Networks Constrained to Change Workshop
21-23 March 2011
Barclays Room, Green Templeton College
Woodstock Road, Oxford

Engineering and Physical Sciences Research Council

Programme

The main goal of the workshop is to explore a number of aspects relating to networks dynamics. The work to be presented ranges from quasi-static behaviour to pure dynamics, and in contexts such as biological, technological and social systems. Specific features of how network elements can change will also be discussed. There will be scheduled time for discussions regarding promising future lines of research in this field.

Monday 21st March

14.30 – 15.30 Felix Reed-Tsochas, CABDyN Complexity Centre, University of Oxford

"Spontaneous emergence of social influence in online systems"

Online environments provide extremely interesting contexts that allow us to study large-scale collective behaviour in social systems, addressing questions such as the role of social influence in cultural markets, and the spread of competing innovations or products among a population of users. Specifically, we track the popularity of a complete set of applications installed by the user population of Facebook over a period of approximately two months in 2007. This allows us to capture the behaviour of all individuals who can influence each other in this particular context. This setting also has the advantage that it allows us to follow the evolution of both popular and unpopular application, thus avoiding one key source of selection bias that could skew our findings. We analyse the collective behaviour of the potential user population by extending standard temporal fluctuation scaling methods, and are able to show that two distinct regimes of behaviour emerge. Once applications are above a particular threshold of popularity, social influence processes appear to induce highly correlated adoption behaviour among the users. This propels some of the applications to extraordinary levels of popularity, but also increases volatility. Below this threshold, the signature of social influence in collective behaviour seems to vanish almost entirely. By constructing a synthetic time series of the application installations, we can show that the empirically observed behaviour in the two different regimes can be understood in terms of the differing effects of local and global mechanisms. In closing, I will discuss the possibility of testing a microscopic model that can generate some of the features we observe.

15.30 Coffee Break

16:15 – 17.15 Eduardo López, CABDyN Complexity Centre, University of Oxford

"Connectivity phase transitions induced by disorder"

We introduce a model of percolation induced by disorder, in which a network initially homogeneous with all of its links of equal weight, is then disordered by the introduction of heterogeneous weights for the links. We consider a pair of nodes i and j to be connected when the ratio α_{ij} of length of the optimal path between them before (ℓ_{ij}) and after (ℓ'_{ij}) the introduction of disorder does not increase beyond a tolerated ratio τ. The quantity α_{ij}, which we call the length factor of the path, emerges as a useful quantity to study the percolation problem in great detail, allowing us to relate our model to previous results in the problem of the weak-strong disorder optimal path problem. By identifying the most probably value of α_{ij} for a system, labelled α_c, we are able to find the percolation threshold for our model and relate it to theoretical arguments.
Finally, by considering the distribution of sizes of connected components in this disorder induced percolation problem, we present evidence that the transition is of first order, with the size of the discontinuity dependent on the amount of disorder present in the system.

Tuesday 22nd March

9.30 – 10.30 Jari Saramäki, Department of Biomedical Engineering and Computational Science, Helsinki University of Technology

"Temporal paths and patterns in mobile communication networks"

In temporal networks, where nodes are connected through sequences of temporary events, information or resources can only flow through paths that follow their time-ordering. The properties of these temporal paths play a crucial role in dynamic processes: consider, e.g., simple SI spreading dynamics, whose speed is determined by the time it takes to complete such paths. I will discuss temporal path lengths and distances, their measurement, and their relationship to static graph distances. With the help of time-domain null models, one can also measure the effects of temporal correlations and heterogeneities, such as burstiness, on temporal distances and spreading processes. These effects may be very different depending on the system in question: in human communication networks, temporal heterogeneities are seen to increase temporal distances and slow down spreading dynamics, whereas in an air transport network their effect is the opposite. Furthermore, in the mobile communication network, sets of consecutive events give rise to dynamic motifs, that is, patterns of communication transferring information and triggering activity between a number of people. I will present some early results related to these.

10.30 Coffee Break

11.15 – 12.15 Serguei Saavedra, Northwestern Institute on Complex Systems (NICO), Kellogg School of Management, Northwestern University

"From collective to individual survival in social and ecological networks"
Co-authors: Serguei Saavedra, Daniel B. Stouffer, Jordi Bascompte and Brian Uzzi

The architecture of mutualistic networks facilitates coexistence of individual participants by minimizing competition relative to facilitation. However, it is currently unknown whether this benefit is received by each participant in equal portions or it is commensurate with their contributions. Yet, this fact is important to understanding the trade-offs faced by individuals when becoming part of a network. Here we address these questions by applying a novel measure of a node's contribution to network architecture to an ensemble of ecological and socio-economic mutualistic networks. We find that, paradoxically, individual contributions to the collective are inversely associated with their survival in the network. Individuals in cooperative networks face a critical dilemma of whether to contribute more to increase the collective survival of the network or contribute less to selfishly increase their own individual chances.

12.15 Lunch for registered attendees

14.30 – 15.30 Luke Heaton, Department of Physics, University of Oxford

"Growth and transport in fungal networks"

Multi-cellular organisms have evolved sophisticated systems to supply individual cells with the resources necessary for survival. Compared to xylem and phloem in plants or the vascular system of animals, transport through fungal networks is poorly understood, despite the fact that transport in fungi is ecologically critical. Furthermore, this natural transport system has the benefit that the networks are accessible, and development can be readily followed in a time series. We have developed several models to investigate how cells in a fungal network might respond to local cues in order to form a globally efficient transport network. The central observation is that the fluid within fungal networks is incompressible, so as the network grows, there must be a mass flow from the sites of water uptake to the sites of growth. Our models suggest that the minimum currents consistent with the observed growth are sufficient to transport resource from the source of material to the growing tips over the time scale of growth. This suggests that the active transport mechanisms observed in the growing tips of fungal networks may not be required for long range transport.

15:30 – 17.00 Discussion on dynamics networks and effects

Wednesday 23nd March

9.30 – 10.30 Diego Garlaschelli, Leiden Institute of Physics, University of Leiden

"Global and local patterns of spatial embeddedness in networks"

In many complex networks, vertices are naturally located in some metric space. Examples include geographically embedded webs such as transportation, trade, mobility and communication networks. The effects of spatial constraints, and in particular distance, on the structure of these networks are traditionally assessed using global (e.g. gravity) models. However, this approach requires the assumption of a universal functional dependence on distance, does not explain missing links, and does not capture differences in the behaviour of individual vertices. Here we propose a model-free approach that consistently takes into account both observed flows and missing links to characterize the patterns of spatial embeddedness at both global and single-vertex levels. We systematically find that individual vertices deviate strongly from the overall behaviour captured by global models. Most vertices turn out to be insensitive to distances, and the average tendency of distance to suppress interactions is due only to a minority of vertices experiencing spatial constraints. Surprisingly, for some vertices distance can even locally enhance interactions.

10.30 Coffee Break

11.15 – 12.15 Discussion and conclusions

For catering purposes we ask for registration by 12.00 noon on Friday 18th March 2011. Please email Dorota Pawlik info.cabdyn@sbs.ox.ac.uk