SOE 3: Traffic Dynamics, Urban and Regional Systems II

Time: Monday 10:15–12:00 Location: H44

SOE 3.1 Mon 10:15 H44

Towards a non-equilibrium statistical physics for mobility on road networks — •Bazzani Armando[1], Rambaldi Sandro[2], and Marchioni Monica[3] — [1]University of Bologna, INFN, Bologna, Italy — [2]University of Bologna, INFN, Bologna, Italy — [3]University of Bologna, Bologna, Italy

New communication technologies allow to record dynamical microscopic data on large social systems. In Italy single vehicle trajectories are monitored by a GPS system for insurance reason. The data concern 2% of the whole vehicle population and the trajectories are sampled at a spatial scale of 2 Km. Recent studies of Florence urban area[A.Bazzani et al "Statistical Laws in Urban Mobility from microscopic GPS data in the area of Florence" submitted for publication 2009] have pointed out that in the average the GPS data represent an urban mobility that can be described by an ergodic principle based on the existence of a "mobility energy" for the daily mobility paths and by a Benford's law for the activity downtime distribution. To enrol the system complexity is then necessary to study transient states out of equilibrium, like, for instance, the rise of congestion phenomena. In this work we analyze the GPS data recorded on the whole Emilia-Romagna region during November 2007 to look for congestion effects and their evolution. We propose to describe the congestion dynamics by using the instant velocity and the trajectories of the monitored vehicles. We consider also the behavior of some selected drivers that are used to move in the considered area.

SOE 3.2 Mon 10:30 H44

Braess's paradox at work: does an incomplete highway upgrade pay off? — •Thimo Rohlf — Programme d'Epigenomique, Genopole Campus 1 - Genavenir 6, 5 rue Henri Desbruères, F-91030 Évry cedex, France — Max-Planck-Institute for Mathematics in the Sciences, Inselstr. 22, D-04103 Leipzig, Germany

It is well known that adding new roads to an existing road network may sometimes increase congestion (Braess's paradox). Here, we investigate this problem for the special case of a highway that is two-lane only in a limited section, using the Nagel-Schreckenberg model of traffic flow. We compare fundamental diagrams and average travel time for different relative lengths of the two-lane section with the purely one-lane and purely two-lane case. Further, the influence of different foresight ranges and different types of cooperative behavior at the bottlenecks near the merging points of both lanes is studied.

SOE 3.3 Mon 10:45 H44

Phase Synchronization in Train Connection Timetables — •Christoph Fretter[1], Matthias Müller-Hannemann[1], Lachezar Krumov[2], Karsten Weihe[2], and Marc-Thorsten Hütt[3] — [1]Martin Luther Universität Halle-Wittenberg — [2]TU Darmstadt — [3]Jacobs University Bremen

Train connection timetables are an important research topic in algorithmics. Finding optimal or near-optimal timetables under the subsidiary conditions of minimizing travel times and other criteria is an important contribution to the functioning of public transportation. In addition to efficiency (given, e.g. by minimal average travel times), the robustness of the timetable, i.e. a minimization of delay propagation, is an important criterion. Here we study the balance of efficiency and robustness in train connection timetables from the perspective of synchronization, exploiting the fact that a major part of the trains run nearly periodically. We find that synchronization is highest at intermediate-sized stations. We argue that this synchronization perspectives opens a new avenue towards an understanding of train connection timetables by representing them as spatiotemporal phase patterns. Robustness and efficiency can then be viewed as properties of this phase pattern.

15 min. break

SOE 3.4 Mon 11:15 H44

Optimization of packing problems — •Johannes J. Schneider, Andre Müller, and Elmar Schömer — Center for Computational Research Methods in Natural Sciences, Johannes Gutenberg University of Mainz, Staudinger Weg 7, 55099 Mainz, Germany

Everybody knows this problem: goods just bought in the supermarket have to be packed in the rear trunk of the car, often while considering constraints, like fruit which must not be squashed. Analogously, we face packing problems when we have to pack suitcases when going on holiday. Also in logistics, packing problems occur: the traveling salesperson has to pack the truck in a way corresponding to the sequence of the customers on the tour. Further packing problems occur in textile industry as well as in wood- and metal-working industry.

In this talk, a multidisperse packing problem shall be considered, in which hard disks with different sizes are packed in a circular environment in a way that the radius of the circumcircle around the disks is minimum. We present our packing algorithm, with which we were able to beat and to match all world records established in an international contest in competition between 155 groups from 32 countries. Our packing algorithm was rated by the Time Magazine to be one of the 50 best inventions of the year 2009.

SOE 3.5 Mon 11:30 H44

Network harness: bundles of routes in public transport networks — Bertrand Berche[1], Christian von Ferber[2,3], and •Taras Holovatch[1,2] — [1]Laboratoire de Physique des Matériaux, Université Nancy 1, FR — [2]Applied Mathematics Research Centre, Coventry University, UK — [3]Physikalisches Institut, Universität Freiburg

Public transport routes sharing the same grid of streets and tracks are often found to partly proceed in parallel. Similar phenomena are observed in other networks built with space consuming links such as cables, pipes, neurons, etc. To quantify this behavior we use the notion of network harness described by the harness distribution $P(r, s)$: the number of sequences of s consecutive stations that are serviced by r parallel routes. For certain PTNs that we have analysed we observe that the harness distribution may be described by power laws. These power laws observed indicate a certain level of organization and planning which may be driven by the need to minimize the costs of infrastructure. This effect may be seen as a result of the strong interdependence of the evolutions of both the city and its PTN. To further investigate the significance of the empirical results we have studied one- and two-dimensional models of randomly placed routes modeled by different types of walks. While in one dimension an analytic treatment was successful, the two dimensional case was studied by extensive simulations showing that the empirical results for real PTNs deviate significantly from those of randomly placed routes but can be described by a model of interacting self-avoiding walks.

SOE 3.6 Mon 11:45 H44

Modelling of driver behavior based on Langevin analysis — •Michael Langner and Joachim Peinke — Institut für Physik, Carl von Ossietzky Universität, 26129 Oldenburg, Deutschland

This work is part of the project Integrated Modeling for Safe Transportation (IMoST). In this project we develop models for driver behavior in selected situations. Our goal is to develop advanced driver assistance systems (ADAS) for the automotive domain. The first investigated scenario covers the merging while entering an autobahn. We made different experiments with test subjects in a simulator to gain the necessary data for our analysis. We present different ways how a stochastic model of the driver behavior can be estimated directly from the given data by using the Langevin analysis. The aim is to generate a drift and diffusion based stochastic model directly from the data, which is equivalent to a potential based model.