

Simulation Study of Vehicle Platooning Maneuvers with Full-State Tracking Control

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Abstract: In this paper, we present the simulation study of vehicle platooning control using Adams and Matlab. Motions of most vehicles are governed by nonholonomic systems and multiple variables require to be controlled in a coordinated manner to ensure a vehicle to follow a path. For a nonholonomic vehicle system, it is understood that the convergence of coordinate variables to their respective desired trajectories individually does not guarantee the successful tracking of a given path for the vehicle. The performance of a control needs to be evaluated at system level. A realistic and comprehensive simulation environment will enable us to study various vehicle configurations with sophisticated controllers. An integrated presentation of performance of individual variables provides a clear view of vehicle motions and control performance at a system level. In our project, vehicle models are built using mechanical prototyping software - ADAMS and sophisticated controllers are constructed using control design software - MATLAB/SIMULINK. The integration of these two popular software packages enables the simultaneous computations of vehicle motion, control action as well as the system performance in a numerical simulation environment in a synchronized manner resembling to real time running as close as possible. This integration of vehicle prototype models and nonlinear control structures is flexible in parameter settings and comprehensive for advanced control design study. Furthermore, simulation results are shown in the form of vehicle motion.

With such an integrated numerical simulation environment, vehicle platooning with full-state control is studied, simulated and presented. Vehicles in platooning formation is prototyped and modeled using ADAMS. Full-state control problem is formulated and a nonlinear output feedback controller is derived. A control structure is built in MATLAB/SIMULINK. Integrated simulation provides us with results in animation of vehicle platooning maneuvers. All these have been successfully carried out and will be described in details.

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