Collective Behavior of Two Classes of Car Following Models

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In this talk I'll focus on fundamental properties of car-following (CF) models of highway traffic. These models describe the collective motion of individual vehicles in continuous space and time. In CF models, each vehicle is described by a simple system of ordinary differential equations (or delay differential equation, when reaction time is accounted for) that captures the response of its driver to the relative motion of the vehicle ahead of it.

Since the mid-1990s there has been a burst of activity in the Physics literature in simulating highly simplified CF models and demonstrating features of these models such as wave patterns and large amplitude Stop and Go waves which are in qualitative agreement with real-world traffic data. These results have re-invigorated activity in the mathematical analysis of CF models and active areas of investigation have included
stability properties and nonlinear dynamics, the derivation of equivalent PDE models via a formal continuum limits, and the subsequent analysis of these PDE's.

In this talk I'll focus on two specific CF models, namely the Intelligent Driver Model, IDM, and the Aw-Rascle-Greenberg Model, ARG. We shall show that for both of these models there are no car crashes and no velocity reversals. These questions concern well-posedness and are addressed by a-priori estimates which are independent of the number of cars in the system.

We also establish that both the IDM and ARG models support Stop and Go waves.