Hyperbolic Traffic Models with Self-Exciting Accident Dynamics

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Abstract

Traffic accidents exhibit self-excitation properties, meaning that the occurrence of one accident increases the likelihood of subsequent accidents in nearby locations. To model this phenomenon, we couple hyperbolic partial differential equations (PDEs) with space dependent flux function that describe traffic flow dynamics with a stochastic process. These are used to model traffic accidents. A key aspect in this modeling framework is to compare two different choices of stochastic processes which are used to capture short-term and medium-term accident properties. Both approaches capture the interplay between accident occurrence and macroscopic traffic behavior, allowing for a comprehensive analysis of accident risk also in road networks.

In this talk, we present numerical methods for solving the coupled system, focusing on the statistical moments and long-time behavior of the accident process. The effectiveness of our methods are demonstrated through numerical simulations. Finally, we validate our model against real-world accident data, emphasizing the impact of self-excitation on traffic risk assessment.