Abstract
Instead of this micro-modeling approach of traffic congestion, the macroscopic or network fundamental diagram (MFD or NFD) aims to simplify the complex micro-modeling task of the urban network where the collective traffic flow dynamics of sub-networks capture the main characteristics of traffic congestion, such as the evolution of space-mean flows and densities in different regions of the city. The MFD can be utilized to introduce elegant control strategies to improve mobility and decrease delays in large urban networks, that local ones are unable to succeed. We develop methodologies to model and understand the collective behavior for different types of urban systems, with emphasis in conflicts for the same road space. Regularity conditions for well-defined MFDs are discussed. We also develop optimization tools and investigate what type of real-time active traffic management schemes (congestion pricing, vehicle restriction, large scale traffic signal control, dynamic bus lanes) can improve mobility measures in a city for cities of different structures. We build a hierarchical feedback control network of multiple levels. The validation of the modeling methodologies and the traffic management schemes are conducted in various and complex city structures scenarios using large data sets from field experiments and advanced micro-simulations.

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