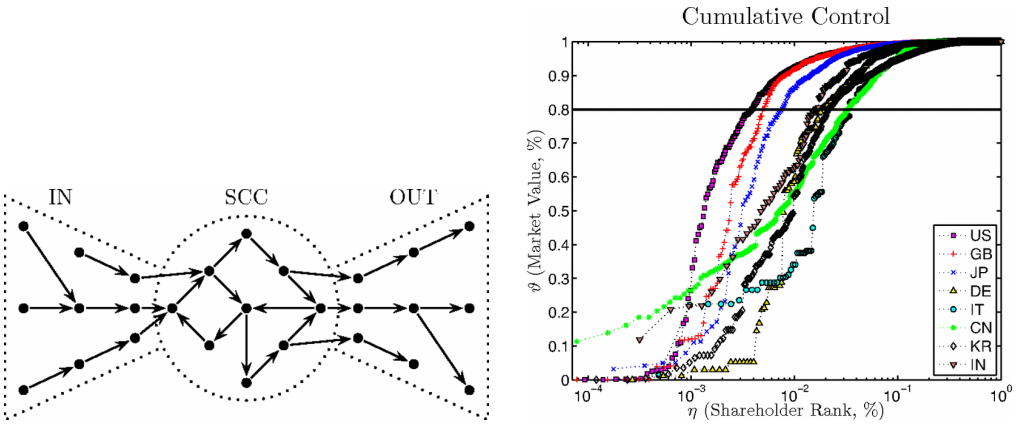


Figure 5.19: Left: schematic illustration of a bow-tie topology: the central area is the strongly connected component (SCC), whilst the left (IN) and right (OUT) sections contain the incoming and outgoing nodes, respectively. Right: cumulative distribution of *control* value across all shareholders in the network.

5.17 Physics of Risk

Duration 27 months (September 2006 – November 2008)

Funding program COST-P10 action, Swiss State Secretariat for Education and Research SERI (Project C05.0148)

Project partners ETH Zürich, Chair of Systems Design, ETH Zürich, Institute for Operations Research, Zürich University of Applied Sciences Winterthur, Institute for Data Analysis and Process Design, University of Fribourg, Department of Physics, University of Geneva, Department of Theoretical Physics

Total budget 715,000 CHF

Benefit for the Chair 327,780 CHF

This project is related to our research topic **Systemic Risk** (Section 2.1.4).

The network structure of a social or economic organisation directly relates to system properties such as robustness against perturbations, or adaptivity in a changing environment. For organisations, the risk to fail thus can be seen as coming from these different sources, namely lack of robustness and lack of adaptivity. In a first part of this project we thus aim at quantifying the relations between network structure, robustness and adaptivity of organisations by means of both theoretical and empirical investigations.

Failure risk propagation is a phenomenon with great impact in today's society. In a second part of the project, we thus aim at understanding how failures and bankruptcies of firms affecting other connected firms, might impact global dynamics, i.e., leading to cascading of failures or not. We use the well-studied paradigm of multiplicative processes to model firm growth, but in contrast to previous works, we couple the budget growth of firms, creating a connected network of firms. Indeed, it is widely known that network topology has a huge impact in the process that occurs on it, and we intend to study this influence in the global dynamics of the system. We will investigate how different mechanisms of failure cost absorption by neighbouring firms influences the global dynamics taking into account the topology. The results will provide valuable insight into how policies and individual hedging strategies affect the vulnerability of the whole system, in other words, the systemic risk, an issue poorly addressed by current theories.

As one of the deliverables of this project, we organised the international workshop "The Physics Approach to Risk: Agent-Based Models and Networks" (see Section 7.1.16).

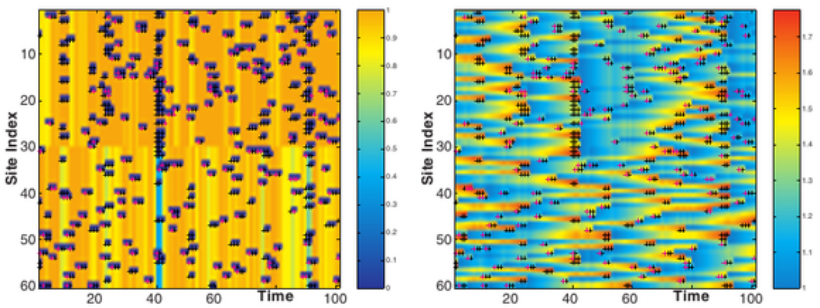


Figure 5.20: Visualisation of the time evolution of distress in a network.

5.18 Measuring and Modeling Complex Networks across Domains

Duration 40 months (February 2005 – May 2008)

Funding program EU 6th Framework Programme, NEST PATHFINDER "Tackling complexity in science". Contract Nº 12999 (NEST)

Project partners University of Oxford (UK), Technische Universität Dresden (Germany), Politechnika Warszawska (Poland), INSEAD Business School (France), Stockholm University (Sweden)

Total budget 1,500,000 EUR

Benefit for the Chair 372,100 CHF

This project is related to our research topics **Financial networks** (Section 2.3.2) and **Analysis of biological systems** (Section 2.1.3).

The MMCOMNET project has set out to measure and model complex networks from different domains, with the goal of understanding their structure, function and behaviour. The project seeks to integrate macroscopic or top-down approaches, and bottom-up approaches utilising recent findings from the science of complexity. The investigation focuses on data and models of some specific systems chosen as examples from three different domains, representing biological, socio-economic and innovation networks. These systems include: fungal networks, textile supply networks, credit networks, venture capital networks, road and transportation networks. The project exploits advances in complexity science to elucidate the individual and collective behaviour of agents. The participants are developing models which simulate the different combinations of agents and network dynamics that can account for desirable behaviour. Criteria for choosing between alternative combinations provide insights into how agents and networks adapt, and the trade-offs that occur between different network functions. In the case of the supply-chain model, for example, the conditions that enable networks to retain their integrity in the face of local disruptions are being investigated.

The overall aim of the project is to generate modelling approaches and formulate universal principles to aid in the management of complex networks in real-world situations. The desirable properties observed in model networks can potentially be transferred to networks involving computers, information, business and enterprise, power grids, and railway or other transport systems. The potential long-term benefits from this project are therefore great, and could improve the quality of life of almost everybody in the EU.

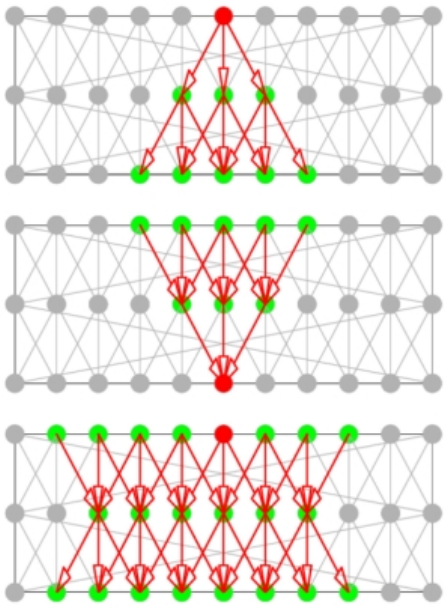


Figure 5.21: Propagation of production failures in a simplified network of supply. Failures propagate downwards to the initial shock (the node in red) or upwards or both, depending on the cost involved.

6 Teaching

In 2004, when Frank Schweitzer started at ETH Zürich, he became part of the new *Department of Management, Technology, and Economics* (D-MTEC) and has been involved from the beginning in developing the curriculum for the new Master of Science program in Management, Technology, and Economics (MSc MTEC). This program is targeted at Swiss and international students with a technical background, who want to obtain additional qualifications in management and economics – to meet the requirements of leading technology oriented companies. At the same time, the scientific frontiers in management and economics have to be an integral part of this educational program, with ETH Zürich aiming to be a player in the top league of scientific research institutions.

For us, this meant developing completely new courses on subjects we had not dealt with before. The challenge is not only to pay attention to the requirements of practitioners, but also to provide a strong quantitative methodological background to advance scientific research on these topics. In all these courses emphasis is put on the quantitative understanding of socio-economic systems, to model their structure and dynamics and to optimise and design their behaviour

Currently, we offer three different courses at the master level, which are all accompanied by extensive exercises. One course, *Systems Dynamics and Complexity* is a core course of the MTEC curriculum. The other two courses, *Complex Networks* and *Agent-Based Modelling of Social Systems* are elective courses in the master programs in agricultural science, management, technology and economics, mathematics and physics. The syllabuses of the two elective courses have changed in the past years. *Complex Networks* had predecessors in our courses on *Economic Networks* and *Complex Adaptive Systems*. *Agent-Based Modelling* had predecessors in our courses on *Collective Dynamics of Firms* and *Dynamics of Companies*. Figure 6.1 shows the increase in the number of students attending two of the courses.

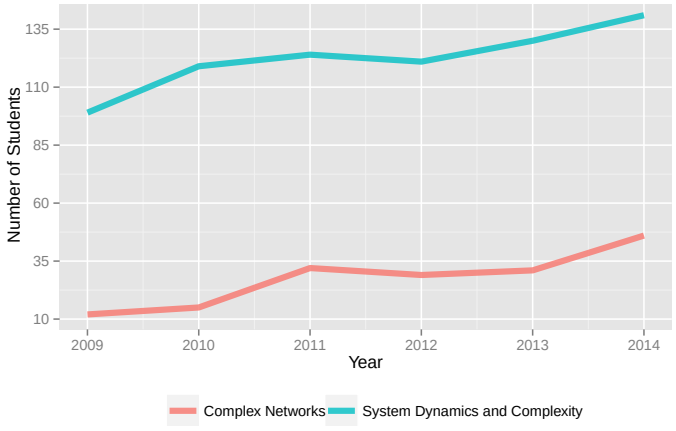


Figure 6.1: Registered students at the beginning of the semester. For the numbers of Complex Networks, its precedent courses Economic Networks and Complex Adaptive Systems were used.

6.1 Systems Dynamics and Complexity

Why are problems not simple? Why do some systems behave in an unintended way? How can we model and control their dynamics? The course provides answers to these questions by using a broad range of methods encompassing systems oriented management, classical systems dynamics, nonlinear dynamics and macroeconomic modelling. The course is structured along three main tasks:

1. Finding solutions
2. Implementing solutions
3. Controlling solutions

Part 1 introduces complexity as a system immanent property that cannot be simplified. It introduces the problem solving cycle, used in systems oriented management, as an approach to structure problems and to find solutions.

Part 2 discusses selected problems of project management when implementing solutions. Methods for identifying the critical path of subtasks in a project and for calculating the allocation of resources are provided. The role of quality control as an additional feedback loop and the consequences of small changes are discussed.

Part 3, by far the largest part of the course, provides more insight into the dynamics of existing systems. Examples come from biology (population dynamics), management (inventory modelling, technology adoption, production systems) and economics (supply and demand, investment and consumption). For systems dynamics models, the software program Vensim is used to evaluate the dynamics. For economic models analytical approaches, also used in nonlinear dynamics and control theory, are applied. These together provide a systematic understanding of the role of feedback loops and instabilities in the dynamics of systems. Emphasis is on oscillating phenomena, such as business cycles and other life cycles.

Weekly self-study tasks are used to apply the concepts introduced in the lectures and to come to grips with the software program ***Vensim****.*

1. Systems: Basic Concepts
Lecture 01– Overview, Problems - Basic Concepts

- About this course: administrative issues, self-study tasks, seminars
- Problems and their solutions: finding, implementing, understanding

Exercise 01: Systems and Systems thinking (discussion exercise)

2. Systems Engineering
Lecture 02 – Systems Engineering/Problem Solving Cycle

- Systems engineering/ systems oriented management: basic approach
- Problem solving cycle (PSC) I: situation analysis, definition of objectives
- Problem solving cycle II: search for solutions, validation and decision

Exercise 02: PSC – Airport example I (discussion exercise)

3. Project Management
Lecture 03 – Project Management I/Project Scheduling

- Project phases
- Bar chart scheduling

- Critical path method: precedence network, forward and backward pass, float

Exercise 03: PSC – Airport example II (discussion exercise)

Lecture 04 – Project Management II/Quality Control

- Milestone-trend diagram
- Integrated cost and date control
- Feedback loops, modelling stocks and flows

Exercise 04: PEST and SWOT analysis (discussion exercise)

4. System Dynamics

Lecture 05 – System Dynamics I/Modelling

- What is modelling? software program overview (Vensim)
- Feedback processes, causal loops
- Example: predator-prey population dynamics

Exercise 05: Population Dynamics (Vensim exercise)

Lecture 06 – Systems Dynamics II/Inventory Modelling

- Workforce-inventory model
- Case study: high velocity industry

Exercise 06: Workforce Inventory Dynamics (Vensim exercise)

Lecture 07 – Systems Dynamics III/Market Growth

- Demand life cycle
- Technology adoption
- Mixed source model

Exercise 07: Adoption of Innovations (Vensim exercise)

5. Nonlinear Dynamics

Lecture 08 – Nonlinear Dynamics I: Bifurcations and Chaos

- Control parameters, bifurcation
- Logistic map
- Chaos, Liapunov exponent

Exercise 08: Logistic Map (Applet exercise)

Lecture 09 – Nonlinear Dynamics II: Applications to Economics

- Supply and demand

- Cobweb dynamics
- Market interaction, bifurcation diagrams

Exercise 09: Cobweb Dynamics (Vensim exercise)

6. Economic Dynamics

Lecture 10 – Economic Dynamics/Production Functions

- Cobb-Douglas production function
- Solow model

Exercise 10: Coupled Cobweb Dynamics (Vensim exercise)

Lecture 11 – Nonlinear Dynamics of Economic Cycles I

- Business cycles
- Time-dependent production function
- Kaldor trade model

Exercise 11: Neoclassical Growth Model (Vensim exercise)

Lecture 12 – Nonlinear Dynamics of Economic Cycles II

- Samuelson's multiplier-accelerator model
- Hick's model
- Goodwin model

Exercise 12: Kaldor Model and Business Cycles (Vensim exercise)

Summary

Lecture 13 – Summary

- Finding, implementing and cotrolling solutions

Exercise 13: Hicks'and Goodwin's Models of Business Cycles (Vensim exercise)

6.2 Complex Networks

Networks matter! This holds for social and economic systems, for technical infrastructures like the Internet as well as for information systems like the World Wide Web. How can we understand the evolution of such networked systems and what are the local processes that shape their global features? How does their topology influence dynamical processes like epidemic spreading, cascading failures or consensus? And how can we characterise the importance of a specific node? In this course, students get a broad overview of the methods used in the quantitative study of complex networks.

The course will show how networks can be represented mathematically and how properties of their link structures as well as the importance of individual nodes can be quantified. Students will understand how networks influence the spreading of information, epidemics or the propagation of cascading failures. We will explore how complex link topologies emerge from simple network formation processes and we will study methods that allow us to assess the systemic risk associated with the topology of complex social, economic and technical systems.

Weekly exercises are available and are encouraged to complete in ***Python*** *using the* ***igraph*** *package.*

1. Random Graphs and Complex Networks

Lecture 01 – Motivation

In this lecture, participants will get an overview of the course and will learn the differences between an agent-based modelling and a complex networks perspective.

- Administrative issues and overview of the course
- Introduction: Agent-based modelling vs. a network approach
- Motivation: The role of network structures in complex systems
- Illustrative examples of complex networks in nature, society, economy and technology

Exercise 01: Introduction to igraph and python

Lecture 02 – Introduction to Graphs and Networks

In this lecture, students will learn how to mathematically represent complex networks and how to quantitatively analyse the importance of nodes.

- Basic definitions: graph, network, adjacency matrix, path, cut, degree
- Importance of nodes: betweenness, closeness and degree centrality
- Modules and clusters: clustering coefficient and modularity
- Example: Open Source collaboration network

Exercise 02: Analysis of empirical networks with igraph

Lecture 03 – Ensemble Perspective of Complex Networks

In this lecture, participants will learn how networks can be represented and analysed from a statistical point of view.

- Educational Objective: Learn
- Graph theory vs. network science: the ensemble perspective
- Erdős-Renyi (ER) random graph model
- Degree distribution and average degree in ER graphs
- Counterexample: degree distribution in OSS collaboration network

Exercise 03: Generating random graphs with igraph

Lecture 04 – Connectivity in Complex Networks

Educational Objective: In this lecture, students will understand what kind of statements one can make about the properties of a network if one only knows the distribution of node degrees.

- Understand what the degree distribution alone tells about the structure of networks
- Ensembles of networks with fixed distribution of degrees: Molloy-Reed algorithm
- Mathematical analysis of network topology: generating functions
- Condition for a giant connected component: the Molloy-Reed criterion
- Example: OSS collaboration network vs. instances of Molloy-Reed ensemble

Exercise 04: Exploring the connectivity phase transition in igraph

Lecture 05 – Analyzing Robustness and Resilience

In this lecture, participants will learn how the distribution of node degrees influences systemic risk in networked systems.

- Analysis of network robustness: random failures
- Analysis of network resilience: targeted attacks
- Scale-free degree distributions: super-resilience vs. super-susceptibility
- Counterexample: Internet topology vs. random scale-free networks

Exercise 05: Simulating robustness and resilience of networks

2. Dynamical processes on Complex Networks

Lecture 06 – Diffusion processes and Feedback centrality

In this lecture, students will learn how the structure of complex networks influences a simple model for information diffusion and how we can use this to learn about the importance of nodes.

- Random walk processes in complex networks
- Perron-Frobenius theorem: when does a unique stationary distribution exist?
- Eigenvector centrality and the random surfer model
- Example: PageRank in a network of linked documents

Exercise 06: Eigenvector vs. betweenness centrality in an OSS social network

Lecture 07 – Spectral properties of Complex Networks

In this lecture, students will learn how the influence of a network's topology on dynamical processes is captured in the eigenvalues of adjacency matrices.

- Powers of adjacency matrices and algebraic methods
- Algebraic connectivity, Fiedler vector, eigenvalue gap and eigenratio of complex networks
- Synchronisation of agents in complex networks
- Example: inadvertent synchronisation in Internet router networks

Exercise 07: Simulating information diffusion in networks with clusters

Lecture 08 – Epidemics and cascading processes

In this lecture, students will see how the network perspective can be used to understand the resilience of online communities.

- k-core decomposition of networks
- Cascading processes in networks
- A cascade model for social resilience
- Example: case study in Friendster community

Exercise 08: k-core decomposition of Friendster network

3. Network evolution: Emergence of Complex Structures

Lecture 09 – Stochastic Optimisation of Network Structures

In this lecture, students will understand why statistical physicists are often studying complex networks and they will learn that the emergence of some network structures can be understood as a (distributed) optimisation process.

- Complex networks: the perspective of statistical mechanics
- Link costs and link potentials: generating energy landscapes for networks
- Heterogeneous agent fitness: emergence of scale-free networks
- Example: Multiplicative Attribute Graph Model with Node Fitness (Leskovec)

Exercise 09: Simulating random scale-free networks with Molloy-Reed algorithm

Lecture 10 – Structure formation in growing networks

In this lecture, students will learn that feedback phenomena in the growth of networks can lead to the formation of complex structures.

- A non-equilibrium perspective on growing complex networks
- Feedback in network growth: the preferential attachment model
- Analysing preferential attachment: emergence of scale-free degree distributions
- Example: Modelling growing citation networks

Exercise 10: Scale-free networks: Comparison between preferential attachment and Molloy-Reed

Lecture 11 – Strategic Network Formation

In this lecture, participants will see that strategic behaviour of agents can lead to the formation of complex networks and they will learn that strategies which are - from an agent's perspective - optimal can result in networks that are - from a systems perspective - not optimal.

- Ensemble perspective vs. agent-based models for network formation
- Strategic link formation
- Pareto stability vs. efficiency of network structures
- Example: evolution of Research & Development collaborations

Exercise 11: Efficient vs. Pareto stable networks

Lecture 12 – Evolution of multi-layer networks

In this lecture, students will see that the coupling of different layers of complex networks can lead to new systemic properties.

- Socio-technical and cyber-physical systems: Multiple layers of complex networks
- Network formation: Coupling and feedback between network layers
- Network cascades in multi-layer networks
- Example: Collaboration and citation networks in science

Exercise 12: Simulating coupled networks in igraph

Lecture 13 – Temporal Networks

In this lecture, students will understand that the dynamics of links in networks adds an additional dimension of complexity on top of the network topology.

- Motivation: inseparable time scales between network evolution and dynamical processes
- Basics of temporal networks: time-respecting paths, inter-event times and node activities
- Time-aggregated representations and non-Markovian temporal networks
- Example: RealityMining dynamic social network

Exercise 13: Betweenness centrality in temporal networks

6.3 Agent-based Modelling of Social Systems

Individuals live in groups! Their weave of dynamical and differentiated interactions results in complex societies, whose properties and ruling principles can only be fully unravelled when studying the underlying social system from a formal standpoint.

In this course, we use agent-based modelling as a bottom-up tool to study social systems. Agents have internal degrees of freedom (opinions, strategies), the ability to perceive, and to change, their environment, and to interact with other agents. Their (inter)actions result in collective dynamics with emergent properties that need to be analysed and understood quantitatively. We focus on a parsimonious description of the agent behaviour which relates individual interaction rules to the dynamics on the system level, and complements engineering and machine learning approaches to modelling. Whilst the lectures focus on the theoretical foundations of agent-based modelling, they are illustrated on a more practical level in weekly exercise classes.

*Exercises will be completed by using the programming language **Python**. During the exercise classes, assistants will help the students with implementation issues and answer their questions, to help them reach the solution by themselves. During the second half of the semester the students will work in groups on a project: formulating, implementing and analyzing an Agent Based Model.*

Introduction
Lecture 01 – Introduction, Motivation *19.02.2015*

- administrative issues, motivation: formal understanding of social mechanisms
- what are agents; simulation techniques and tools - Python

Exercise: Learning about Python/NumPy, installation (due: 26.02.2015)

1. Models of Boolean agents
Lecture 02 – Opinion dynamics I *26.02.2015*

- cellular automata: Conway's Game of Life
- voter models; social impact theory

Exercise: Running two sample models in Python (game-of-life and voter model (due: 05.03.2015)

Lecture 03 - Path dependence and basic game theory *05.03.2015*

- lock-in effects: linear and non-linear Polya urn models
- introduction to game theory: minority game

Exercise: Implementation of linear and non-linear Polya models (due: 12.03.2015)

Lecture 04 - Modelling cooperation *12.03.2015*

- modelling cooperation in a game-theoretic setting
- social herding and cooperation

Exercise: Implementation of Prisoner's dilemma game (due: 19.03.2015)

Lecture 05 – Systemic risk *19.03.2015*

- introduction to networks: nodes and links, node degree, coreness
- models of cascading failure

Exercise: Course project – introduction, topics overview (due: 26.03.2015)

2. Models of Brownian agents

Lecture 06 – Opinion dynamics II *26.03.2015*

- bounded confidence models
- how groups can foster consensus

Exercise: Implementation of bounded confidence model (due: 02.04.2015)

Lecture 07 – Competition: hierarchy and reputation *02.04.2015*

- direct and indirect reciprocity
- reputation model with emergent hierarchy

Easter Break: no exercise class (due: 16.04.2015)

Lecture 08 – Strategic interactions *16.04.2015*

- knowledge production
- efficiency of a system versus local stability

Exercise: Course project – the model formulation (due: 23.04.2015)

Lecture 09 – Emotions *23.04.2015*

- agent-based modelling of emotions: communication as nonlinear interaction
- collective emotions in product reviews

Exercise: Course project – the model formulation (due: 30.04.2015)

3. Models of spatial interactions

Lecture 10 – Migration *30.04.2015*

- Schelling's segregation model
- Prisoner's dilemma with migration

Exercise: Course project – implementation (due: 07.05.2015)

Lecture 11 – Collective motion *07.05.2015*

- social force model, swarming in simple systems
- trail formation and human motion

Exercise: Course project – implementation (due: 21.05.2015)

Lecture 12 – Competition in space *21.05.2015*

- extended reputation model: radius of influence
- Sugarscape model

Exercise: Course project – analysis (due: 28.05.2015)

Lecture 13 – Summary *28.05.2015*

- wrap-up of the course
- Q&A

Exercise: Course project presentations

7 Events

Events organised by our team are an important measure to increase our visibility. This was of particular importance ten years ago, when we started and had not established our reputation, yet. During the first years, SG seminars with distinguished external speakers were organised on a regular basis – whereas today many of our guest speakers are invited to the ETH Risk Center Seminar Series, jointly organised with the ETH Risk Center (and its predecessor, the CCSS Seminar Series, jointly organised with the Chairs involved in the Competence Center 'Coping with Crises in Complex Socio-Economic Systems' CCSS).

In addition to these activities, we also organised international workshops and schools for young scientists on research topics we are involved in. Some of these workshops were hosted in Zürich, which allowed us to attract invited speakers and participants from all over the world to ETH Zürich. In many cases, these workshops became the starting point of fruitful collaborations with researchers from Switzerland and abroad. They were a good opportunity for us to disseminate the results of our research.

Neue Zürcher Zeitung International | Reflexe | 17.09.12 / Nr. 216 / Seite 7 / Teil 01

LEHREN AUS DER FINANZKRISE

Besser verstehen, wieso die Politik was macht

Peter A. Fischer · An der ETH in Zürich haben sich vergangene Woche Forscher aus verschiedenen Disziplinen und Weltgegenden getroffen, um am Latsis Symposium unter dem Titel «Economics on the Move – Trends and Challenges from the Natural Science» Lehren aus der Finanzkrise zu ziehen.

Klar zeigte sich, dass die herkömmlichen ökonomischen Modelle den Finanzsektor krass vernachlässigt haben und überhaupt die Mikrofundierung makroökonomischer Systeme verbessert werden muss. Aus der Physik adaptierte Modelltechniken können vielleicht helfen, besser zu verstehen, wie die Dynamik in Systemen wirkt. Denn es genügt eben nicht, dass Komponenten stabil sind, damit ein System stabil ist. Die sich rasch weiterentwickelnde Verhaltensökonomie will dazu beitragen, dass wir besser verstehen, wie sich eine Dynamik entfaltet. Dennoch bleiben wohl ganz simple Erkenntnisse aus der Ökonomie gültig: Feinsteuerung funktioniert selten, es braucht möglichst einfache Regeln

Figure 7.1: Neue Zürcher Zeitung reflecting on the *Latsis symposium* organised by the Chair of Systems Design at ETH Zürich, 2012

7.1 Workshops and Schools

7.1.1 Satellite Workshop: Dynamics on and of Complex Networks VII

Date and Location September 24, 2014, Lucca, Italy

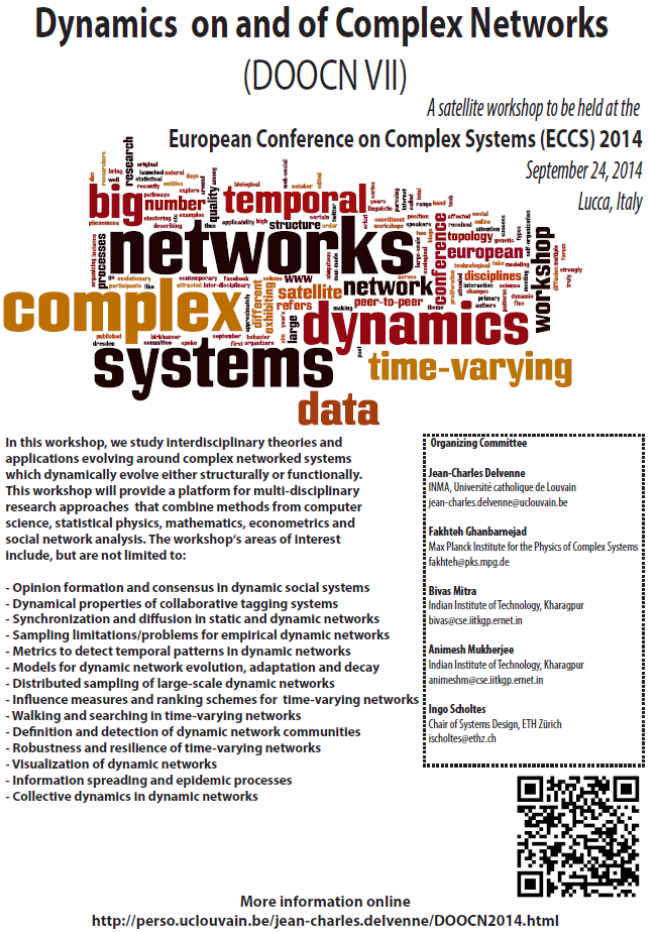
Conference European Conference on Complex Systems 2014

Website `http://perso.uclouvain.be/jean-charles.delvenne/DOOCN2014.html`

"Network Science" has recently attracted the attention of a large number of researchers from across various disciplines, mainly due to its ubiquitous applicability in modelling the structure and dynamics of large-scale complex systems (both natural and man-made). Examples of such systems, exhibiting complex interaction patterns among their constituent entities, range from genetic pathways and ecological networks to the WWW, peer-to-peer networks, and blogs and online web-social networks (such as Facebook, Orkut and Twitter).

For the past six years, the primary aim of the series of workshops "Dynamics on and of Complex Networks", held as a satellite meeting of the European Conference on Complex Systems, has been to explore the (statistical) dynamics on and of such complex networks. Dynamics on networks refers to the different types of so called processes (e.g. proliferation, diffusion etc.) that take place on networks. The functionality/efficiency of such processes is strongly affected by the topology as well as the dynamic behaviour of the network. On the other hand, Dynamics of networks mainly refers to various phenomena (for instance self-organisation, evolutionary clustering) that go on in order to bring about certain changes in the topology of the network.

This year's theme was on Big Data.



7.1.2 Satellite Workshop: Quantitative Analysis of Collective Behavior: From the Lab to the Wild

Date and Location August 9, 2014, Princeton, USA

Conference Animal Behavior Society 2014 Conference

Website `http://abs2014.princeton.edu/`

Recent advances in computer vision and telemetry have made it possible to gather high-resolution spatiotemporal data on the movements and interactions of animals within groups (and increasingly in populations as a whole), both in laboratory and field conditions. The development of these methods has largely been driven by the aim of understanding the individual rules that govern collective behaviour, but are increasingly being applied in a broader ecological context. Behavioral researchers are currently creating and testing new analytical frameworks in order to make sense of the unprecedented volume and precision of the data collected. Such frameworks are necessary to get an integrated understanding of mechanisms of coordination and the dynamic emergent functional properties of animal groups.

In this workshop, we will present an overview of the latest research achieved by employing automated techniques to measure animal behavior and social interactions in both laboratory and field settings. In particular, we will focus on studies which have involved the collection of high-frequency data at multiple scales. We will also review existing and in-development tools to gather and process such data, to build dynamic networks of interactions, and to analyze information transfer in large animal populations. We will stress the importance of developing methods that can apply across systems, and scales, in order to obtain an integrated understanding of the social and ecological factors underlying collective animal behavior.

he workshop will gather students and researchers at all levels studying social and group behaviors in the laboratory and/or in the field. It will feature short presentations on the latest tools and techniques (existing or in development) to collect and process interaction and movement data from animal groups. The workshop will also feature discussion panels aimed at identifying future research directions and collaboration areas to unify laboratory and field studies of collective behavior.

7.1.3 Satellite Workshop: Higher-Order Models in Network Science

Date and Location June 3, 2014, Berkeley, USA

Conference International School and Conference on Network Science (NetSci2014)

Website `http://www.hons.netsci2014.net`

The study of complex systems from a network perspective has undoubtedly been a success story so far. Innumerable studies have shown how schematizing the elements and their interactions of a complex system with nodes and links can help us to provide insights into the system's structure, dynamics, and function. The increasing availability of data on complex systems creates a great opportunity for this approach to further prosper. That is, we anticipate that more and more systems can and will be studied with tools from network science.

However, the fact that the data are increasingly rich and complex also give rise to new and unique challenges: Studies of time-varying complex systems facilitated by newly available high-resolution longitudinal data question the effectiveness of the conventional network approach and suggest that higher-order models are required to gain insight into the structure and dynamics of such systems. For similar reasons, models enriched by node activities or temporal motifs have been suggested. Moreover, increasingly available rich data on static networks have stimulated work on augmented network models that incorporate multiple layers, modules, or link types.

All these approaches are seemingly different, yet they all highlight the same thing: For a number of complex systems, a simple abstraction of their organisation into nodes and links is not sufficient for understanding their structure, dynamics, and function. This observation raises fundamental questions: When are simple network models sufficient and when are they not? What additional ingredients are needed to accurately model the dynamical processes? With access to more and more relational data, what are the most efficient ways to capture the structural information? These are questions that we would like to address in this workshop.

7.1.4 Satellite Workshop: SAOS2014 - 2nd International Workshop on Self-Optimisation in Organic and Autonomic Computing Systems

Date and Location February 25, 2014, Lübeck, Germany

Conference ARCS2013: 26th International Conference on Architecture of Computing Systems

Website `www.informatik.uni-augsburg.de/lehrstuehle/oc/Veranstaltungen/oc-ws-arcs14/`

Initiatives like Autonomic Computing (AC) and Organic Computing (OC) are based on the insight that we are increasingly surrounded by large collections of autonomous systems, which are equipped with sensors and actuators, aware of their environment, communicating freely, and organising themselves in order to perform the required actions and services. The presence of networks of intelligent systems in our environment opens fascinating application areas but, at the same time, bears the problem of their controllability.

Hence, different design concepts (like the MAPE cycle and the Observer/Controller framework) have been developed to allow for a self-organised control process at runtime that relieves the designer from specifying all possibly occurring situations and configurations within the design process. Instead, the system itself takes over responsibility to find proper reactions on perceived changes in the environmental conditions. As designers are not able to foresee all possibly occurring situations and circumstances the system will face during its operation time the self-organisation process of the system will focus on self-optimising the system's behaviour. Such self-optimising behaviour can be achieved at various levels of the system's design, ranging from basic control architectures over self-organised coordination or collaboration methods and domain-specific optimisation techniques to the application and customisation of machine learning algorithms. Furthermore, several related topics (e.g. trust and security in collaborative systems) provide necessary functionality to enable self-optimising behaviour in AC and OC systems. special session will further address the question how methods, abstractions and ideas from the (statistical) physics perspective on complex adaptive systems – with examples coming from nature, society and technology – can be utilised in the design, modelling and analysis of organic and autonomic computing systems. Special emphasis will be laid on how the recently developed statistical mechanics of networks – encompassing complex and dynamic structures – can facilitate the design of robust and adaptive computing architectures that inherit some of the remarkable properties of natural systems. An important aim is to strengthen the ties between complementary research communities that otherwise rarely get in contact.

Figure 7.2: The participants of the SAOS2014 workshop, including the organisers

7.1.5 Satellite Workshop: Sozioinformatik 2013

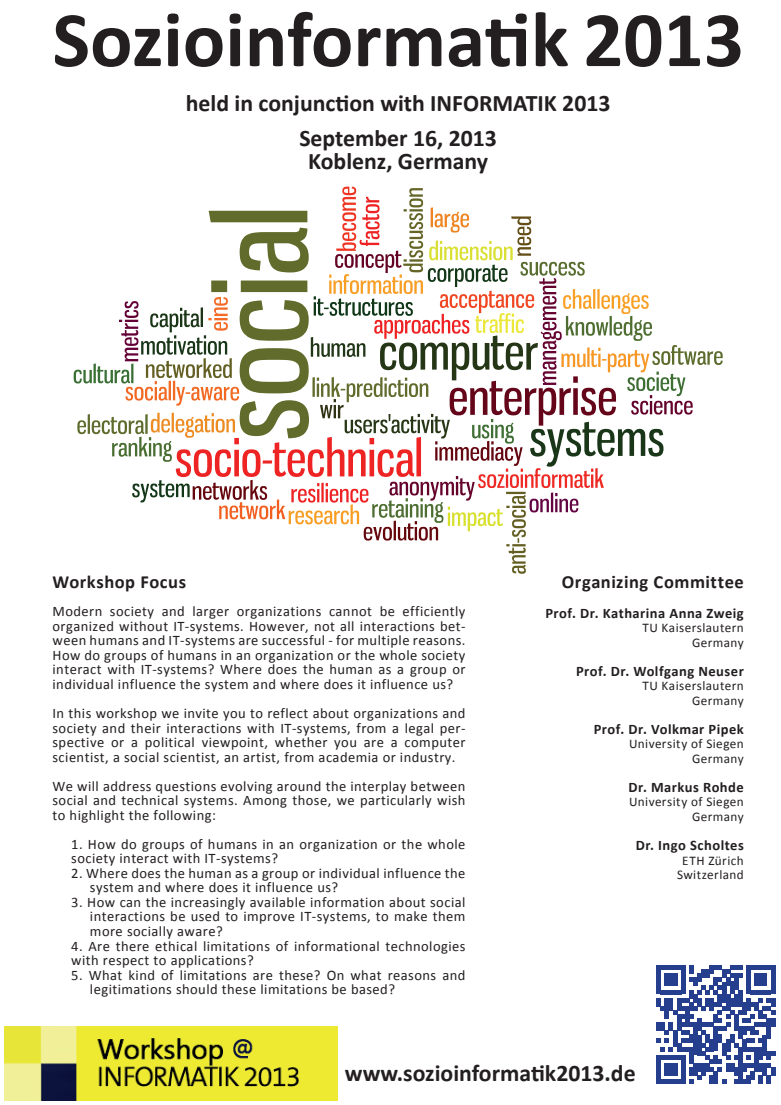
Date and Location September 16, 2013, Koblenz, Germany

Conference 43rd annual meeting of the Gesellschaft für Informatik 2013

Website `http://www.sozioinformatik2013.de/`

Modern society and larger organisations cannot be efficiently organised without IT-systems. However, not all interactions between humans and IT-systems are successful - for multiple reasons. How do groups of humans in an organisation or the whole society interact with IT-systems? Where does the human as a group or individual influence the system and where does it influence us? And how can the increasingly available information about social interactions be used to improve IT-systems, to make them more socially aware?

In this workshop we invite you to reflect about organisations and society and their interactions with IT-systems, from a legal perspective or a political viewpoint, whether you are a computer scientist, a social scientist, an artist, from academia or industry. The workshop is open for all original contributions of maximum 12 pages (LNCS style), which will be peer-reviewed. A publication by Springer in their complex system series is currently under negotiation. As the field is still very dispersed, without a common conference or journal, we explicitly welcome review-like articles which summarise the state of the art on the interaction of society or organisations and IT-systems in your respective field.



7.1.6 Satellite Workshop: Dynamics on and of Complex Networks VI

Date and Location September 18, 2013, Barcelona, Spain

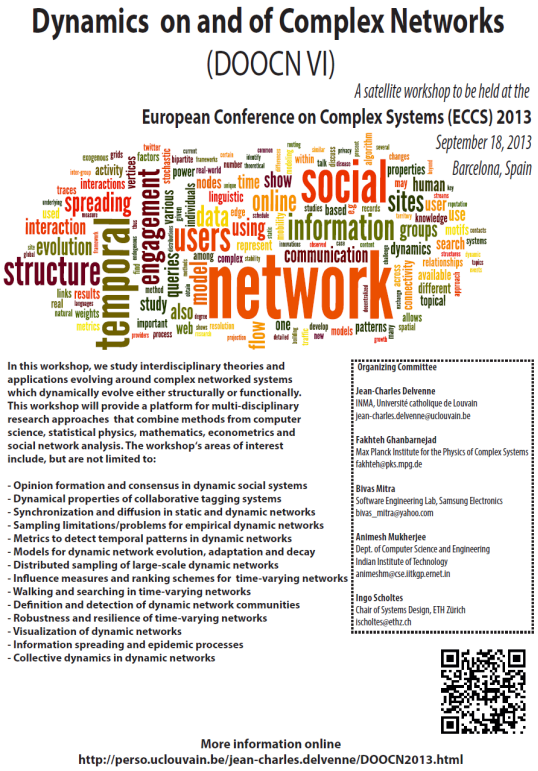
Conference European Conference on Complex System 2013

Website `http://perso.uclouvain.be/jean-charles.delvenne/DOOCN2013.html`

"Network Science" has recently attracted the attention of a large number of researchers from across various disciplines, mainly due to its ubiquitous applicability in modelling the structure and dynamics of large-scale complex systems (both natural and man-made). Examples of such systems, exhibiting complex interaction patterns among their constituent entities, range from genetic pathways and ecological networks to the WWW, peer-to-peer networks, and blogs and online web-social networks (such as Facebook, Orkut and Twitter).

For the past five years, the primary aim of the series of workshops "Dynamics on and of Complex Networks", held as a satellite meeting of the European Conference on Complex Systems, has been to explore the (statistical) dynamics on and of such complex networks. Dynamics on networks refers to the different types of so called processes (e.g. proliferation, diffusion etc.) that take place on networks. The functionality/efficiency of such processes is strongly affected by the topology as well as the dynamic behaviour of the network. On the other hand, Dynamics of networks mainly refers to various phenomena (for instance self-organisation, evolutionary clustering) that go on in order to bring about certain changes in the topology of the network.

It has become clear from the past series of DOOCN workshops that modelling dynamical networks such as dynamic trafficking networks or telephone/human communication networks have gained enormous importance. However, in the constantly changing modern world, there is an urgent need to understand problems related to systems that dynamically evolve in either structurally or functionally, or both. One such important area is semiotic dynamics – how communication systems dynamically evolve over time, how opinions/shared conventions emerge in dynamically changing social media, how collaborative tagging systems function etc. Consequently, this year the workshop will focus on this particular theme, i.e., "Semiotic dynamics in time-varying social media".



7.1.7 SASOST2013: Self-Adaptive and Self-Organising Socio-Technical Systems

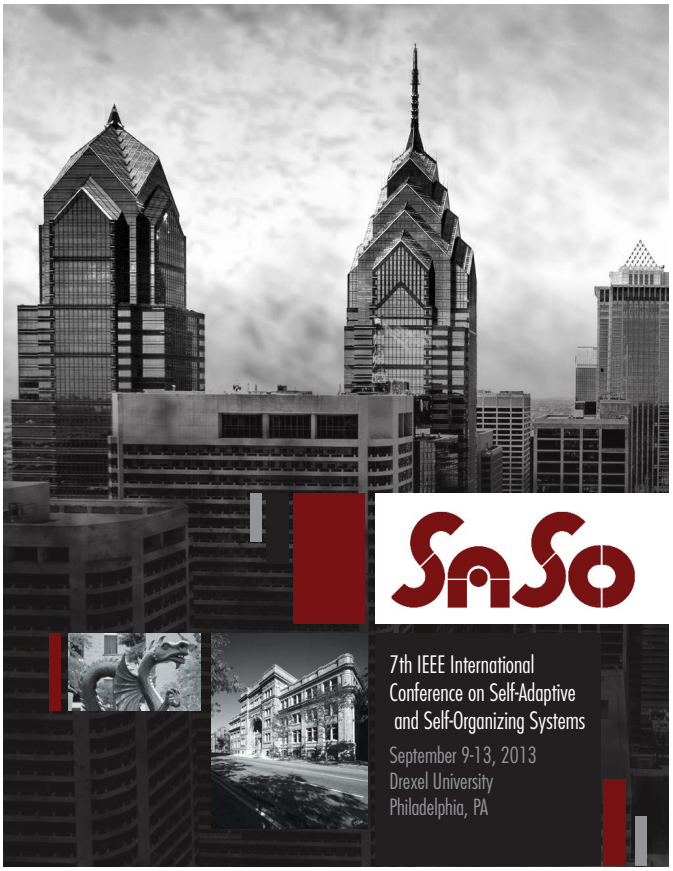
Date and Location September 9, 2013, Philadelphia, USA

Conference 8th IEEE International Conference on Self-Adaptive and Self-Organizing Systems

Website `http://sasost.isse.de/`

The aim of the SASO conference series is to provide a forum for the foundations of a principled approach to engineering systems, networks and services based on self-adaptation and self-organisation. To this end, the meeting aims to attract participants with different backgrounds, to foster cross-pollination between research fields, and to expose and discuss innovative theories, frameworks, methodologies, tools, and applications. The complexity of current and emerging computing systems has led the software engineering, distributed systems and systems management communities to look for inspiration in diverse fields (e.g., complex systems, control theory, artificial intelligence, sociology, and biology) to find new ways of designing and managing networks, systems and services. In this endeavor, self-organisation and self-adaptation have emerged as two promising interrelated approaches.

The seventh edition of the SASO conference embraces the inter-disciplinarity and the scientific, empirical and application dimensions of self-systems, and welcomes novel results on both self-adaptive and self-organizing systems research. It seeks to emphasise the interconnection of basic research between and within fields, and the increasing protrusion of self-systems into the human sphere, evaluating their impact on society, environmental sustainability, commerce, living/working spaces and critical infrastructure. Contributions must present novel theoretical or experimental results, or practical approaches and experiences in building or deploying real-world systems, applications, tools, frameworks, etc. Contributions contrasting different approaches for engineering a given family of systems, or demonstrating the applicability of a certain approach for different systems, are equally encouraged.



7.1.8 Satellite Workshop: Dynamic Information and Communication Networks 2013

Date and Location June 3, 2013, Copenhagen, Denmark

Conference International School and Conference on Network Science (NetSci2013)

Website `http://web.sg.ethz.ch/NetSciSat2013/wordpress/`

In this NetSci 2013 Satellite Workshop we address the question how novel insight in the field of temporal/dynamic networks can be used in the context of information and communication networks.

A particular focus of this workshop will be on providing a truly interdisciplinary forum that integrates the interests of mathematicians and theoretical physicists working on network theory with the needs of computer and information scientists interested in the modelling and design of communication and information networks.

7.1.9 Latsis Symposium 2012 - Economics on the Move

Date and Location September 11 – 14, 2012, Zurich, Switzerland

Website `http://web.sg.ethz.ch/Latsis_2012`

Different from other events, the Latsis Symposium 2012 will not focus on analyzing the failure of previous economic (and political) decisions, or the shortfall of mainstream economic theories. Rather, it poses a provocative question:

Can economics as a scientific discipline that must extricate itself from its current conceptual crisis, benefit from concepts, methods and insights developed in other disciplines, notably the natural sciences?

Instead of tackling this question in the broadest way, the Latsis Symposium will concentrate on three aspects where the relation between economics and other scientific disciplines already became obvious: **(1) behavioural economics**. **(2) systemic risk**, **(3) economic networks.** Each of these topics is discussed on a separate day, featuring various high-profile speakers. The symposium aims to provide a forum for interdisciplinary knowledge-transfer and leaves ample room for stimulating discussions. Additionally, the symposium is preceded by a satellite workshop with three different tracks.

7.1.10 CSECS2012: International Workshop on Complex Sciences in the Engineering of Computing Systems

Date and Location February 28, 2012, Munich, Germany

Website `http://web.sg.ethz.ch/workshops/csecs-2012/`

The emergent properties of complex adaptive systems pervade natural and social sciences. Interestingly, also man-made systems like the Internet, the Web or Peer-to-Peer networks are being studied by an increasingly large and diverse research community that is frequently subsumed under the term Complex Science. Among the current research, the study of the properties of complex network systems, as well as dynamical processes unfolding within them have been particularly successful. Such studies have uncovered some of the principles that contribute to the astonishing robustness and adaptivity of various systems which can be framed in the formalism of networks. Some of these systems also exhibit properties of self-organisation. During the last decade, these advances have paved the way for a number of interesting engineering applications. From an operative viewpoint, the resulting research framework allows to apply the toolkit of statistical physics to a wide variety of systems, each composed by a sufficiently large number of interacting elements. In this workshop, we seek to shed light on how methods, abstractions and ideas from the statistical physics perspective on complex adaptive systems –with examples coming from nature, society and technology– can be utilised in the design, modelling and analysis of current and future computing systems. Being a particularly promising domain, a special emphasis will be laid on how the recently developed statistical mechanics of networks –encompassing complex and dynamic structures– can facilitate the design of robust and adaptive computing architectures that inherit some of the remarkable properties of natural systems.

CSECS 2012

First International Workshop on Complex Sciences

in the Engineering of Computing Systems

to be held at the 25th International Conference on Architecture of Computing Systems

TU München, Germany
February 28/29th, 2012
http://web.sg.ethz.ch/workshops/csecs-2012/

CALL FOR PAPERS

Submission Deadline: December 8th, 2011 (hard)

The emergent properties of complex adaptive systems pervade natural and social sciences. Interestingly, also man-made systems like the Internet, the Web or Peer-to-Peer networks are being studied by an increasingly large and diverse research community that is frequently subsumed under the term *Complex Science*. Among the current research, the study of the properties of complex network systems, as well as dynamical processes unfolding within them have been particularly successful. Such studies have uncovered some of the principles that contribute to the astonishing robustness and adaptivity of various systems which can be framed in the formalism of networks. Some of these systems also exhibit properties of self-organization. During the last decade, these advances have paved the way for a number of interesting engineering applications. From an operative viewpoint, the resulting research framework allows the toolkit of statistical physics to be applied to a wide variety of systems, each composed by a sufficiently large number of interacting elements.
In this workshop, we seek to shed light on how methods, abstractions and ideas from the (statistical) physics perspective on complex adaptive systems – with examples coming from nature, society and technology – can be utilized in the design, modeling and analysis of current and future computing systems. Being a particularly promising domain, a special emphasis will be laid on how the recently developed *statistical mechanics of networks* –encompassing complex and dynamic structures– can facilitate the design of robust and adaptive computing architectures that inherit some of the remarkable properties of natural systems. An important aim of the workshop is to strengthen the ties between complementary research communities that otherwise rarely get in contact. By this, we hope to contribute to the formation of a community centered around computer engineering, and with an interdisciplinary component, that focuses on the following question: how can the dynamics unfolding in computing infrastructures be analyzed, as well as actively managed and utilized, based on abstractions and methods from statistical physics.
This workshop intends to address these questions in the context of different computing systems. The focus of the workshop includes – but is not limited to – the following topics:

- Complex systems approaches to design and analyze robust and adaptive architectures
- Applications of the statistical mechanics of networks to self-organized formation and optimization of communication structures
- Complex network science approaches to adaptive large-scale network-on-chip designs
- Statistical mechanics perspective on self-organizing peer-to-peer topologies
- Statistical methods to quantify properties of large dynamic communication networks
- Applications of percolation theory to the analysis of robustness in (interdependent) communication networks
- Modeling and analysis of information diffusion and error spreading in communication networks
- Modeling of cascading failures in cyber-physical systems
- Applications of complex networks and random graph theory in the modeling of Internet architecture
- Application of complex networks science to the design and analysis of energy/smart grid infrastructures
- Physics-inspired models for autonomic and organic computing systems
- Application of reaction-diffusion systems to computing
- Monte-Carlo methods for the (run-time) adaptation and optimization of computing systems
- Application of physics abstractions to systems engineering and analysis
- Network science approaches to the modeling and analysis of software structures like inheritance hierarchies or dependency networks
- Physics-inspired, non-conventional programming models for self-organizing, spatial and many-core computing systems
- Physics-inspired field-based coordination approaches
- Non-linear synchronization and consensus phenomena in communication and wireless networks
- Socio-physical models for collective user behavior in pervasive systems, opportunistic networking as well as in novel user-oriented online services

Important Dates

Submission Deadline	**December 8th, 2011**
Acceptance Notification	2 weeks after submission
	December 22nd latest
Camera-ready Deadline	January 3rd, 2012
Workshop	**February 28/29th, 2012**

Organizers

Ingo Scholtes, Claudio J. Tessone
ETH Zurich, Switzerland
{ischoltes, tessonec}@ethz.ch

Jacob Beal
BBN Technologies, MIT CSAIL
jakebeal@bbn.com

Paper Submissions

The organizers welcome the submission of papers in English language of up to 12 pages describing original work previously unpublished and currently not under review elsewhere. Interdisciplinary work that demonstrates how methods, models and abstractions from complex sciences and statistical physics can facilitate the engineering of reliable and adaptive computing architectures is particularly solicited. All submissions will be blindly reviewed by at least three members of the program committee. Accepted papers will be published in the GI Edition – Lecture Notes in Informatics (LNI) series. Selected high-quality contributions of interest to a wider community may be invited to resubmit an extended version to the interdisciplinary journal Advances in Complex Systems.

Contact

For more information on the workshop, submission and formatting instructions, the review process, as well as for a list of the tentative program comittee, please visit the website of the workshop at

http://web.sg.ethz.ch/workshops/csecs-2012

or contact the organizers.

7.1.11 Satellite Workshop: 1st International Workshop on Socio-Aware Networked Computing Systems

Date and Location October 3, 2011, Ann Arbor, USA

Conference 5th IEEE International Conference on Self-Adaptive and Self-Organizing Systems

Website `http://socioaware.syssoft.uni-trier.de/2011`

The design and operation of distributed computer systems has traditionally been driven by technical aspects and considerations. However, the usage characteristics of information and communication systems are both implicitly and explicitly determined by social interaction and the social graph of users. This aspect is becoming more and more evident with the increasing popularity of social network applications on the internet. The performance, resilience and reliability of distributed systems can thus be improved by considering social aspects already in and for their design. The aim of this workshop is to elaborate how such socially adaptive networked computing systems can be created.

This workshop seeks to shed light on the question how the increasing pervasion of technical infrastructures with social aspects affects the engineering of reliable and scalable networked computing systems. Another interesting question is how suitable mathematical modelling of social phenomena can influence and inspire the design of distributed algorithms, network topologies and communication protocols, resulting in what may be called socio-aware information and communication systems.

7.1.12 International Workshop: Coping with Crises in Complex Socio-Economic Systems

Date and Location June 20 – 24, 2011, Zürich, Switzerland

Website `http://www.ifb.ethz.ch/comphys/conferences/ccss-workshop2011/`

Social systems typically feature crises, i.e. unstable and dangerous situations that are characterised by abrupt and large-scale changes. Such disruptions are very hard to predict with any precision and even harder to control. Indeed, crises often convey an impression that key decision makers have lost control and that events unfold in an unstoppable and even catastrophic way. Examples include environmental crises, the collapse of transportation systems, as well as financial and social crises such as poverty, social conflicts or wars. These and other issues will be addressed during the meeting.

7.1.13 CYBEREMOTIONS Workshop: Emergent Emotions on the Web

Date and Location June 6– 8, 2011, Zürich, Switzerland

Website `http://web.sg.ethz.ch/workshops/cyberemotions/`

The Workshop is focused on research methodologies developed to study and analyze phenomena related to any means of communication provided by the Internet, trying to identify, describe, and predict the Collective Emotional States among Web Users. It mainly aims to strengthen the collaboration between different Working groups of the CYBEREMOTIONS Project

7.1.14 Satellite Workshop: WEIN2010 - 5th International Workshop on Emergent Intelligence on Networked Agents

Date and Location May 10–11, 2010, Toronto, Canada

Conference AAMAS2010: Ninth International Conference on Autonomous Agents and Multiagent Systems

Website `http://web.sg.ethz.ch/workshops/wein2010/`

The WEIN Workshop series started as a Japanese initiative and has been part of AAMAS, the International Conference on Autonomous Agents and Multiagent Systems, regularly since 2006. Multi Agent Systems (MAS) allow to study the emergence of systemic properties which result from the interaction of a large number of agents, rather than from single agents. Intelligence can be seen as such an emergent property. This means that the ability of a system to solve a problem, to optimise an outcome, or to adapt to a changing situation in a prospective manner may not be traced back to individual capabilities, but to the collective effort of many agents. A framework to model these MAS is provided by the complex networks approach, where agents are represented by nodes and their interactions are represented by links. Thus, the underlying network structure of a MAS plays a crucial role in explaining emergent properties. Networked agents, on the other hand, may be able to actively change this structure by forming new links or cutting existing ones. Consequently, there is not only a strong relation, but a coevolution in the dynamics of agents and their network of interactions.

7.1.15 International Workshop: Coping with Crises in Complex Socio-Economic Systems

Date and Location June 8–12, 2009, ETH Zürich.

Website `http://www.soms.ethz.ch/workshop2009/index`

The interdisciplinary workshop aims at a quantitative understanding of crises in social and economic systems. These crises are unstable and dangerous situations characterised by abrupt and large-scale changes, which are very hard to predict with conventional methods and even harder to control. The workshop was co-organised with the Chairs of the CCSS Competence Center. It was accompanied by a summer school for young scientists and daily think tank discussions. This workshop contained two satellite workshops: "Extreme Events in Agent-Based Socio-Economic Models" and "Modelling Interdependency between Technological and Human Systems under Crisis Scenarios", co-organised by the COST Action MP0801 "Physics of Competition and Conflicts".

7.1.16 International Workshop: The Physics Approach to Risk: Agent-Based Models and Networks

Date and Location October 27–29, 2008, ETH Zürich

Website `http://web.sg.ethz.ch/workshops/cost-p10/`

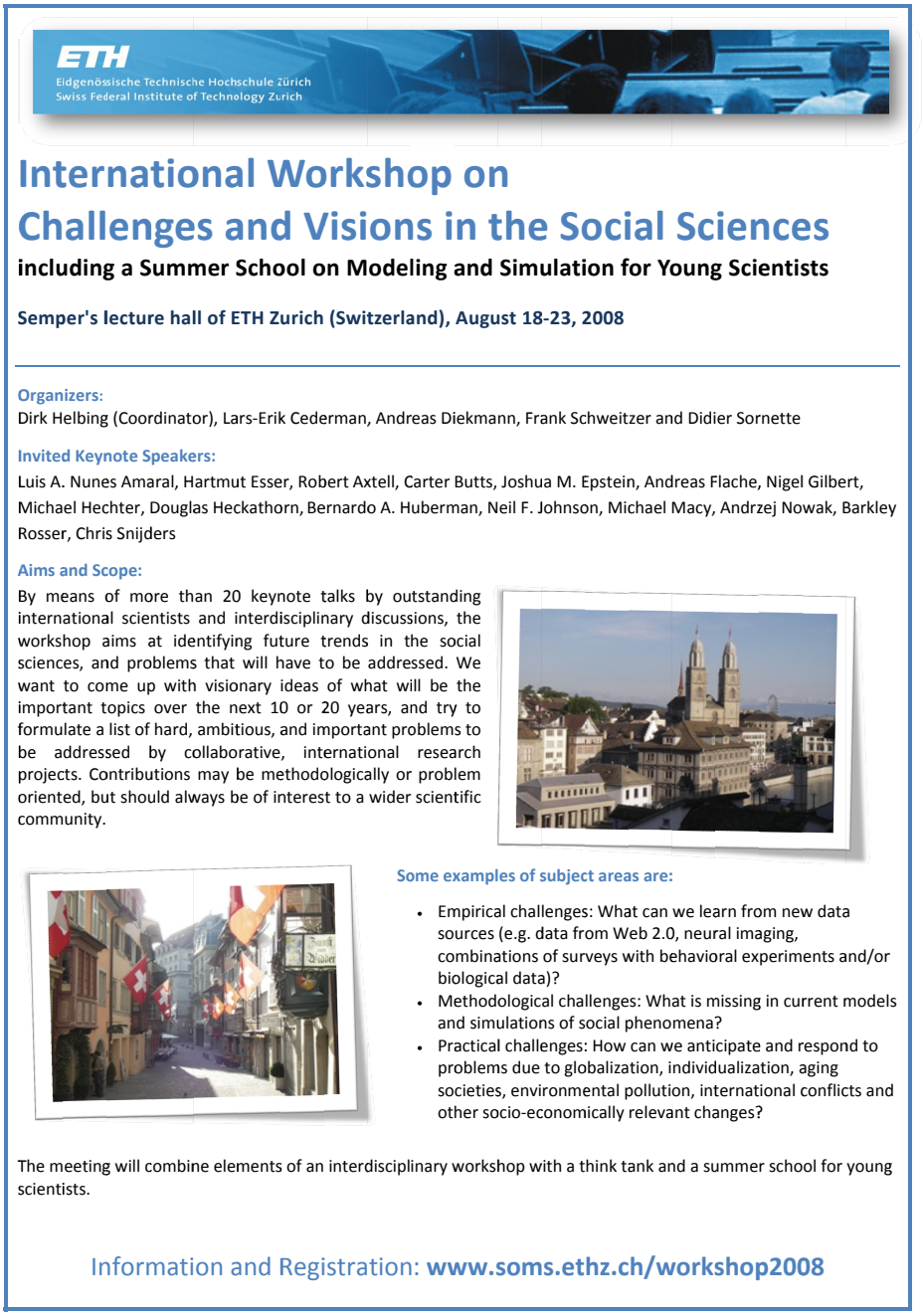
This workshop marked the transition between two COST actions: the COST-P10 'Physics of Risk' and the new COST-MP0801 'Physics of Competition, Cooperation and Conflicts'. The aim of the workshop was to join the European "activists" of COST-P10, to discuss the scientific outcome of this action in an open-minded atmosphere, to think about the challenges of COST-MP0801, and to outline possible collaborations with Swiss colleagues. There were presentations from the three working groups of COST-P10: Physics of Risk, Agent-based Models, and Networks.

7.1.17 International Workshop: Challenges and Visions in the Social Sciences

Date and Location August 18–23, 2008, ETH Zürich

Website `http://www.soms.ethz.ch/workshop2008`

The interdisciplinary workshop aimed at identifying future trends in the social sciences. Emphasis was given to visionary ideas of what will be the important topics over the next 10 or 20 years. An aim was to formulate a list of hard, ambitious, and important problems to be addressed by collaborative and international research projects. The workshop was accompanied by daily think tank discussions and a summer school for young scientists.



7.1.18 Satellite Workshop: Enhancing Social Interaction: Recommendation Systems, Reputation, P2P, Trust and Social Networks

Date and Location October 5, 2007, Dresden, Germany

Conference ECCS2007: European Conference on Complex Systems

Website `http://www.sg.ethz.ch/events/workshops/ECCS_satellite`

The one-day workshop was organised as a Satellite Workshop of the European Conference on Complex Systems (ECCS). Scientific Organisation: Stefano Battiston (ETH Zürich), Nigel Gilbert (Univ. of Surrey), Stefano Leonardi (La Sapienza, Rome).

The workshop aimed at the challenges resulting from emerging technologies to enhance social interaction on the Internet. What can complex system theory offer to design social interactions in the Web 2.0, using concepts of trust, reputation, or P2P? Contributions focused on the design of mechanisms and incentives that can preserve the functionality of systems, or enhance robustness against non-cooperative behaviour of free riding or malicious agents.

7.1.19 International Workshop: Trust-Based Networks and Robustness in Organisations

Date and Location March 13–17, 2006, ETH Zürich

Website `http://web.sg.ethz.ch/workshops/TW_Trust/`

This was the last thematic workshop of the European Network of Excellence (NoE) "Complex Systems" (EXYSTENCE). The aim of the workshop was to explore the possible integration of existing models of trust-based networks and their further development towards real-world oriented implementations. The workshop brought together a pool of experts in trust-based networks from social science, computer science, and physics. It was structured into two parts: a first part with presentations and general discussions and a second part with working groups focusing on specific topics. The results of the discussion were compiled in a final report and submitted to the IST Program of the European Commission to contribute to the design of future grant calls.

7.1.20 DPG Summer School: Dynamics Of Socio-Economic Systems: A Physics Perspective

Date and Location September 18–24, 2005, Physikzentrum Bad Honnef, Germany

Website `http://web.sg.ethz.ch/workshops/Summerschool05/`

The summer school reviewed the current development in modelling social and economic systems by using methods originally developed in statistical physics and complex systems theory. A broad spectrum of topics on economic, social, urban and cultural problems was presented by leading experts. The school was organised as an official school of the German Physical Society (DPG) as the follow-up event of a Winter School held in Konstanz, Germany, in February 2004.

7.1.21 Annual Meeting: Arbeitskreis Physik sozio-ökonomischer Systeme

Date and Location March 4–9, 2005, Berlin, Germany

Conference DPG Annual Meeting "Physik seit Einstein"

Website `https://www.dpg-physik.de/dpg/gliederung/fv/soe/veranstaltungen/Berlin2005/Berlin2005.html`

The conference was the last of a series of conferences organised by Frank Schweitzer between 2002 and 2005, when he was the chairman of the AKSOE, the division for the physics of socio-economic systems of the German Physical Society (DPG). The AKSOE conference of 2005 covered 5 invited talks and about 60 contributed talks and posters from German and international scientists. The conference was part of the DPG annual meeting on condensed matter physics, which attracted more than 5.000 participants in total. A particular highlight of the AKSOE conference, as in previous years, was the ceremony of the 'Young-Scientist Award for Socio- and Econophysics' with the President of the Royal Society, Lord Robert May, giving the keynote talk.

7.2 Seminars

7.2.1 Seminars of the Chair of Systems Design

The SG Seminars are mostly given by external guests and cover all topics that are of interest to our team. They tend to focus on new research areas and results.

11.11.14 Yves-Alexandre de Montjoye, MIT Media Lab, Cambridge, USA
The Predictive Power and Privacy of Metadata

27.10.14 Dr. Charlie Brummitt, Columbia University, New York, USA
Risk and contagion: controlling self-organized criticality and contagious sudden changes

20.09.14 Yang-Yu Liu, Assistant Professor, Harvard Medical School, Boston, USA
Controllability and Observability of Complex Systems

17.03.14 Sean P. Goggins, Informatics Institute and School of Information Science and Learning Technologies, University of Missouri, USA
Finding the Heartbeat in Virtual Organizations: the Example of Forking Repositories on GitHub

04.12.13 Cristian Danescu-Niculescu-Mizil, Max Planck Insitute for Software Systems, Saarbrücken, Germany
Language and Social Dynamics in Online Communities

21.12.12 Ginestra Bianconi, Department of Physics Northeastern University, Boston, USA
Human interaction on the fast time scale and group formation in simple animals

20.12.12 Yamir Moreno, Institute for Biocomputation and Physics of Complex Systems (BIFI), University of Zaragoza, Spain
Online Networks and the Diffusion of Protests

13.11.12 Katharina Zweig, Graph Theory and Complex Network Analysis Group, Technical University Kaiserslautern, Germany
Network Analysis Literacy

25.09.12 Johan Bollen, School of Informatics and Computing, Indiana University, Bloomington, USA
Leveraging social media to model collective mood states

14.05.12 Sander van Doorn, Behavioural Ecology, University Bern, Switzerland
The evolution of generalized reciprocity on social interaction networks

08.05.12 Sidney Redner, Department of Physics, Boston University, USA
Statistical Physics of Citations

30.03.12 Mauro Napoletano, Observatoire Français des Conjonctures Economiques (OFCE), Nice, France
Income Distribution, Credit and Fiscal Policies in an Agent-Based Keynesian Model

13.03.12 Yoshi Fujiwara, Graduate School of Simulations Studies, University of Hyogo, Japan
Chained Financial Failures at Nation-wide Scale in Japan

13.03.12 Hideaki Aoyama, Kyoto University, Japan
Statistical Physics of Labour Productivity

12.03.12 Yuji Aruka, Faculty of Commerce, Chuo Universtity, Tokyo, Japan
The nature of technology and a Japanese connection to creative coincidence

12.12.11 Niloy Ganguly, Department of Computer Science & Engineering, IIT Kharagpur, India
Effects of a Soft Cut-off on Node-degree in the Twitter Social Network

07.06.11 Jukka-Pekka Onnela, Harvard Medical School, Boston, USA
Harnessing network science to reveal our digital footprints

05.04.11 Felix Reed-Tsochas, University of Oxford, UK
Innovation adaption in an online social network

30.11.10 Hiroshi Yoshikawa, Faculty of Economics, University of Tokyo, Japan
A Criticism of Modern Micro-grounded Macroeconomics

30.03.10 Ulrik Brandes, Department of Computer and Information, University of Konstanz, Germany
Classification in Network Ensembles using Latent Roles

24.11.09 Jürgen Kurths, Postdam Institute for Climate Impact Research and Institute of Physics, Humboldt University, Berlin, Germany
Synchronization and Complex Networks: Are such Theories Useful for Earth and Life Sciences?

14.07.09 Shin Jae Kyun, Yeungnam University, Gyeongsan, South Korea
Information Accumulation System by Inheritance and Diffusion

05.05.09 Manfred Milinski, Department of Evolutionary Ecology, Max-Planck-Institute for Evolutionary Biology, Plön, Germany
Evolutionary economy and the climate crisis game

04.11.008 Mauro Gallegati, Università Politécnica delle Marche, Italy
Interdisciplinary Seminar: An Agent-Based Approach to Business Fluctuatoins

22.09.08 Julien Hendrickx, Université Catholique de Louvain, Belgium
Local consensus in Hegselmann-Krause opinion dynamics model

06.08.08 Thanasis Papaioannou, Athens University of Economics and Business, Greece
Providing Incentives for Honest Feedback in Electronic Environments

23.07.08 Thomas Brenner, Philipps University Marburg, Germany
Measuring Regional Innovation Efficiency and the Impact of R&D Employment and Networks

07.05.08 Geoffrey B. West, Santa Fe Institute, USA
Universal Scaling Laws in Biology From Genomes to Ecosystems

23.07.08 Geoffrey B. West, Santa Fe Institute, USA
Size matters! Growth, Innovation and the Pace of Life: is it Sustainable?

20.12.07 Luigi Marengo, Scuola Superiore S. Anna, Pisa, Italy
How much should society fuel the greed of innovators?

30.11.07 György Szábo, Research Institute for Technical Physics and Materials Science Budapest, Hungary
Mechanisms supporting cooperation in evolutionary Prisoner's Dilemma games

19.09.07 Raúl Toral, Spain Institute for Cross-Disciplinary Physics and Complex Systems, Palma de Mallorca, Spain
Constructive effects induced by heterogeneity: an application to a model for opinion formation

24.05.07 Jörg Reichardt, University of Würzburg, Institute for Theoretical Physics, Germany
Analyses of economic networks using the toolbox of statistical physics

25.06.07 Wander Jager, University of Groningen, Faculty of Economics and Business Marketing Institute, Netherlands
Multi agent simulation of human behaviour using psychological theory

23.05.07 Christian Müller, Institute for Computational Science, ETH Zürich, Switzerland
Parameter optimization and sensitivity analysis of an agent-based model in social psychology

15.03.08 Koen Frenken, Faculty of Geosciences, Utrecht University, the Netherlands
Global optimisation of modular systems

14.03.07 Koen Frenken and Giorgio Fagiolo, Faculty of Geosciences, Utrecht University, the Netherlands
Issues in Economic Geography

21.02.07 Mayuko Nakamaru, Tokyo Institute of Technology, Japan
Spread of Two Linked Social Norms on Complex Interaction Networks

12.09.06 Reinhard König, University of Karlsruhe (TH), Germany
Simulation methods for spatial processes

06.09.06 Claudio J. Tessone, Institut Mediterrani d'Estudis Avançats, Palma de Mallorca, Spain
Opinion Spreading and Neighbourhood Models

21.04.06 John Casti, Wissenschaftszentrum Wien and The Kenos Circle, Vienna, Austria
On the Limits to Scientific Knowledge

11.04.06 Werner Ebeling, Humboldt-Universität Berlin, Germany
Dynamik von Innovationen in stochastischen Modellen

11.04.06 Werner Ebeling, Humboldt-Universität Berlin, Germany
Probleme der Dynamik und stochastischen Theorie dissipativer Hamiltonscher Systeme

26.01.06 Gabrielle Wanzenried
Ansätze der Ökonometrie und ihre Anwendung auf Schweizer Firmendaten

16.01.06 Nicole Saam, Universität Erfurt, Germany
Modellierung intergouvernmentaler Verhandlungen – Gedankenexperiment oder empirische Sozialforschung?

11.11.05 Dirk Helbing, Institute for Transport and Economics, TU Dresden, Germany
A unifying approach to the dynamics of production, supply and traffic networks

16.06.05 Didier Sornette, Dept. of Earth and Space Sciences, University of California
Mechanism for and Detection of Pockets of Predictability in Complex Adaptive Systems

22.04.05 Bernardo A. Huberman, Hewlett Packard Laboratories, Palo Alto, USA
Encouraging risk taking in organizations

7.2.2 ETH Risk Center Seminar Series

In establishing the interdisciplinary ETH Risk Center, the ETH Zürich places itself among the leading proponents of Integrative Risk Management (IRM). In this spirit the aim of the Risk Center's activities is to build an integrated view of risk landscapes and develop the means to understand, assess, compare and manage these. Its research output will help societies to better manage risk portfolios and to design novel solutions and collaborative risk reduction schemes.

The Risk Center fosters both top-down initiatives and bottom-up collaborative research projects linked with R&D. It also serves as an interface between academia and industry.

Autumn Semester 2014

23.09.14	Dr Peter Burgherr, Paul Scherrer Institut (PSI) and Jennifer Giroux, ETH Zürich **Examining the Targeting of Energy Infrastructure: Applying a Qualitative and Quantitative Approach**
30.09.14	Greg Davies, Head of Behavioral Investment Philosophy Barclays London, UK **Maximising Anxiety Adjusted Return: Don't Let the Best Be the Enemy of the Achievable**
07.10.14	Prof. Tom Hurd, McMaster University, Hamilton, Canada **Random Financial Networks and Locally Treelike Independence**
14.10.14	Prof. James Gleeson, University of Limerick, Ireland **Cascade Dynamics and Systemic Risk in Banking Networks**
21.10.14	Dr Felix Matthes, Energy & Climate Policy Öko-Institut, Berlin, Germany **Electricity Market Design: Developing a Sustainable Economic Basis for the Future Power System**
28.10.14	Prof. Stijn Claessens, International Monetary Fund, Washington DC, USA **Risk Scenarios in the World Post Global Financial Crisis**
04.11.14	Boris Köpf, IMDEA Software Institute, Madrid, Spain **Managing the Trade-off Between Security and Performance in Software Systems**
11.11.14	Pierre Lauquin, Long-Term Risk Manager, Nestlé, Vevey, Switzerland **Nestlé: Structured Approach to Face Risk and Crisis**
18.11.14	Prof. Michael Ward, Duke University, Durham, USA **Predicting the Risk of Irregular Regime Changes: Which Leaders Will Are Likely To Be Thrown Out?**
25.11.14	Prof. Hardin Tibbs, CEO of Synthesis Strategic Consulting, Cambridge, UK **Cyberpower Strategy and Socio-Political Risk**
02.12.14	Dr Valeria Bignozzi, University of Firenze, Italy **How Superadditive Can a Risk Measure Be?**

Spring Semester 2014

25.02.14 Prof. Qiang Xie, Tongji University, China
Natural Disaster Prevention to Electrical Grid Infrastructures in China: Earthquake, Wind Storms, and Icing

11.03.14 Dr Jérôme Kreuser, CEO, RisKontroller Global, USA
Risk Management in Public Institutions is Different: Everyone is Different in its Own Way

18.03.14 Prof. Richard de Neufville, MIT, USA
Flexibility in Engineering Design

25.03.14 Prof. Bruno Sudret, ETH Zürich
Computational Methods for Uncertainty Quantification in Engineering Risk Analysis

08.04.14 Prof. Victor Galaz, Stockholm University, Sweden
Connectivity, Risk and Global Governance - A Multi-Theoretical Social Science Perspective

15.04.14 Prof. Giovanni Puccetti, University of Firenze, Italy
Complete Mixability and Asymptotic Equivalence of Worst-Possible VaR and ES Estimates under General Marginal Assumptions

29.04.14 Prof. Ole Peters London Mathematical Laboratory, UK
Decision Theory 2.0

06.05.14 Prof. Scott E. Page University of Michigan, USA
Unpacking Collective Intelligence

13.05.14 Prof. Vittorio Loreto, Sapienza University of Rome, Italy
The Dynamics of Correlated Novelties

20.05.14 Niels Viggo Haueter, Swiss Re, Head Corporate History, Zürich
Competing Forms of Risk Management in History - Caritas, Entrepreneurship, and the State

27.05.14 Dr Arnaud Mignan, ETH Zürich
Extreme Cascade Events and Risk Governance - The Early Life of a Generic Multi-Risk Framework

Autumn Semester 2013

24.09.13 Dr. Olivia Woolley Meza, ETH Zürich
Little Information is not so Dangerous After All: Global Information Reduces Vaccination Efficacy

01.10.13 Prof. Peter Howitt, Brown University, Providence, USA
Theory and Practice of Monetary Policy

08.10.13 Dr. Roman Muraviev, Twelve Capital AG, Zürich
Catastrophe Bonds

15.10.13 Prof. José F. Mendes, Aveiro University, Portugal
Avalanche Collapse of Interdependent Networks

22.10.13 Prof. Scott Backhaus, Los Alamos National Laboratory, USA
Grid Science - An Interdisciplinary Approach to Electrical Grid Analysis, Control and Optimization

29.10.13 Prof. Raissa D'Souza, University of California, Davis, USA
Percolation, Cascades and Control of Interdependent Networks

05.11.13 Prof. Gerard de Jong, Institute for Transport Studies University of Leeds, UK
Predicting Uncertainty of Traffic Forecasts

14.11.13 Prof. Friedemann Freund
Earthquake Forecasting from a Global and Multidisciplinary Perspective: Science, Technology and Economics

19.11.13 Prof. Tso-Chien Pan, Nanyang Technological University, Singapore
Challenges in Catastrophe Risk Management of Asia

26.11.13 Prof. Stephan Pickl, Bundeswehr, University Munich, Germany
Characterization of Resilience and Operation Processes in Aviation Management and Humanitarian Logistics

03.12.13 Prof. Giovanni Sansavini, ETH Zürich
Failures in Engineered Complex Systems and Systems of Systems: a New Modeling and Simulation Challenge Calling for Innovative Techniques and Tools

Spring Semester 2013

12.03.13 Pierre-Alain Graf, CEO of Swissgrid, Frick, Switzerland
Managing Security of Supply in a Highly Interlinked System

19.03.13 Dr Richard Olsen, CEO of Olsen Ltd., Zürich
Global Systems Science: From First Principles to the Mechanics of a Flourishing Economy

26.03.13 Prof. Enrico Zio, École Centrale Paris, France
The Complexity of Analyzing Vulnerability and Failures in Complex Engineered Systems

09.04.13 Prof. Gabe Mythen, University of Liverpool, UK
Pre-Crime and Counter-Terrorism: Vigilant Vistas or Pre-Emptive Delirium?

16.04.13 Dr Peter Müller, Director General, Federal Office of Civil Aviation, Bern-Ittigen, Switzerland
Risk Based Oversight in Aviation

23.04.13 Prof. Tiziana Di Matteo, King's College, London, UK
Spread of Risk Across Financial Markets: Better to Invest in the Peripheries

07.05.13 Prof. Bozidar Stojadinovic, ETH Zürich
Performance-Based Engineering of Resilient Communities

14.05.13 Dr Lukas Gubler, Chief Risk Officer, Axpo Trading, Dietikon, Switzerland
Risk Management in Energy Trading - A Practitioner's View

21.05.13 Prof. Aaron Clauset, University of Colorado, Boulder, USA
Estimating the Historical and Future Probabilities of Large Terrorist Events

28.05.13 Prof. Marco Scarsini, Singapore University of Technology and Design, Singapore
Fear of Loss, Inframodularity and Transfers

Autumn Semester 2012

25.09.12 Prof. David Basin, Chair for Information Security, ETH Zürich
Information Security Risks: Possibilities and Probabilities

02.10.12 Prof. Brian K. Min, Department of Political Science, University of Michigan, USA
Distributing Power: Evidence on Public Goods Provision by Satellite

09.10.12 Prof. Serge Paul Hoogendoorn, Transport & Planning Dept., Delft University of Technology, the Netherlands
Innovations in Data Collection for Evacuation Modeling and Management

16.10.12 John V. Duca, Vice President & Senior Public Advisor, Federal Reserve Bank of Dallas
How Complex Interactions Between Finance, Housing, and Consumption Can Lead to Deep Recessions

23.10.12 Prof. Semyon Malamud, Assistant Professor of Finance, EPFL, Lausanne, Switzerland
Decentralized Exchange

30.10.12 Prof. Luciano Pietronero, Professor of Condensed Matter Physics, University of Rome, Italy
A New Metric for the Economic Complexity of Countries and Products

06.11.12 Prof. Ortwin Renn, Environmental Sociology & Technology Assessment, University of Stuttgart, Germany
Risk Governance: A New Concept to Deal with Complex, Uncertain and Ambiguous Risks

13.11.12 Prof. Valérie November, ESpRi Group, École Polytechnique Fédérale de Lausanne, Switzerland
Spatiality of Risks

20.11.12 Dr. Peter Taylor, James Martin Research Fellow, University of Oxford, UK
Risk and the Cost of Uncertainty

27.11.12 Prof. Vyacheslav I. Yukalov, Joint Institute of Nuclear Research, Dubna, Russia
Risk Management for Self-Organized Complex Systems

04.12.12 Prof. Damir Filipovic, Head of Swiss Finance Institute, EPFL, Lausanne, Switzerland
Risk-Based Solvency Regulation

11.12.12 Prof. Norio Okada, Integrated Disaster Risk Management, Kyoto University, Japan
Japan after 3/11/2011 Disaster(s)

18.12.12 Prof. Leonardo Duenas-Osorio, Rice University, Houston, USA
Complex Systems Pathways to Risk-Based Decision Support in Infrastructure Engineering

Spring Semester 2012

28.02.12 Dr. Rene Schnieper, Head Insurance, FINMA & Dr. Hansjörg Furrer, Head Quantitative Risk Management, Insurance, FINMA, Bern, Switzerland
The Swiss Solvency Test

06.03.12 Dr. Stefan Brem, Federal Office for Civil Protection, Bern, Switzerland
Critical Infrastructures in Switzerland: Strategy, Risks and Measures

13.03.12 Prof. Hideaki Aoyama, Graduate School of Science, Kyoto, Japan University &, Prof. Yoshi Fujiwara, Graduate School of Simulation Studies, University of Hyogo, Japan
Statistical Physics of Labour Productivity: Chained Financial Failures at Nation-wide Scale in Japan

20.03.12 Prof. Paul Embrechts, ETH Zürich
Copula Theory and Applications: Quo Vadis?

27.03.12 Vinicio Cellerini, CEO of Global Corporate Switzerland, Zürich Insurance Company Ltd
Daniel M. Radulovic, Proposition Manager, Zürich Risk Room, Zürich Insurance Company Ltd
The Zürich Risk Room - Structured Insights into the Complexities of Global Risks

03.04.12 Prof. Michael Bell, Imperial College, London, UK
Game-theoretic Models of Infrastructure Reliability

17.04.12 Christoph Menn, Head, Product Development & Strategy SwissRe, Zürich
Meeting Societal Needs: Challenges to the Re/Insurance Industry

24.04.12 Prof. Frank Schweitzer, ETH Zürich
Systemic Risk

08.05.12 Prof. Sidney Redner, Boston University, USA
Statistical Physics of Citations

15.05.12 Daniel Zuberbuehler, Director, Audit Financial Services, KPMG, Zürich
Bank (capital) Regulation before and after the Financial Crisis – A Power Game

22.05.12 Prof. Claudio Loderer, Managing Director, Swiss Finance Institute, Zürich
Luck and Entrepreneurial Success

29.05.12 Dr. Thibault Gajdos, Director of Research, CNRS GREQAM and IDEP, Paris & Marseille, France
Beliefs and metacognition: lessons from psychophysical experiments

Autumn Semester 2011

20.09.11	Dr. Vladyslav Sushko, University of California, Santa Cruz **Stochastic Herding by Institutional Investment Managers**
27.09.11	Prof. Nicholas Christakis, Harvard University, USA **The Biological Bases and Consequences of Social Networks: Are We Wired to Share Risks?**
04.10.11	Prof. Antoine Bommier, ETH Zürich **On the Meaning of Risk Aversion**
11.10.11	Prof. Shlomo Havlin, Bar-Ilan University, Ramat Gan, Israel **Cascading Failures in Interacting Networks**
18.10.11	Dr. Gregor Lämmel, TU Berlin **Escaping the Tsunami: Risk reducing Evacuation Strategies for Large Urban Areas**
25.10.11	Prof. Ravi Bhavnani, The Graduate Institute, Geneva, Switzerland **Modeling Rumor Dynamics in Ethnic Violence**
01.11.11	Prof. Dirk Helbing, ETH Zürich **FuturICT - New Science and Technology to Manage our Complex, Connected World**
08.11.11	Prof. Wolfgang Kröger, ETH Zürich **Fukushima updated - Nuclear Safety being put to the Acid Test**
15.11.11	Prof. Ryan Murphy, ETH Zürich **Real Options in the Laboratory: Modeling Risk Preferences in Risky Dynamic Environments**
22.11.11	Prof. Hans Rudolf Heinimann, ETH Zürich **Integrative Risk Management - A Systems View of an Emerging Concept**
29.11.11	Dr. Stefano Battiston, ETH Zürich **Systemic Risk in Financial Networks**
06.12.11	Prof. Hans Föllmer, Humboldt Universität zu Berlin, Germany **Risk and Uncertainty: On the Role of Probability in Finance**
13.12.11	Prof. Lucas Bretschger, ETH Zürich **ETH - Studie Energiezukunft Schweiz – Ergebnisse und Diskussion zu den Folgen der Klimakonferenz in Durban**

7.2.3 CCSS Seminar Series

The CCSS Seminar series *'Modeling Complex Socio-Economic Systems and Crises'* is jointly organised by the six chairs which founded the Competence Center 'Coping with Crises in Complex Socio-Economic Systems' (CCSS). It focuses on an interdisciplinary scientific audience and features presentations and subsequent discussions on the of modelling of socio-economic systems.

The courses take place every semester since 2008, as a mixture between a seminar primarily for post-doctorial positions and PhD students and a colloquium involving invited speakers. Participants get an overview of the state of the art in the field, in a well understandable way. From the presentations, they learn how novel mathematical models for open problems are developed, how they are analysed by means of computers, and how the results are defended in response to critical questions.

CCSS
COPING WITH CRISES
IN COMPLEX SOCIO-ECONOMICS SYSTEMS
A Competence Center of ETH Zurich

Fall Semester 2009

22.09.09 Moritz Hetzer, MTEC ETH (invited by: Didier Sornette)
Altruistic punishment for human cooperation: A Darwinian perspective

29.09.09 Michael Faber, IBK ETH (Kay W. Axhausen)
HazNeth and risk research

06.10.09 David Charypar, IVT ETH (Kay W. Axhausen)
Continuous demand generation and simulation

13.10.09 Sebastian Schutte, GESS ETH Zürich (Lars-Erik Cederman)
Estimating conflict zones in civil wars based on population, infrastructure, and terrain

20.10.09 Stefania Vitali, MTEC ETH Zürich (Frank Schweitzer)
The network of global corporate control

27.10.09 Theo Arentze, TU Eindhoven (Kay W. Axhausen)
Social networks and influences on activity-travel behavior

Christine Horne, Washington State University (Dirk Helbing)
The Rewards of Punishment

03.11.09 Michael Ghil, ENS Paris (Didier Sornette)
Coupling climate and macroeconomic dynamics

10.11.09 Nils Weidmann, Princeton (Lars-Erik Cederman)

Promises and Pitfalls in the Spatial Prediction of Ethnic Violence

17.11.09 Stefan Bornholdt, University of Bremen (Hans Jürgen Herrmann)
In an economy of lemmings: Why the next crisis is just around the corner

24.11.09 Jürgen Kurths, University of Potsdam (Frank Schweitzer)
Synchronization and complex networks: Are such theories useful for earth and life sciences?

01.12.09 Konstantin Klemm, University of Leipzig (Hans Jürgen Herrmann)
Predator-prey dynamics with altruistic agents

08.12.09 Tobias Galla, SOMS ETH Zürich (Dirk Helbing)
Chaos and noise in game dynamical learning

Amin Mazloumian, SOMS ETH Zürich (Dirk Helbing)
Congestion Spreading in urban Road Networks

15.12.09 Cars H. Hommes, University of Amsterdam (Didier Sornette)
More hedging instruments may destabilize markets

Spring Semester 2009

17.02.09 Fritz Busch, TU Munich (Kay Axhausen)
Data capture, Information collation and traffic management

24.02.09 Dirk Helbing, ETH Zürich
On the Emergence of Cooperation and the Collapse of Societies

03.03.09 Carlo Jaeger, Potsdam Institute for Climate Impact Research (Dirk Helbing)
Social Systems and Complexity

10.03.09 Lucilla de Arcangelis, University of Napoli (Hans Hermann)
Spam flooding of your mailbox

17.03.09 Harald C. Gall, Giacomo Ghezzi, University of Zürich (Thomas Maillart)
Collaborative software engineering

24.03.09 Guido Caldarelli, CNR-INFM, Italy (Frank Schweitzer)
A Schroedinger-like equation for the PageRank

31.03.09 Alex Saïchev, ETH Zürich (Didier Sornette)
Theory of Zipf's Law

07.04.09 Francesco Ciari, Andreas Horni, ETH Zürich (Kay Axhausen)
Current Work on Matsim

21.04.09 Paolo Tasca, ETH Zürich (Frank Schweitzer)
Information mirages and systemic risk in financial markets

05.05.09 Manfred Milinski, MPI for Evolutionary Biology (Frank Schweitzer)
Evolutionary economy and the climate crisis game

12.05.09 Lubos Buzna, Univ. of Zürich, Wenjian Yu, ETH Zürich (Dirk Helbing)
Modeling and simulation of conflicts in migration games

19.05.09 Georges Harras, ETH Zürich (Didier Sornette)
Stochastic resonance and the excess volatility puzzle in financial markets

Wanfeng Yan, ETH Zürich (Didier Sornette)
Systematic tests of the LPPL model for financial bubbles and crashes

26.05.09 Kamil Mizgier, ETH Zürich (Dirk Helbing)
Modeling defaults of companies in multi-stage supply chain networks

Thomas Maillart, ETH Zürich (Dirk Helbing)
Beyond Shannon: Characterizing Internet Traffic with Generalized Entropy Metrics

Fall Semester 2008

16.09.08 Adilson Motter, Northwestern University
Collective dynamics in complex networks of dynamical systems

30.09.08 Michael Maes, Rijksuniversitet Groningen
Homophily, persuasion and opinion polarization. laboratory experiments on polarization in small groups

07.10.08 Carlos Perez Roca, CSIC, Spain
Understanding the effect of population structure on the evolution of cooperation. A systematic study of binary social dilemmas

14.10.08 David Charypar, ETH Zürich
Parallel event-driven queue-based traffic flow microsimulation

21.10.08 Marc Barthelemy, CEA Paris
Modeling and measuring city formation and growth

28.10.08 Slava Yukalov, Dubna, Russia
Quantum theory of decision making: A solution for 9 different paradoxes

04.11.08 Domenico Delli Gatti, Cath. University of Milano
Emergent macroeconomics: An agent-based perspective

11.11.08 Stefano Battiston, ETH Zürich
Systemic Risk

Albert Diaz-Guilera, University of Barcelona
Systemic risk – Dynamics on complex networks: information flow and synchronization

18.11.08 Julian Wucherpfennig, ETH Zürich
Path Dependence in Civil Wars

25.11.08 Aaron Clauset, Santa Fe Institute
Statistical Patterns in Global Terrorism

02.12.08 Gabriele Tedeschi, Polytechn. University of Marche
Herding effects in order driven markets: The rise and fall of gurus

Christian Schneider, ETH Zürich
Scale-free network robustness to attack

09.12.08 Thomas Maillart, ETH Zürich
Fitting power laws probability distributions and social dynamics

Heiko Rauhut, ETH Zürich
A research perspective on social norms and conflict

8 Services

8.1 Journals

The nomination as an editor for a scientific journal is certainly a public recognition of the scientific reputation of a person. But in return for the honour, one has to make a strong commitment to serve for the journal in various respects, such as handling manuscripts, choosing referees, evaluating the papers and the referee reports, communicating with authors, settling the various cases of disagreement and disconsent between authors and referees. This takes time, but requires also a profound knowledge about the recent achievements in the area, upcoming trends, etc.

The situation becomes even more demanding for the editor-in-chief who in addition also takes responsibility for the journal's scientific profile and attractiveness to authors, its further development and standing in the competitive market of scientific publications.

On the other hand, it is great a opportunity to shape the future of such a journal, by addressing the right trends at the right time, by attracting the right authors, and by making the journal known for its distinct profile and quality. We are very happy to have such different opportunities as listed below.

The particular emphasis is on journals with a strong interdisciplinary profile, which allow researchers with different scientific background to publish in the same journal for the mutual benefit of the contributing areas. The impact of such a 'bridge' cannot be simply measured in numbers such as the impact factor, rather the value is seen in fostering the collaboration of a multidisciplinary community.

8.1.1 EPJ Data Science

Publisher EDP Sciences, Societa Italiana di Fisica, Springer

Website `http://www.epjdatascience.com`

The 21st century witnesses the establishment of data-driven science as a complementary approach to the traditional hypothesis-driven method. This (r)evolution accompanying the paradigm shift from reductionism to complex systems sciences has already largely transformed the natural sciences and is about to bring the same changes to the techno-socio-economic sciences, viewed broadly.

EPJ Data Science offers a publication platform to address this evolution by bringing together all academic disciplines concerned with the same challenges:

- how to extract meaningful data from systems with ever increasing complexity
- how to analyse them in a way that allows new insights
- how to find new empirical laws, or fundamental theories, concerning how natural or artificial (complex) systems work

Editorial board

Editors-in-Chief

Frank Schweitzer	ETH Zürich, Switzerland
Alessandro Vespignani	Northeastern University, USA

Editorial board

Stefano Battiston	ETH Zürich, Switzerland
Vincent D. Blondel	Universite catholique de Louvain, Belgium
John Brownstein	Harvard Medical School, USA
Ciro Cattuto	ISI Foundation, Italy
Santo Fortunato	Aalto University, Finland
Fosca Giannotti	KDD Lab, Italy
Jennifer Golbeck	University of Maryland, USA
César A. Hidalgo	MIT Media Lab, USA
Janusz Hołyst	Warsaw University of Technology, Poland
Hawoong Jeong	Korea Advanced Institute of Science and Technology, South Korea
David Lazer	Northeastern University, USA
Rosario Nunzio Mantegna	Università di Palermo, Italy
Madhav Marathe Virginia	Bioinformatics Institute, USA
Filippo Menczer	Indiana University, USA
Jukka-Pekka Onnela	Harvard University, USA
Marcel Salathé	The Pennsylvania State University, USA
Maxi San Miguel	Universitat de les Illes Balears, Spain

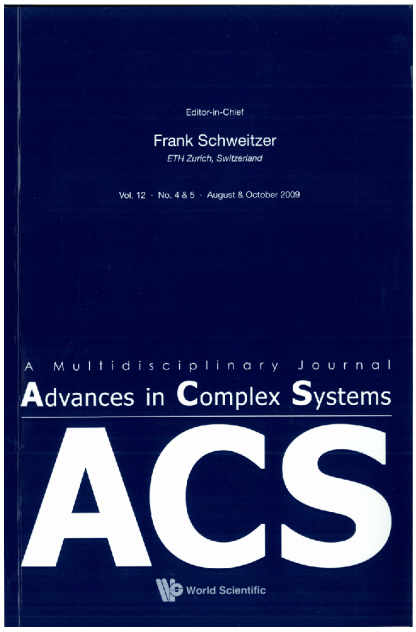
8.1.2 ACS – Advances in Complex Systems

Publisher World Scientific, Singapore

Website `http://www.worldscientific.com/worldscinet/acs`

The journal ACS is a classic in the area of complex systems research. It was established in 1997, and Frank Schweitzer is an editor of ACS since the very beginning. He became the editor-in-chief of ACS at the end of 2006 and took responsibility for a major overhaul of the journal. Changes involved a complete new editorial board of 20 editors, a refined aims and scope, a faster publishing schedule and, after all, a completely new cover layout.

Ever since, ACS has grown both in visibility and reputation and is now considered a major outlet for truely interdisciplinary research. In addition to physics and mathematics, ACS also covers computer sciences, biological systems, social and economic systems, and traffic and environmental systems. Notably, ACS publishes topical sections on hot interdisciplinary topics such as 'Language Dynamics' or 'Guided Self-Organisation', but also topical issues from major conferences in the area of complex systems research. ACS is published with 8 issues/year plus, occasionally, supplementary topical issues.



Aims and Scope

ACS – Advances in Complex Systems aims to provide a unique medium of communication for multidisciplinary approaches, either empirical or theoretical, to the study of complex systems. The latter are seen as systems comprised of multiple interacting components, or agents. Nonlinear feedback processes, stochastic influences, specific conditions for the supply of energy, matter, or information may lead to the emergence of new system qualities on the macroscopic scale that cannot be reduced to the dynamics of the agents. Quantitative approaches to the dynamics of complex systems have to consider a broad range of concepts, from analytical tools, statistical methods and computer simulations to distributed problem solving, learning and adaptation. This is an interdisciplinary enterprise.

The goal of ACS, therefore, is to promote cross-fertilization of ideas among all the scientific disciplines having to deal with their own complex systems. These include, but are not limited to, biology, physics, engineering, computer sciences, economics, cognitive science and the social sciences. It is in fact the exchange of concepts and techniques developed within areas as diverse as spin glass physics, game theory, molecular biology, evolutionary optimization, or psychology – which has proven itself to be a major driving force in complex systems research.

ACS predominantly publishes original research articles in the field of complex systems and encourages submissions of papers which result from collaborations across traditional academic disciplines. As a peer-reviewed journal, ACS is committed to the highest scientific standards. Papers published in ACS should be written in a way that makes them accessible to a wide range of scientific disciplines. For details, please see the Guidelines for Contributors in this journal.

To encompass all aspects in the field of complex systems, papers in ACS are organised into five research sections, each of which is handled by a section editor. The list below – which is neither complete nor exclusive – gives some information about the possible topics covered in each section. This demonstrates the position of ACS as a truly multidisciplinary scientific journal in the field of complex systems research.

Overview of Sections and Selected Topics

1. Fundamental Concepts of Complex Systems
   - Structure and dynamics of complex networks
   - Interacting systems, collective dynamics
   - Evolution, emergence of functionality
   - Population dynamics, pattern formation
   - Fluctuation phenomena and stochastic processes
2. Adaptive Social and Economic Systems
   - Agent based models of social organizations
   - Social and economic networks
   - Evolutionary game theory, cooperation
   - Economic growth, financial systems, systemic risk
   - Traffic and environmental systems
3. Complex Computer Systems
   - Learning and adaptation, self-management
   - (Distributed) multi-agent coordination
   - Bio-inspired solutions to computational problems
   - Network science applied to complex computer systems
   - Formal models for large-scale systems

Editorial Board

8.2 Boards and Program Committees

Editorial Boards (Frank Schweitzer)

- EPJ Data Science
  Springer Open
  Editor-in-Chief, 2013 – present
- The European Physical Journal B: Condensed Matter and Complex Systems
  EPJ Sciences Les Ulis Cedex A
  Editor, 2006 – 2007
  Editor-in-Chief (Complex Systems), 2007 – 2012
  External Advisors, 2012 – present
- ACS - Advances in Complex Systems
  World Scientific Singapore
  Editor, 1998 -2007
  Editor-in-Chief, 2007 – present
- Journal of Economic Interaction and Coordination
  Springer Berlin Heidelberg
  Editor, 2005 – present
- International Journal of Modern Physics C
  World Scientific Singapore
  Associate Editor, 2005 – present
- Springer Complexity
  Springer Berlin Heidelberg
  Editorial and Programme Advisory Board, 2006 – present
- Springer Series in Synergetics
  Springer Berlin Heidelberg
  Editorial and Programme Advisory Board, 2004 – present
- Selbstorganisation
  Jahrbuch für Komplexität in den Natur-, Sozial- und Geisteswissenschaften
  Duncker & Humblot Berlin
  Wissenschaftlicher Beirat, 1990 – 2000

Advisory Boards (Frank Schweitzer)

- Institute for Scientific Interchange, Torino, Italy
  Scientific Advisory Board, 2010-2013
- Society for Economic Science with Heterogeneous Interacting Agents
  Council, 2006 – present
- German Physical Society (DPG)
  Council, 2006 – 2009
- CABDyN Complexity Centre, Oxford University, UK
  International Advisory Board, 2005-

Program committees of conferences (Frank Schweitzer)

- International Conference on Computational Social Science (IC2S2)
  Helsinki, Finland, 8 - 11 June 2015
- 10th International Conference on Signal-Image Technology & Internet-Based System (SITIS 2014)
  Marrakech, Morocco, 23 - 27 November 2014

- 3rd Workshop on Complex Networks and their Applications
  Marrakech, Morocco, 23 - 27 November 2014
- Workshop "What's in a dyad? Interaction and Exchange in Social Media" (DYAD) at SocInfo 2014
  Barcelona, Spain, 10 November 2014
- Workshop on Social Influence (SI 2014) at SocInfo 2014
  Barcelona, Spain, 10 November 2014
- 6th International Conference on Social Informatics (SocInfo 2014)
  Barcelona, Spain, 10 - 13 November 2014
- 10th European Social Smulation Association Conference (ESSA 2014)
  Barcelona, Spain, 1 - 5 September 2014
- WEHIA2014 - Workshop on Economic Science with Heterogeneous Interacting Agents
  Tianjin, China, 12 - 19 June 2014
- 5th Workshop on Complex Networks (CompleNet 2014)
  Bologna, Italy, 12 - 14 March 2014
- 6th International Conference on Agents and Artificial Intelligence (ICAART 2014)
  Loire Vally, France, 6 - 8 March 2014
- CODYM2013 - Cultural and opinion dynamics: Modeling, Experiments and Challenges for the future
  Barcelona, Spain, 18 September 2013
- ECCS2013 - European Conference on Complex Systems
  Barcelona, Spain, 16 - 20 September 2013
- 9th European Social Smulation Association Conference (ESSA 2013)
  Warsaw, Poland, 16 - 20 September, 2013
- Econophysics Colloquium 2013 and 2013 Asia Pacific Econophysics Conference
  Pohang, Korea, 29 - 31 July, 2013
- 18th Annual Workshop on the Economic Science with Heterogeneous Interacting Agents (WEHIA 2013)
  Reykjavik, Iceland, 20 - 22 June, 2013
- 12th International Conference on Autonomous Agents and Multi-Agent Systems
  Saint Paul, Minnesota, USA, 6 - 10 May, 2013
- 3th Conference on the Analysis of Mobile Phone Datasets (NetMob 2013)
  Boston, Massachusetts, USA, 2 - 3 May, 2013
- 4th Workshop on Complex Networks (CompleNet 2013)
  Berlin, Germany, 13 -15 March, 2013
- 5th International Conference on Agents and Artificial Intelligence (ICAART 2013)
  Barcelona, Spain, 15 - 18 February, 2013
- Track on Applications in Social Science and Organization, Winter Simulation Conference
  Berlin, Germany, 9 - 12 December, 2012
- Epistemological Perspectives on Simulation Conference (EPOS 2012)
  San Antonio, Texas, USA, 10 - 13 October, 2012
- 10th German Conference on Multi-Agent System Technologies (MATES 2012)
  Trier, Germany, 10 - 12 October, 2012
- Third International Workshop on Managing Financial Instability in Capitalist Economies (MAFIN 2012)
  Genoa, Italy, 19 - 21 September 2012

- CODYM 2012 - Cultural and opinion dynamics: Modeling, Experiments and Challenges for the future
  Brussels, Germany 5 September, 2012
- ECCS'12 - European Conference of Complex Systems
  Brussels, Germany 3 - 7 September, 2012
- 3rd Workshop on Complex Networks (CompleNet 2012)
  Melbourne, Florida, USA, 7 - 9 March, 2012
- 4th International Conference on Agents and Artificial Intelligence (ICAART 2012)
  Vilamoura, Portugal, 6 - 8 February, 2012
- 9th German Conference on Multi-Agent System Technologies (MATES 2011)
  Berlin, Germany, 6 - 7 October, 2011
- 7th European Social Simulation Association Conference (ESSA 2011)
  Montpellier, France, 19 - 23 September, 2011
- Econophysics Colloquium 2011
  Vienna, Austria, 14 - 15 September, 2011
- International Conference on Econophysics (ICE)
  Shanghai, China, 4 - 6 June, 2011
- 3rd International Conference on Agents and Artificial Intelligence (ICAART 2011)
  Rome, Italy, 28 - 30 January, 2011
- Econophysics Colloquium 2010
  Taipei, Taiwan, 04 - 06 November, 2010
- Unwindig Copmlexity: Statistical Physics Perspectives on Complex Systems and Complex Materials
  STATPHYS 24, Port Douglas, Australia, 24 - 26 July, 2010
- Society for Economic Science with Heterogeneous Interacting Agents (ESHIA2010)
  Alessandria, Italy, 23 - 25 June, 2010
- Engineered & Social Networks: Theory and Applications (ICCS 2010)
  Amsterdam, Netherlands, 31 May - 2 June, 2010
- 9th Asia-Pacific Complex Systems Conference (Complex'09)
  Tokyo, Japan, 4 - 7 November, 2009
- Econophysics Colloquium 2009
  Erice, Italy, 26 - 31 October, 2009
- IEEE Toronto International Conference Science and Technology for Humanity (TIC-STH 2009)
  Toronto, Ontario, Canada, 26 - 27 September, 2009
- 6th European Social Simulation Association Conference (ESSA 2009)
  Guildford, UK, 14 - 18 September, 2009
- 1st International Workshop on Managing financial instability in capitalistic economies (MAFIN 09)
  Reykjavik, Iceland, 3 - 5 September, 2009
- 3rd International Workshop on Emergent Intelligence on Networked Agents (WEIN'09)
  7th International Joint Conference on Autonomous Agents and Multiagent Systems (AAMAS09) Budapest, Hungary, 10 - 15 May, 2009
- APFA7 and Tokyo Tech - Hitotsubashi Interdisciplinary Conference "New Approaches to the Analysis of Large-Scale Business and Economic Data"
  Japan, Tokyo, 1 - 5 March, 2009

- Winter Workshop on Economics with Heterogeneous Interacting Agents (WEHIA 2008)
  Taoyuan, Taiwan, 05 - 07 December, 2008
- Agent Based Spatial Simulation (ABS2)
  Paris, France, 24 - 25 November, 2008
- GWAL-8: 8th German Workshop on Artifical Life
  Leipzig, Germany, 30 July - 01 August, 2008
- Econophysics Colloquium 2008
  Kiel, Germany, 28 - 29 August, 2008
- ICCGI 2008, 1st International Workshop on Computational P2P Networks: Theory & Practice
  Athens, Greece, 27 July - 1 August, 2008
- 4th International Conference in Statistical Physics - SigmaPhi
  Crete, Greece, 14 - 18 July, 2008
- 2nd World Congress on Social Simulation (WCSS-08)
  Washington DS, USA, 14 - 17 July, 2008
- Conference on Economic Science with Heterogenous Interacting Agents (ESHIA 08)
  Warsaw, Poland, 19 - 21 June, 2008
- 3rd International Workshop on Emergent Intelligence on Networked Agents (WEIN'08)
  7th International Joint Conference on Autonomous Agents and Mulitagent Systems (AAMAS 2008)
  Estoril, Portugal, 12 - 13 May, 2008
- GIACS Conference "Data in Complex Systems"
  Palermo, Italy, 7 - 9 April, 2008
- Workshop on Heterogeneous Agent Systems and Complex Networks
  ECCS'07 - European Conference of Complex Systems
  Dresden, Germany, 4 October, 2007
- ECCS'07 - European Conference of Complex Systems
  Dresden, Germany, 1 - 5 October, 2007
- Econophysics Colloqium 2007
  Ancona, Italy, 27 - 29 September, 2007
- The Fourth European Social Simulation Association Conference - ESSA'07
  Toulouse, France, 10 - 14 September, 2007
- SPIE International Symposium Complex Systems II
  Canberra, Australia, 4 - 7 December, 2007
- Econophysics Colloqium 2006
  Tokyo, Japan, 23 - 25 November, 2006
- ECCS'06 - European Conference of Complex Systems
  Oxford, UK, 25 - 29 September, 2006
- GWAL-7: 7th German Workshop on Artificial Life
  Jena, Germany, 26 - 28 July, 2006
- 4th Workshop on Agents in Traffic and Transportation (ATT)
  5th International Joint Conference on Autonomous Agents and Mulitagent Systems (AAMAS 2006)
  Hakodate, Japan, 9 May, 2006
- Workshop on Emergent Intelligence on Networked Agents (WEIN'06)
  5th International Joint Conference on Autonomous Agents and Mulitagent Systems (AAMAS 2006)
  Hakodate, Japan, 8 May, 2006

- ECCS2005 - European Conference of Complex Systems
  Paris, France, 14 - 18 November, 2005

Participation in Committees (Frank Schweitzer)

- Studienkommission
- Berufungkommission
- Informatikkomission

Program Committee & Chairing Activities (Ingo Scholtes)

- Elected Steering Comittee Member, 8th IEEE International Conference on Self-Adaptive and Self-Organizing Systems (SASO2014)
- Sponsoring Co-chair and Workshop Co-chair, 6th IEEE International Conference on Self-Adaptive and Self-Organizing Systems (SASO 2013)
  Philadelphia, USA, 9 - 1,3 September, 2013
- Co-chair, 1st International Workshop on Self-Optimisation in organic and autonomic computing systems
  Prague, Czech Republic
- Program Committee Co-Chair, 5th IEEE International Conference on Self-Adaptive and Self-Organizing Systems (SASO)
  Lyon, France, 2012

Program Committee (Antonios Garas)

- Temporal and Dynamic Networks: From Data to Model, Satellite workshop at NetSci13
  Copenhagen, Denmark, June, 2013

8.3 Reviews

As a service to the scientific community, we write quite a number of reviews on submissions for journals and conferences. This activity involves all members of our team and is supervised by Frank Schweitzer. Certainly, it is very time consuming, but it also helps to learn about the strengths and weaknesses in scientific publications and gives a good overview of recent research trends. As can be seen in Figure 8.1, a vast inclining number of 300 reviews were prepared by members of our team.

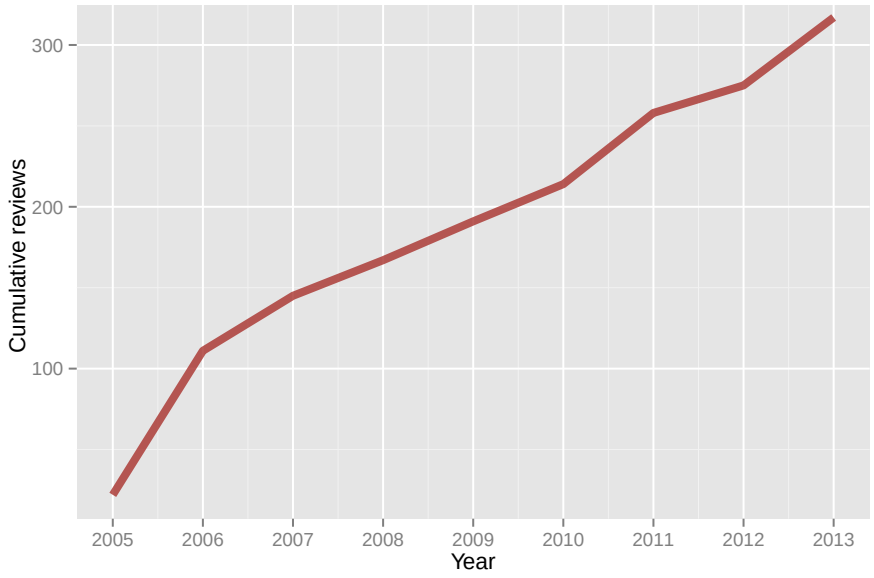


Figure 8.1: The cumulative reviews that have been written per year by Chair of Systems Design

8.4 ETH Beamer

The Chair of Systems Design provides a class file, and the necessary backgrounds, in order to create LaTeX presentations according to the ETHZürich format. The class is based on the general beamer class, supports both 4:3 and 16:9 aspect ratios, and the use of Helvetica fonts. It uses the color palette provided by the Corporate Design (CD) Manual, and the desired color is passed as a class option with it's respective name: ETH1-ETH9. As a service to ETH employees an example .tex file is provided, aiming to highlight the use of some default options.

8.5 ETH Briefstyle

The Chair of Systems Design has provided a template for the ETH Brief style for LaTeX. By the time of creation in 2005 there was only a general Microsoft Word template for the ETH Brief provided by the ETH. We filled this gap by providing an additional LaTeX template for those who not use Microsoft Word. Currently, ETH has build upon this template to create an updated version to match its new format requirements.

8.6 eCitationEditor

In order to simplify the process of updating the current publication list in the ETH Institutional Bibliography E-Citations, we have developed the software eCitationEditor. It allows to edit publications (with all the mandatory and optional fields of E-Citations) manually in a comfortable way. In particular, it allows to import BibTeX records both by importing existing BibTeX database files and by pasting BibTeX records from the clipboard (which is particularly handy

when collecting updated bibliographic information from the publisher's online database or from the Web of Science). As a service to ETH employees, here we provide this software for your own use.

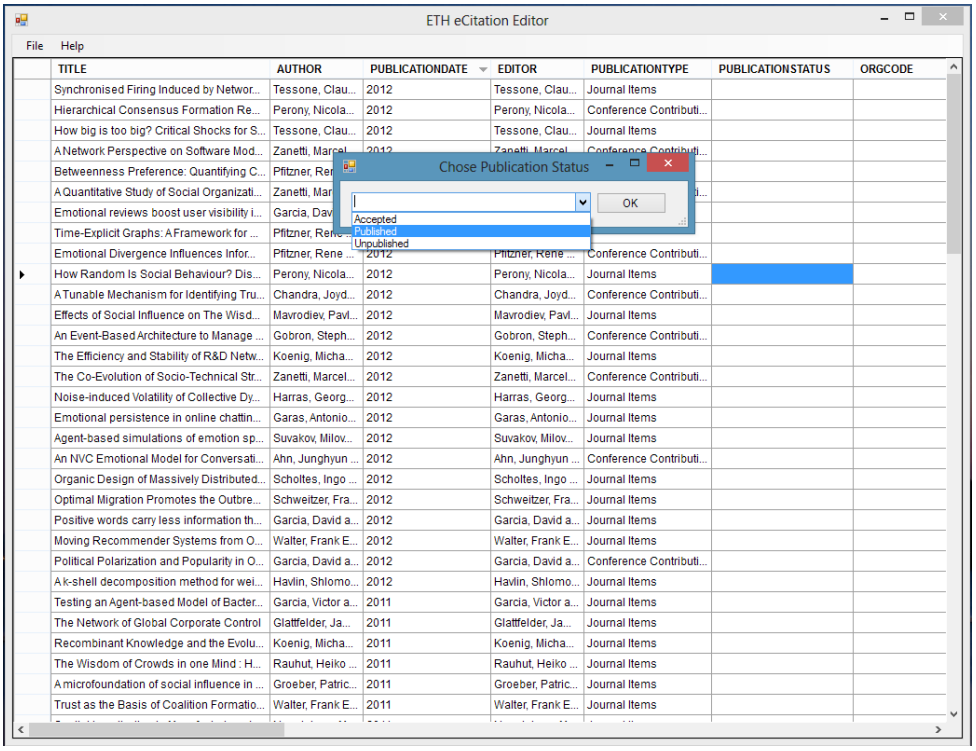
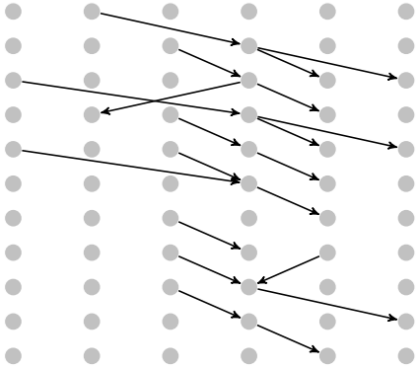


Figure 8.2: A screenshot of the eCitationEditor

8.7 Temporal Networks Visualizer

The command line tools and the library of this package can be used to compare weighted aggregate networks from temporal sequences of edges, create tikz and png figures of temporal unfoldings of dynamic networks, compute betweenness preference distributions of empirical networks, generate null model realizations based on empirical data and create second-order aggregate networks. An example for a time-unfolded network with 6 nodes and 10 time steps is shown in figure 8.7.



This project is available on gitHub with Open Source C#-code under `github.com/IngoScholtes/TemporalNetworks`.

8.8 NETVisualizer

NETVisualizer is an OpenSource, OpenGL-based network and graph visualization framework for .NET 4.0 / Mono 2.10x and higher. Its main features are:

- Efficient rendering of large networks based on OpenGL and OpenTK
- Support for the visualisation of temporal networks (both as aggregated and dynamic representation)
- Visualisation modes using straight and customisable curved edges
- Integrated PDF export
- Simple and clean network interface that does not impose constraints on how you implement networks in your code
- Simple to use in your own code, a single line of code is sufficient to fire up an OpenGL visualisation and start exploring a network
- Easy-to-grasp interface for custom graph layouting algorithms
- Integrated multi-core aware Fruchterman-Reingold layout which makes use of all available cores
- Integrated frame grabbing capabilities that allow to produce high quality videos
- Full mouse control allows panning, zooming and selection of nodes
- Fully customisable coloring of background, nodes and edges
- Node and edge sizes and colors can be conveniently and dynamically computed based on elegant lambda expression interface
- No external dependencies except OpenTK (libraries included)
- Fully documented: Each method and field is explained and in-method comments help you to understand and extend the existing code
- Integrated, maximally simple demo that can be used as boilerplate code for your own project
- Platform-independent, built on OpenTK, runs on Windows, MacOS X and Linux
- The fully documented source code is available on a dedicated gitHub project page.

Please note that NETVisualizer shares parts of its OpenGL rendering backend with our graph layout software Cuttlefish.

8.9 Cuttlefish: Dynamic Network Visualization

At the Chair of Systems Design, networks from very different domains are analysed: economic networks, social networks, biological networks, networks of software dependencies, and networks in technological systems. This variety poses a challenge, as the classical network analysis tools do not account for the idiosyncrasy of each network type. A second challenge results the fact that most of these networks exhibit a highly heterogeneous degree distribution. Classical force directed layout algorithms, such as the spring-layout, do not cope very well with such a topology as Figure 8.9 shows. Highly connected clusters are compressed to undifferentiated lumps and nodes with low degrees spread out disproportionally.

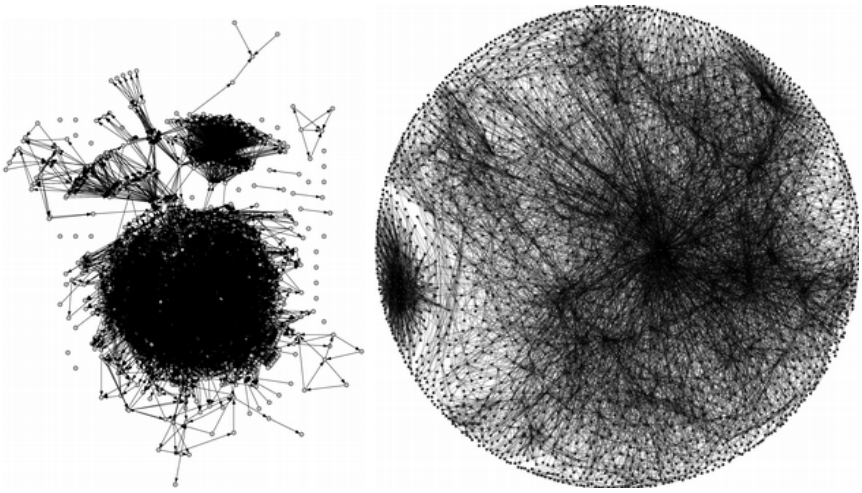


Figure 8.3: Left: The spring-layout algorithm produces less readable figures. Right: our ARF algorithm produces better readable figures.

We have addressed these challenges by developing our own tools, for instance a new variation of force-directed layout: ARF uses a different set of force equations than the spring-layout algorithm. The new equations balance attraction and repulsion and thus distribute also highly heterogeneous networks well in the layout space, as the comparison of figure 8.9 shows.

Another new tool developed at the Chair of Systems Design is the network analysis tool Cuttlefish. It offers a versatile plug-in mechanism which allows users to extend its functionality. This way Cuttlefish adapts to the problem domain like the animal from which it borrowed the name. Furthermore, Cuttlefish is a a platform independent open source project in SourceForge, released under GNU General Public License. Its code and documentation are available for the whole community and the participation of external users and developers is encouraged.

Its high extensibility and multi-purpose features make Cuttlefish an useful tool also for researchers outside of the Chair of Systems Design. GraphML and pajek files can be loaded, as well as file formats for special visualisation, or file formats for changes taking place in the network. Cuttlefish creates figures from snapshots and tex files using PSTricks or Tikz for scalable graphics. Eventually, Cuttlefish allows browsing a large network stored in a database by applying filters to the nodes and edges displayed. In addition to ARF, other well-known layout algorithms are implemented, such as Kamada-Kawai, Fruchterman-Reingold, Spring and ISOM.

8.10 Working Paper Series for CCSS and the ETH Risk Center

For the the ETH Risk Center as well as the Competence Center "Coping with Crises in Complex Socio-Economic Systems" (CCSS), it is important to broadly disseminate its output to the scientific comunity. In particular, there should be a technical framework to efficiently host the research papers produced by the Chairs involved in the ETH Risk Cente and CCSS and to allow an automated aggregation of the respective information for activity reports, etc. As a deliverable for the ETH Risk Center and CCSS, our Chair has developed a Working Paper Series portal, which meets these requirements, which can be found at:
`http://web.sg.ethz.ch/ethz_risk_center_wps/` (for the ETH Risk Center)
`http://web.sg.ethz.ch/wps` (for CCSS)

The WPS portal allows members of the ETH Risk Center and CCSS to upload recent papers they want to share with other scientists. Their submissions become instantaneously available thought this portal, but also get automatically indexed in two leading social science repositories: RePEc and SSRN

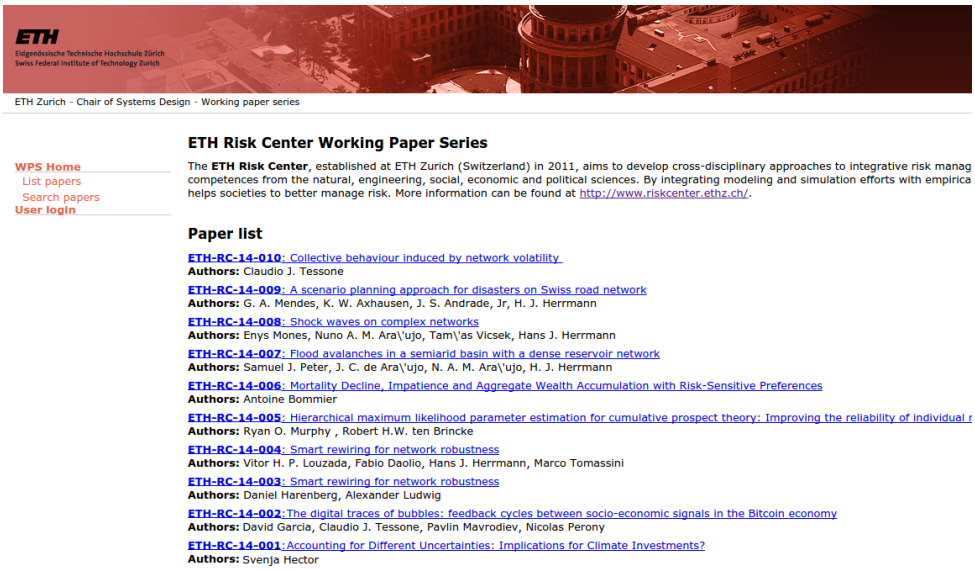


Figure 8.4: Snapshot of the CCSS Working Paper Series as of 15.11.2014.

8.11 Social Media

8.11.1 Twitter

The use of social media has exploded the past five years. Furthermore, Twitter is not only a leisure activity anymore, but has been used for academic purposes as well. Many scientists and research groups have their own Twitter feed, where they post their publications and start discussions. By following other scientists in the field, they are being kept up to date with the latest publications. Twitter also provides easier access to publications and news for students and other interested people.

At the Chair of Systems Design, we have our own Twitter page, where we strive to have new tweets every week of maximal 140 characters. These can include new publications of our own or publications of our colleagues. Especially during events as conferences, an increase in the use of Twitter is visible. It is an interactive way to update fellow scientists and upcoming lectures. Our Twitter-feed is reachable via:

`http://twitter.com/ETHZSystDesign`

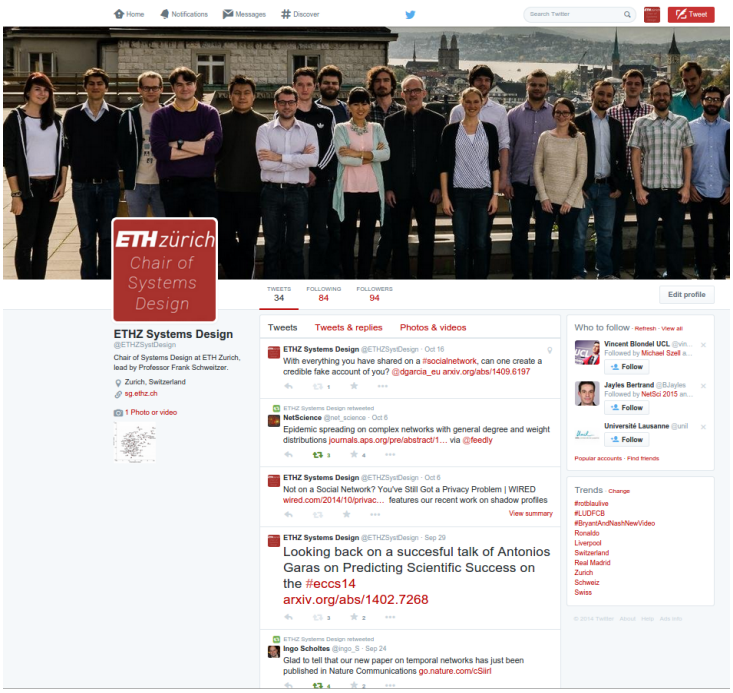


Figure 8.5: A snapshot of our Twitter page

8.11.2 Google+

Among other Social Media, Google+ is a medium that is commonly used by researchers. It is a way to keep in touch in a less condensed way than Twitter. Google+ allows users to create longer posts and include more figures, but it is less commonly used by researchers. The Google+ is reachable via
`https://plus.google.com/b/113416551553806856428/113416551553806856428/posts`

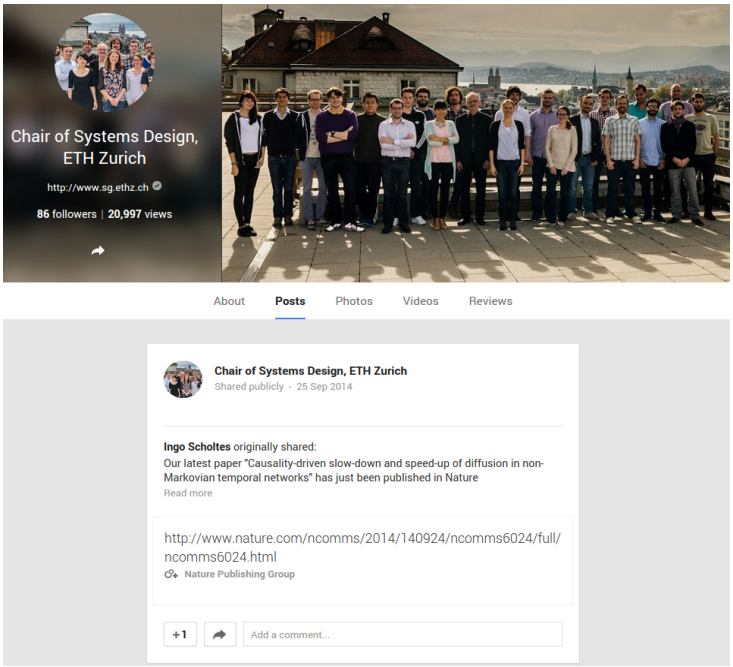


Figure 8.6: A snapshot of our Google+ page

Chair of Systems Design
ETH Zürich
D-MTEC, WEV
Weinbergstrasse 56/58
8092 Zürich
Switzerland

www.sg.ethz.ch