"A Simulation-based Optimization Framework for Urban Traffic Control"

Abstract: The complexity of traffic flow in congested urban road networks has motivated the development of advanced traffic simulators that are able to capture in detail the interactions of individual drivers with both the network supply components and with adjacent drivers. These simulation tools can provide accurate network performance estimates in the context of scenario-based analysis. Nevertheless, their integration within an optimization framework to systematically identify congestion mitigation strategies remains an intricate task. In order to derive traffic management frameworks that are both realistic and computationally tractable, information from the simulation tool should be combined with information from a traffic model that analytically captures the structure of the underlying problem.

In this talk, we present an approach that combines information from a calibrated microscopic traffic simulation model of the Lausanne city center with an analytical queueing network model, which analytically describes the key traffic interactions, e.g. how upstream and downstream queues interact, how this interaction is linked to network congestion. The framework resorts to a derivative-free trust region algorithm. We illustrate its use with a traffic signal control problem.

By coupling simulation-based and analytical traffic models, we bridge the gap between these two independent research streams, and derive methods that achieve an attractive trade-off between detail and tractability.

Bio: Carolina Osorio is an Assistant Professor in the department of Civil & Environmental Engineering at MIT. Professor Osorio's research interests are in applied probability theory, simulation and simulation-based optimization for transportation problems, including macroscopic traffic modeling, large-scale traffic management and transportation systems analysis.

She also develops operations research methods such as analytical models, simulation-based models and optimization methods to mitigate network congestion for health care systems and biological networks. In 2011, her paper “A simulation-based optimization framework for urban traffic control” received the Best Graduate Student Paper Award from the Transportation Research Forum (TRF).

Osorio received a M.Sc. in Statistics from the University College London in the UK in 2005 and her PhD in Mathematics in 2010 from the Ecole Polytechnique Fédérale de Lausanne, in Switzerland.