The Road to Future Urban Mobility

Session co-chairs
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We are currently witnessing an increasing integration of our energy, transportation, and cyber networks, which, coupled with the human, or communication network, is giving rise to a new level of complexity in our communities. Progress in pervasive sensing brings an unprecedented volume of data allowing us to observe, measure, and evaluate the transactions, performance, and efficiency of the critical infrastructures. Recent emergence and explosion of data from citizen sensors via social media and other cyber platforms provides a unique opportunity to understand and anticipate the human dynamics in transportation. To seize this opportunity, we need to enhance our understanding of the interactions between the vehicles as well as vehicles and infrastructure. Developing novel science and technology is necessary to observe, measure, analyze, and model mobility, using a data-driven understanding of complex connected vehicle technologies that are governed by both physical and behavioral sciences.

The first speaker, Professor Alexandre Bayen, will start his talk by providing a brief presentation of the state of the art in traffic monitoring, leading to new results in routing games. Routing games offer a simple yet powerful model of congestion in traffic networks, both in transportation and communication systems. The congestion in such systems is affected by the combined decision of the agents (drivers or routers), so modeling the decision process of the agents is important, not only to estimate and predict the behavior of the system, but also to be able to control it. The talk will discuss the models used for the agents' decision process, often called "learning" as agents "learn" information about the system or about the other agents.

With the increase in connectivity (e.g., vehicle-to-vehicle, vehicle-to-infrastructure) and in real-time responsiveness (e.g., on-demand mobility services), travelers and vehicles are becoming "real-time optimizers" of their trips. The urban mobility challenges and breakthroughs of the next decades will be marked by our capacity to optimize the aggregate performance of large-scale transportation systems while accounting for how the hundreds of thousands of "real-time optimizers" will locally interact among themselves and with the infrastructure. The second speaker, Professor Carolina Osorio, will be describing work in the field of simulation-based optimization that addresses these challenges. The proposed algorithms enable the highest-resolution traffic models to be used to optimize the design and the operations of large-scale urban networks. The use of these algorithms to address transportation problems in collaborations with various transportation agencies will be presented.

As more and more people compete for the usage of the limited road infrastructure, it is increasingly important to manage urban transportation networks by appropriate design and control approaches. At the same time, the massive amount of data from novel sources offers a unique way to understand how individual participants make choices and how individual choices may accumulate into large-scale congestion phenomena. An emerging approach to modeling these interactions is using macroscopic models derived from fluid dynamics consisting in hyperbolic conservation laws. The third speaker, Dr. Paola Goatin will discuss the application of

data-driven macroscopic traffic models to solving optimization and control problems in urban transportation systems.

The development of self-driving cars constitutes a paradigm shift in mobility, which will drastically change patterns, ownership models, and requirements against the infrastructure. The fourth speaker, Dr. Jonas Nilsson from Volvo Cars Corporation will discuss the new challenges brought by autonomy, based on experiences from Volvo's Drive Me project, in which 100 customers have the chance to use their vehicles in autonomous driving mode on public roads in Gothenburg, Sweden. In addition, the talk will elaborate on the impact these challenges have on system design and verification.