SOE 15: Traffic, Urban and Regional Systems I

Time: Thursday 12:30–13:15 Location: GÖR 226

SOE 15.1 Thu 12:30 GÖR 226

Optimal bikeability of urban street networks — •Christoph Steinacker, David Storch, Marc Timme, and Malte Schröder — Chair for Network Dynamics, Institute for Theoretical Physics and Center for Advancing Electronics Dresden (cfaed), TU Dresden

Individual transport in cities is most commonly enabled by private cars, an unsustainable status quo both ecologically and socially. In particular on intra-city length scales, cycling constitutes a broadly accessible and more sustainable alternative. However, insufficient and poorly designed bike lanes often hinder more prevalent bike use.

Here, we aim at identifying bike lane networks that enable fast and safe bicycle travel in cities. Evaluating bike-sharing data on millions of city trips, we estimate bike travel demand and find optimally bike-friendly network topologies. In a reverse percolation process starting from ideal conditions of a complete bike lane network, we successively neglect the least used bicycle paths. Intriguingly, even just a few bike paths, if chosen wisely, may already result in a strongly bike-friendly network. Our results may support the planning of street networks towards more sustainable individual transport.

SOE 15.2 Thu 12:45 GÖR 226

Fluctuation-induced nonlinear dynamics in networks coupled street traffic — •Verena Krall[1,5], Max Günthner[2,3,4,5], Malte Schröder[1], and Marc Timme[1] — [1]Chair for Network Dynamics, Center for Advancing Electronics Dresden (cfaed), Institute of Theoretical Physics, Technical University Dresden — [2]Institute of Theoretical Physics, University of Tübingen — [3]Werner Reichardt Center for Integrative Neuroscience — [4]Bernstein Center for Computational Neuroscience — [5]Both authors contributed equally

It is long known that traffic congestions may emerge spontaneously – out of nowhere. However, statistical physics studies, while providing both qualitative and quantitative insights, were so far mostly restricted to the consequences of interactions between cars on individual streets and neglected traffic flow patterns in coupled street networks.

Here we present a simple model system of interacting streets in which congestion spontaneously suddenly appears due to fluctuations in the rate of incoming cars. Agent-based simulations indicate an instability even in regimes where mean field theory predicts stable traffic flow patterns.

Our results thus underline the limitations of mean field predictions in noisy, nonlinear systems, in particular for predicting the collective nonlinear dynamics of mobility systems.

SOE 15.3 Thu 13:00 GÖR 226

Intrinsic inefficiencies in on-demand ride-hailing — Philip Marszal[1], •Malte Schröder[1], Debsankha Manik[2], and Marc Timme[1] — [1]Chair for Network Dynamics, Institute for Theoretical Physics and Center for Advancing Electronics Dresden (cfaed), TU Dresden — [2]Max-Planck-Institute for Dynamics and Self-Organization, Göttingen

Efficient mobility services constitute essential prerequisites for making cities sustainable, both economically and ecologically. Widespread accessibility to mobile communication has given rise to a number of new ride-hailing services. Yet, many services, in particular classic taxis, still operate based on first-come-first-served basis. Combining a statistical physics analysis with data-driven modeling, we demonstrate the intrinsic inefficiency of such a service. Given a fixed number of taxis, the system can handle only a limited number of requests. Once this capacity is reached, the system not only overloads, it also stays overloaded until the request rate decreases substantially below the onset rate of overload. This hysteresis effectively reduces the capacity of the service by up to 50% compared to ideal operation. We illustrate how both, clever route pre-planning and including ride-sharing, remove this inefficiency and may contribute to fair and efficient mobility in the future.