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A Modified Fundamental Traffic Diagram for Mixed-Autonomy Highway Traffic Flow

Mingfeng Shang, University of Minnesota

Raphael Stern, University of Minnesota

Abstract

The emergence of automated vehicles may have significant impacts on traffic flow. While many studies suggest that fully automated vehicles can improve traffic flow by changing the macroscopic characteristics at different market penetration rates, recent studies show that partially automated vehicles (e.g., adaptive cruise control vehicles) commercially available on the market may negatively impact the traffic flow. With this in mind, existing traffic control strategies, such as ramp metering, may require further modification due to the change of macroscopic traffic flow characteristics in the presence of mixed autonomy traffic. In this study, we first formulate analytically the fundamental diagram for mixed autonomy traffic, which is dependent on the market penetration rates of automated vehicles. Next, we model and simulate the composite traffic flow with a multi-class macroscopic traffic flow model, and explore possible applications to ramp metering control.