Is calibration of car-following model on spacing enough for autonomous vehicles?

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Conference Paper STRC 2022

STRC

22th Swiss Transport Research Conference
Monte Verità / Ascona, May 18 – 20, 2022

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May 2022

Abstract

Car-following (CF) models are used in traffic simulation scenarios aiming to provide realistic modeling of vehicles' longitudinal movement. In most works, calibration is performed on trajectories of leading and following vehicles either on speed or spacing quantities, with the second to be considered as the most appropriate according to the literature. With the advent of adaptive cruise control (ACC) technology, complexity in simulation of vehicles' longitudinal movement rises. There are intrinsic behavioral differences between human- and ACC-driven vehicles that are visible in experimental observations. Some examples include human-like response time, string instability, hysteretic behavior and others. Since calibration is performed only on spacing, even after proper parametrization we cannot be certain that CF models will be able to reproduce some or all of the above phenomena and to what extend. The aim of this work is to propose a multi-objective calibration framework validated on empirical observations of car platoons. Furthermore, it investigates if, and to what extent, the traffic dynamics and behavioral patterns of ACC vehicles can be reproduced. Two state-of-the-art CF models are calibrated with empirical datasets based on spacing and with the proposed framework. The capability of the models to reproduce the ACC behavior across different dimensions is discussed along with advantages and downsides of each solution.

Keywords

Autonomous vehicle, Adaptive cruise control, Car-following experiment, Model calibration