TRAFFIC MANAGEMENT BY MACROSCOPIC MODELS

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Macroscopic traffic flow models have become popular in transportation engineering and applied mathematics during the last decades. These models give a description of collective dynamics in terms of spatial density and average velocity, which evolve according to partial differential equations derived from fluid dynamics, coupled with suitable closure relations. In fact, even if the continuum hypothesis is clearly not physically satisfied, macroscopic quantities can be regarded as measures of traffic conditions and allow depicting the spatio-temporal evolution of traffic waves. Moreover, they are suitable for analytical investigations and very efficient from the numerical point of view. Therefore, they provide the right framework to state and solve control and optimization problems for real time applications
Starting from the celebrated Lighthill-Whitham-Richards model [6, 10] formulated in the mid 50ties, mathematicians and engineers designed various more sophisticated models in order to capture specific traffic characteristics. These include second order [1, 7], phase-transition [3] and non-local models [2]. Extensions to road networks have also been addressed by providing suitable models describing the dynamics at junctions [4]. These improved models are expected to better match observations based on real data coming form different sources: besides the traditional magnetic loop detectors, the recent technological developments provide data extracted from video recording, GPS, Bluetooth, RFID, etc.
In my talk, I will briefly review the basis of the macroscopic approach for modeling vehicular traffic, and I will show how these models can be efficiently implemented for traffic flow optimization. In particular, I will focus on traffic control strategies based on ramp-metering [9], variable speed limits [5] and partial rerouting [11]. Further control perspectives are offered by the future deployment of autonomous vehicles [8].

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