Agenda

(i) Theoretical Foundations: **Nihat Ay**, **Jeffrey Johnson, Madhav Marathe, Alessandro Panconesi, Rahul Roy**

(ii) Statistical and Data Sciences: **Fatihcan M. Atay**, **Henry Wynn**, **Marko Grobelnik, Hussein Yahia**

(iii) Computational Methods and Computational Sciences: **Rosaria Conte, Devdatt Dubhashi**, **Markus Kirkilionis**, **Fernando Vega Redondo**, **Peter Sloot,**

(iv)Decision Making and Policy: **Chris Barrett, Dinesh Mohan**, **Mario Rasetti, T.V. Somanathan**

DAY 1: Monday 1000 am to 1700 pm

1000-1030: Introductions and Charge

1040-1210: 2 Presentations and discussion (Theoretical Foundations): ***Prof. Nihat Ay*** and ***Prof. Jeff Johnson***

1210-1340: Lunch

1345-1515: 2 presentations and discussion (Decision Making and Policy): ***Prof. Christopher Barrett*** and ***Prof. Dinesh Mohan***

1515-1530: Tea

1530-1730: 3 presentations and discussions: (Theoretical Foundations, Computational and Data Sciences): ***Prof. Rosaria Conte, Prof. Markus Kirkilionis and Prof. Alessandro Panconesi.***

DAY 2: Tuesday 0900 am to 1700 pm

0900-1030: 2 Presentations and discussion (Statistical and Data Sciences): ***Prof. Henry Wynn and Prof. Fatihcan Atay***

1030-1040: Tea Break

1040-1210: 2 Presentations and discussion (Decision Making and Policy): ***Dr. T.V. Somanathan and Prof. Mario Rasetti***

1210-1340: Lunch

1345-1515: 2 presentations and discussion (Computational Methods and Computational Sciences): ***Prof. Fernando Vega Redondo and Prof. Peter Sloot***

1515-1530: Tea

1530-1730: 3 presentations and discussions (Theoretical Foundations, Computational Science): ***Prof. Devdatt Dubhashi , Prof. Rahul Roy and Prof. Grobelnik***

2030 SOCIAL EVENT Ristorante L'Agrifoglio Via Provana 7/E(tel. +39 011 813 68 37)

DAY 3: Tuesday 0900 am to 1200

0900-1100: 3 talks and discussion (Theoretical Foundations, Computational and Data Sciences): ***Prof. Madhav Marathe and Prof. Hussein Yahia (and if possible Dunu Roy)***

1100-1115: Break

1115-1200: Concluding remarks and summary discussion

Titles and Abstracts

Fatihcan M. *Atay,* Max Planck Institute for Mathematics in the Sciences, Leipzig Germany

Title: **Consensus and synchronization: Cooperative dynamics on networks with delayed and time-varying links**

Abstract: Many networks involve time delays in the propagation or the processing of information. Furthermore, the network structure can also be varying in time due to obstacles, failure and recovery of links, changes in social structure, etc. Both of these factors can crucially affect the collective behavior in the network. In this talk I will present some recent theoretical results on the effects of delays and time-varying links on cooperative network dynamics, with a view towards applications in social systems.

Prof. Atay has obtained his PhD in Applied Mathematics from Brown University in 1994. He has held positions in both academia and industry before joining the Max Planck Institute for Mathematics in the Sciences in 2002 as a Principal Investigator. His research interests include dynamical systems, delay equations, networks and graph theory, complex systems, and mathematical neuroscience.

Nihat Ay, Max Planck Institute for Mathematics in the Sciences, Leipzig, Germany

Title: **A Geometric Approach to Complexity**

Abstract: I discuss several complexity measures of random fields from a geometric perspective. Central to this approach is the notion of multi-information, a generalization of mutual

information. As demonstrated by Amari, information geometry allows to decompose this measure in a natural way. In my talk I will show how this decomposition leads to a unifying scheme of various approaches to complexity. In particular, connections to the complexity measure of Tononi, Sporns, and Edelman and also to excess entropy (predictive information) can be established. In the second part of my talk, the interplay between complexity and causality (causality in Pearl's sense) will be discussed. A generalization of Reichenbach's common cause principle will play a central role in this regard.

Prof. Nihat Ay studied mathematics and physics at the Ruhr University Bochum and received Ph.D. in mathematics from the University of Leipzig in 2001. In 2003 and 2004 he was a postdoctoral fellow at the Santa Fe Institute and at the Redwood Neuroscience Institute (now the Redwood Center for Theoretical Neuroscience at UC Berkeley). Following this, he became a member of the Mathematical Institute of the Friedrich Alexander University in Erlangen at the assistant professor level. Since September 2005 he is a Max Planck Resarch Group Leader at the Max Planck Institute for Mathematics in the Sciences in Leipzig where he heads the group Information Theory of Cognitive Systems. As external professor of the Santa Fe Institute he is involved in research on complexity and robustness theory. Since September 2009, he is affiliated with the University of Leipzig as associate professor (Privatdozent) for mathematics.

Christopher Barrett - Virginia Tech, USA

Title Beyond Modeling: Decision informatics for distributed reasoning and action in complex systems

Abstract: Recent political events have been greatly influenced by web services-based information resources and social
media. Similarly, economic processes, infrastructure operations, commerce and nearly every aspect of personal and public life have been importantly affected by internet enabled data, computing and communication systems. In some ways it is an exaggerated, information rich extension of traditional activities, institutional behavior and societal processes. In other ways this is a truly new socio-technical environment. What these information technologies amplify is the fact, perhaps evident since democratic-style institutions first "crowd sourced" a king, that there are many interacting individual stakeholders, interests, and distributed interaction dynamics involved in the observed behavior of societies, individuals and their material environments. Although technologically enabled, we believe that the important interplay of emerging information technologies and socially-coupled systems is beyond the state of knowledge of the enabling technologies or the affected social processes. Indeed, analytical tools in support of decision making- as well the formalized rationale of decisions made- often continue to be organized around outmoded objective observer modeling concepts. Many, perhaps most, analytical decision support essentially reflects a "great man" view wherein a decision maker presides over a (perhaps complicated) system of relatively obedient "others". Theoretical advances, rapidly evolving mobile and distributed computing, and socially embedded decision informatics are being developed that will force changes to this state of affairs in science. Undoubtedly this will enable breakthrough capabilities and cognitive augmentation suitable for truly grand challenge-scale human problems. This talk will overview our work, from fundamental research to actual use, developing such decision/policy informatics for complex, interdependent systems.

Christopher Barrett is Director of the Advanced Computing and Decision Informatics Laboratories (ACDIL) at Virginia Bioinformatics Institute (VBI) and a Professor in the Department of Computer Science at Virginia Tech. Specializing in decision informatics and large-scale modeling of complex systems, these laboratories conduct research on interdependent biological, information, social and technology systems. Computational research related to synthetic information systems and decision informatics involves developing novel and scalable methods for detailed simulations of extremely large systems and implementations using distributed and high performance computing, as well as developing distributed service architectures for users. Representation of intelligence and agency, cognitive processes and social dynamics in these large systems are central features of Professor Barrett's interests This technology applied to decision informatics can play a key role in shaping policies, plans and responses to crisis events as well as normal planning processes. In 2004, Barrett retired from Los Alamos National Laboratory, where he was the leader of the Basic and Applied Simulation Science Group in the Computing and Computational Science Division and built a research program active in theoretical and applied research in intelligent systems, distributed systems and advanced HPC-based computer simulation. He then came to VBI and established the Network Dynamics and Simulation Science Laboratory, which has grown into the ACDIL. He received a Ph.D. in bioinformation systems and an M.S. in engineering science from the California Institute of Technology, was certified as a U.S. Navy aerospace experimental psychologist and has been widely recognized for his work.

Rosaria Conte, Institute of Cognitive Science and Technology, National Research Council Rome, Italy

Title: **When Math Helps (Not) the Social Sciences**

Abstract: Many scientists believe that modeling is indispensable for doing science, i.e. representing target phenomena as highly abstract, ideal-type facts, and generating propositions that account for the properties of these abstract facts. The follow up questions are, what are the general properties of scientific models? Do such properties need to be mathematically described? Or are there non-mathematical models that add value to the scientific process? If so, when and why is it so? In other words, which kinds of non-mathematical models add value and why?

In this talk, the special perspective of the social and behavioral science will be taken. After a short discussion of the properties of model science, mathematical models will be claimed to be invaluable scientific instruments even in the study of social phenomena. However, mathematical modeling cannot be *autarchic*, i.e. meant to replace other types of models, which are necessary for *fully* explaining the phenomena under study. For example, to explain social and behavioral phenomena requires that (a) the proximate causes of phenomena, i.e. the mechanisms underlying them be identified, and (b) the process involving these mechanisms and yielding the phenomena to be explained be unfolded.

Mathematical modeling is sometimes said to be enough for prediction. In the currently dominant view of computational social science (Lazer et al., 2009) computers are used to implement statistical models of vast amounts of data, made available by current ICT applications, to make estimation of future state trajectories. In this paper, we claim that (a) mathematical modeling is not always sufficient for predicting and/or explaining social phenomena; (b) maybe irrelevant for modeling and theorizing upon social phenomena; (c) may lead to wrong expectations concerning social phenomena. We illustrate these arguments by means of examples drawn from well-known mathematical models of social economic phenomena.

Prof. Conte is head of the LABSS (Laboratory of Agent Based Social Simulation) at the ISTC (Institute for Cognitive Science and Technology). She is a cognitive and social scientist, with a special interest for the study of positive social action (altruism, cooperation and social norms), and reputation-based social regulation. Quite active in the MAS field, she contributed to launch the field of social simulation in Europe. She is coordinator of both European and Italian research projects. She is former President of the European Society of Social Simulation (ESSA <http://www.essa.eu.org/>), coordinating the section on Special Interest Groups, and of the Italian Cognitive Science Association (AISC <http://www.aisc-net.it/>). Rosaria Conte has published about 120 among scientific articles and books on cognitive social agents, norms representation and reasoning, and agent-based simulation. Her research interests range from Agent Theory to Multi Agent Systems, from Agent-Based Social Simulation and Cultural Evolution to Info-societies and Virtual Markets. She is now committed in the FP7 Flagship Project FuturICT <http://www.futurict.eu/> as representative of the Italian community

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Devdatt Dubhashi, Department of Computer Science and Engg.,Chalmers University, Chalmers, Sweden

Title: **Data Driven Decision Support**

Abstract: I will present some ideas and preliminary work about using high volume data harvested from the internet and other sources, combined with analysis of temporal dynamics of multiway interactions to build a decision support system for strategic policy making in business and public authorities. Our method uses a model of Markovian dynamics on relationships represented as hypergraphs.

Prof. Dubhashi received his Ph.D. in Computer Science from Cornell University U.S.A. He was a Posdoctoral fellow at the Max Planck Institute for Computer Science in Germany and a Research Asssitant Professor at BRICS (Basic Research in Computer Science, a center of the Danish National Science Foundation) and at the Indian Institute of Technology Delhi before joining Chalmers where he is Professor in the Dept. of Computer Science and Engg.

Marko Grobelnik, Jozef Stefan Institute, Ljubljana, Slovenia
Title: tba
Abstract:

Jeffrey Johnson – Open University, UK

Title: **Hypernetworks**

Abstract: Beyond simplicial complexes: hypernetworks for systems of systems of systems

An expert report1 on complex systems published recently by the European Commission "identified the dynamics of multilevel systems as the area in complex systems science requiring a major paradigm shift, beyond which significant scientific progress cannot be made." … "…they are systems of systems of systems, and we have no scientific formalism for representing the bottom-up and top-down dynamics of multilevel systems from micro-levels to macro-levels through meso-levels." Simplicial complexes with their related homology and cohomology structures are increasingly being seen as a very promising point of departure for modelling complex systems of systems. They provide a natural generalisation of networks. An abstract p-simplex is defined by p+1 vertices and has a geometric representation as a p-dimensional polyhedron in an n-dimensional space, n ³ p. In a 1952 paper2 C. H. Dowker shows that relations can define simplicial complexes. Inspired by this in 1972 R.H.Atkin published his ground breaking a paper3 in which he showed how ideas from algebraic topology can be extended from physics and applied to model social systems. Hypernetworks provide another extension through the concept or relational simplex in which the relations holding together the vertices of a simplex are made explicit4. This presentation will sketch the theory of hypernetworks and show how they provide a new formalism to represent the bottom-up, top-down, horizontal and diagonal dynamics of multilevel systems of systems of systems. It will be shown that conventional simplicial complexes have representational problems that hypernetworks overcome. It will be argued that hypernetworks are necessary if not sufficient for representing the dynamics of complex multilevel systems of systems of systems.

1. 'Complex Systems Science: Expert Consultation Report', Johnson, Bourgine & Hales (eds), ftp://ftp.cordis.europa.eu/pub/fp7/ict/docs/fet-proactive/shapefetip-wp2011-12-06_en.pdf , 2009.

2. 'Homology Groups of Relations', C. H. Dowker, Annals of Mathematics, 56(1), 1952, 84-95

3. 'From cohomology in physics to q-connectivity in social science', R. H. Atkin, International Journal of Man-Machine Studies, (1972) 4, 139-167

4. Hypernetworks in the science of complex systems, J. H. Johnson, to be published by Imperial College Press, 2012.

Jeffrey Johnson is Professor of Complexity Science and Design at the Open University in the UK. He is coordinator of the European ASSYST and Etoile projects (Action for the Science of complex SYstems, and Socially Intelligent ICT, and Enhanced Technology for Open Intelligent Learning Environments), and is a partner in the GSDP and NESS projects (Global System Dynamics and Policy, Non-Equilibrium Social Science). He is a chartered mathematician and a chartered software engineer. He has worked in many areas of application across the social and technical domains. His research into hypernetworks centres on the search for a formalism able to unite at all levels the dynamics of complex physical, biological, social and socio-technical systems

Markus Kirkilionis, University of Warwick, Coventry, UK

Title: **Social interaction and games on networks**

Abstract: Network theories in the social sciences are historically mainly working with static graphs, where social contacts are modelled as binary relations. A well-known example are small-world networks, where relations like 'did act together in the same movie' create the characteristic small-world graph describing a social network of actors. In contrast game theory has moved on to repeated games where timing of strategies plays a crucial role. In this case the investigation of the social system (interpreted as a game) is more complex, as the network topology and the dynamics on the graph work hand in hand and cannot be separated from each other. We give a few examples where dynamic games are better suited to describe the social situation. Moreover some mathematical methods are discussed that are used to determine the qualitative behavior of the underlying dynamical system. Finally we make some comparisons with opinion formation and epidemiology, both are closely related fields.

Madhav Marathe - Virginia Tech, USA

Title: **Network Science of Socially Coupled Systems: A Computational Viewpoint**

Abstract: Developing practical informatics tools and decision support environments for reasoning about large socio-technical networks is complicated and scientifically challenging due to their size, co-evolutionary nature and the need for representing multiple dynamical processes simultaneously. The recent H1N1 epidemic, national and global financial crisis are examples of generalized contagion processes (e.g. opinions, attitudes, beliefs, worms, infectious diseases) and provide examples of the many challenges faced when developing such environments. Recent quantitative changes in high performance pervasive computing have created new opportunities for collecting, integrating, analyzing and accessing information related to large socio-technical networks. The advances in network and information science that build on this new capability provide entirely new ways for reasoning and controlling these networks. Together, they enhance our ability to formulate, analyze and realize novel public policies pertaining to these complex networks. The talk will describe a formal interactionist framework that leads to high performance computing oriented decision-support environments for network, behavioral and social science

Prof. Madhav Marathe is the deputy director of the Network Dynamics and Simulation Science Laboratory and professor in the Department of Computer Science, Virginia Tech. His research interests are in computational network and social science, public health epidemiology, design and analysis of algorithms, communication networks and high performance computing. Before coming to Virginia Tech, he was a Team Leader in the Computer and Computational Sciences division at the Los Alamos National Laboratory (LANL) where he led the basic research programs in foundations of computing and high performance simulation science for analyzing extremely large socio-technical and critical infrastructure systems. He obtained his B.Tech degree in 1989 in Computer Science and Engineering from the Indian Institute of Technology (IIT) Madras, and his Ph.D. in 1994 in Computer Science, from University at Albany. He is currently the George Michael Distinguished Scholar at the Lawerence Livermore National Laboratory (LLNL).

Dinesh Mohan, Indian Institute of Technology, New Delhi, India

Title: **Urban transport as a complex system – need for negative feedback control mechanisms**

Abstract: In nature, stable and sustainable systems have two characteristics: all species, including humans beings, grow to maturity and then stop growth, and all have negative feedback systems to maintain homeostasis. As an important component of economic systems, the transportation sub-system must have negative feedback control to provide disincentives for excess travel by individuals. At present the transportation system is driven largely by positive feedback, encouraging people to travel long distances at high speeds. A longer drive gets you a larger house at lower prices. Even public transport systems (especially grade separated) focus on higher speeds encouraging long distance travel and sprawl. In addition, elevated and underground transit systems further discourage short distance travel because of large door-to-door trip times. Flat fares instead of distance based fares reward long distance travel and penalise those taking short trips. Unless our transport systems build in negative feedback loops against excess consumption and positive feedback for emission less travel, we are unlikely to see much progress

Prof. Dinesh Mohan is Volvo Professor Emeritus for Biomechanics and Transportation Safety at the Transportation Research and Injury Prevention Programme, Indian Institute of Technology, Delhi. He has co-authored end edited four books on safety. He is the recipient of: Distinguished Alumnus Award of Indian Institute of Technology Bombay, the American Public Health Association International Distinguished Career Award, the Bertil Aldman Award of the International Council on Biomechanics of Impacts, the Association for Advancement of Automotive Medicine's Award of Merit and the International Association for Accident & Traffic Medicine's International Award and Medal for outstanding achievement in traffic safety.

Alessandro Panconesi, Department of Informatics, Università La Sapienza, Rome, Italy

Title: **Social Sybil Defense**

Abstract: Social platforms such as Facebook, YouTube, Google+ and many others thrive on the open participation of users. Their very opennes makes them prone to so called sybil attacks: a malicious user, whose aim is to gain (some) control of the social network, may forge a large number of fake identities that, as recent social psychology experiments show, find it not so hard to establish social links with legitimate users. The "Social Defense Hypothesis" stipulates that it is possible to distinguish between honest and sybil identities by relying only on the "social structure" of real-life networks. We will discuss to what extent this can be true and discuss some interesting on-going research on this topic. (Joint work with A.Ayier, L.Alvisi, A.Clement, A.Epasto, S.LAttanzi)

Prof. Panconesi is full professor fo Computer Science at Sapienza, University of Rome. He has a PhD in Computer Science from Cornell University. For his research he has received the ACM Danny Lewin Award, and research awards from IBM, Yahoo! and Google. He works in Algorithms, with (recently) application to problems related to social networks.

Mario Rasetti -- ISI Foundation, Italy

Title: **Topology of Data**

Abstract: Complex systems consisting of large numbers of highly interconnected dynamic units whose structure is usually irregular have recently been the subject of extended research efforts. The complexity of such systems is reflected not only in their structure but also in their dynamics. The usual representation of a wide range of systems of this kind in nature and society resorts to very large data bases. Networks are the concept appropriate for the study of both the topology and dynamics of the data space of such systems. The customary approach to study networks is via graph theory which was well developed for regular and random graphs; however both have been found to be exceptional cases, of limited use in real-world. Recently, along with the discovery of new types of network structures such as the small-world and scale-free networks, the tools of statistical mechanics have been successfully implemented offering explanations and insights into the properties of these systems. In spite of many advances based on statistical mechanics approach to various issues involving data space networks, there is a strong need for a more versatile approach which would rely on new topological methods either separately or in combination with the techniques of statistical mechanics. In particular, the program is to encode the network into a simplicial complex which may then be considered as the combinatorial version of a topological space whose properties may however be studied from combinatorial, topological or algebraic aspects. The motivation stems from Q-analysis and its extension into a combinatorial homotopy theory. In such approach, the invariants of simplicial complexes may be defined from three different points of view (combinatorial, topological or algebraic) each of which provides completely different measures of the complex and, by extension, of the cloud of data (network) from which the complex was constructed. Vector valued quantities representing topological and algebraic invariants can be obtained in this way, whose statistical properties perfectly match their corresponding degree distributions. Such an approach provides a link between topological properties of simplicial complexes and statistical mechanics of networks from which the simplicial complexes were constructed. Although homology groups are computable and provide insight into topological spaces and maps between them, the interest is in discerning which topological features are essential and which can be safely ignored, in analogy with signal processing when a signal is removed from noise. One of the relevant bits of information about the topological data space is the number and type of holes it contains and going beyond standard homological approaches one is interested in finding out which holes are essential and which are unimportant. This is the subject of persistence and persistent homology, whose aim is to extract long-lived topological features (topological signal) which persist over a certain parameter range in contrast with short-lived features (topological noise). With networks encoded into simplicial complexes the topological features which persist over a sequence of simplicial complexes of different sizes provide the most interesting information. Such sequence reflects the generation process of the network or the change of the network when new nodes are introduced or removed. The first step is recognizing persistent and non-persistent features of random, modular and non-modular scale-free networks and networks with exponential connectivity distribution. Main motivation for this task is to show that each of these different types of networks have different persistent homological properties so as to be able to inquire whether these features are generic. Long-lived topological attributes reveal indeed new and important information related to connectivity of the network which could not be inferred using any other conventional methods.

Prof. Mario Rasetti, is Professor of Theoretical Physics and Director of the Graduate School at Politectnico di Torino, as well as President of the ISI Foundation. His interest includes Theory of Condensed Matter (superconductivity), Statistical Mechanics (many electron and spin [classical and quantum] systems), Theory of Non-linear Dynamical Systems, Quantization, Quantum Optics, Quantum Computation and Quantum Information. He is author or coauthor of

more than 250 papers in scientific journals, 2 books. Invited lecturer at over 150 international conferences, workshops and schools.

Rahul Roy, Indian Statistical Institute,New Delhi India

Title: **Random threshold graphs**

Abstract: A random threshold graph is a graph where each node has a weight associated with it and two nodes have an edge between them if the sum of their weights exceeds a threshold value. In systems biology interaction between genes is represented by edges between them, while in social sciences edges between two persons represent that they know each other. The random threshold graph is a model to explain complex genetic expressions in biology, and to explain society formation in social sciences. We discuss equivalent formulations of this model and also some statistical properties of large threshold graphs

Prof. Roy obtained his Bachelors and Masters degrees in Statistics from Indian Statistical Institute, Calcutta and his Ph.D. in Mathematics from Cornell University, Ithaca, USA. At present he is a Professor in the Theoretical Statistics and Mathematics Unit of the Indian Statistical Institute, Delhi, India and an adjunct Professor at the Centre for Bio-informatics, Jawaharlal Nehru University, Delhi, India. He has held visiting positions and sabbatical leaves at Duke University, Durham, USA, TU, Delft, the Netherlands, University of Southern California, Los Angeles, USA and Chiba University, Japan. He is a Fellow of the Indian Academy of Sciences.

T.V. Somanathan, World Bank, Washington, USA

Title: **Public Health and Urban Transport in Developing Countries: Challenges and Opportunities**

Abstract: Urbanization in most countries is correlated with increased income but it poses a special set of development challenges. One such challenge is health. Health outcomes in developing countries are unsatisfactory to begin with; urbanization can affect health positively to the extent it leads to higher incomes for the poor but it also creates or intensifies health problems. There are various approaches to improving health in urban areas in developing countries, but I will argue that some are much more effective than others. Yet, these approaches are often not adequately pursued while costlier and more complex solutions receive greater attention from both the Government and the private sector. Some of the solutions in health require better urban infrastructure--leading to my second theme. Urban infrastructure -- e.g. clean air and water, sewerage, drainage, transport, housing, power--will hold the key to an improved quality of life for a large share of mankind. Without improved urban infrastructure, growth in incomes in poor countries will not produce a commensurate improvement in quality of life. I will discuss some of the policy issues and choices involved in improving urban infrastructure in developing countries and thereby outline some of the opportunities for network science and complexity science to work on.

Dr. T.V. Somanathan holds a Ph.D in Economics from Calcutta University, an Executive Development Program diploma from Harvard Business School, MA and Bachelor of Commerce

degrees from Punjab University and is a member of the Institute of Chartered Accountants of England and Wales and other chartered accounting bodies. He joined India's premier civil service (the Indian Administrative Service) in 1987 and was awarded the Gold Medal for the Best Trainee of his batch. From 1987-1996 and again from 2001-2011, he worked in a variety of positions in state and federal Governments in India including Deputy Secretary (Finance), Executive Director of the Chennai Metropolitan Water & Sewerage Board, Joint Commissioner for Vigilance & Anti-Corruption, Secretary for Planning & Development, Secretary in the Chief Minister's office, Managing Director of the Chennai Metro Rail Corporation and Joint Secretary in the (federal) Ministry for Corporate Affairs. Between 1996 and 2001 he worked at the World Bank, Washington as Financial Economist and later Division Manager for Budget Policy after joining it through the Young Professionals Program, and was in charge of infrastructure projects and financial management. In June 2011 he returned to the World Bank as Director of General Services. He has published over 80 papers and articles on economics and public policy, is the author of a book on Derivatives (Tata McGraw Hill – 1998), and of chapters in Land Reforms in India (M. Thangaraj [ed.] Sage Publications–2003) and Public Institutions in India (Pratap Mehta & Devesh Kapur [eds.] Oxford University Press–2005).

Peter Sloot, Informatics Institute, University of Amsterdam, Amsterdam, The Netherlands

Title: **Simulating Complex Societal Networks: From molecules to mankind**

Abstract: We live in a complex world and are surrounded by complex systems: from a biological cell, made of thousands of different molecules that seamlessly work together, to millions of computer systems that should work together, to our society, a collection of six billion individuals that try to work together. These complex systems display endless signatures of order, disorder, self-organization and self-annihilation. Understanding, quantifying and handling this complexity is one of the biggest scientific challenges of our time.

Most complex systems are not made of identical and undistinguishable components, as for instance gases or magnets are; each gene in a cell, each computer in a network or individual in a country has its own characteristic behavior and provides unique value and contributions to the systems in which they are constituents. More importantly in complex systems the interactions form exquisite networks, each component being in non-linear contact with many selected interaction partners. It is not just complicated, it is complex.

In this talk I will present some results on modelling infectious diseases with Agent Based Complex Networks and introduce a theoretical framework to understand information dissipation in such complex networks. Part of this work was done within the European Dynanets project: www.dynanets.org. More information via: http://staff.science.uva.nl/~sloot/

Fernando Vega Redondo, Economics Department, European University Institute, Florence, Italy

Title: **Social networks and the process of globalization**

Abstract: We propose a stylised dynamic model to understand the role of social networks in the phenomenon we call "globalization." This term refers to the process by which even agents who are geographically far apart come to interact, thus overcoming what would otherwise be a fast saturation of local opportunities. A key feature of our model is that the social network is the main channel through which agents search and exploit new opportunities.

Thus only if the social network becomes globaI (heuristically, "reaches far") can global interaction be steadily sustained. To shed light on the conditions under which such a transformation may, or may not, take place is the main objective of the paper. One of our interesting insights is that in order for a local social network to turn global, the economy needs to display a degree of "geographical cohesion" that is neither too high (for then global opportunities simply do not arise) nor too low (in which case there is too little social structure for the process to take off). And if globalization does arise, we show that it often occurs abruptly and consolidates as a robust state of affairs. We also show how it is affected by improvements in the flow at which information travels in the network, or the range at which the social network helps to monitor behavior.

Henry Wynn, LSE - London School of Economics and Political Science, London UK

Title: **Algebraic methods in the robustness of networks**

Abstract: A relatively new subject which may be named algebraic reliability is the direct application of the theory of monomial ideals to system reliability. Specifically, the structure of a coherent system (if a cut makes the system fail then a worse cut also does) is mapped into the ideal property (if a monomial is in the ideal then any monomial it divides is in the ideal). Tight inclusion-exclusion (IE) bounds can then be exhibited using the minimal free resolution (MFR) of the ideal. The Taylor resolution, which corresponds to standard inclusion-exclusion, is more complex and corresponds to the standard IE. Fast algorithms are available which compute the Betti number of the resolutions and hence the MFR. A research programme is outlined which would apply the methods to the robustness of networks, for example by studying all-terminal reliability and percolation. Since the bounds are distribution free there is scope for further improvement by combining the methods with random graph and other stochastic assumptions on the network.

Prof. Henry Wynn is Professor at the London School of Economics which he joined in 2003 as Head of the Department of Statistics, following a career which included Imperial College, London, and the University of Warwick. He took his BA at Oxford (mathematics)and PhD at Imperial College. His main research interests are statistical theory and methodology, including, in particularly, the optimal design of experiments and computer experiments. He was a founder of the new area of algebraic statistics, which lies on the interface between computational algebraic geometry and statistics. His main area of application has been to industrial statistics and risk, which included, for example a long spell working with CRF Fiat on EU projects.

Hussein Yahia, Centre de Recherche INRIA, Talence Cedex, France

Title: Local Predictability Exponents and universality classes in the framework of reconstructible complex systems.

Abstract: We show that effective computation of Local Predictability Exponents is attainable in a microcanonical formulation without the need of grand ensembles and underlying ergodic hypothesis, by relating predictability in the signal's domain to local reconstructibility. We show examples for various types of complex signals: heartbeat data, remote sensing, and the Speech signal. This paves the way for an accurate description of universality classes in complex systems and fascinating new perspectives in non-linear signal analysis.
