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A Multi-objective Robust Model Predictive Control Strategy for Trajectory Tracking with Variable Constraints*

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Abstract— **This poster aims to solve the benchmark motion control problem of a 4-wheel IWM vehicle. The longitudinal driving/braking force and lateral steering angle should be controlled smoothly with minimum energy cost. Besides, the control of body attitude through wheel vertical force is also considered. The difficulty of the problem lies in establishing a model between the control input and control target and combating unknown disturbances. To solve this problem, we presented a Multi-objective Robust Model Predictive Control (MRMPC) algorithm to optimize the steering wheel angle and allocate wheel torque. Firstly, a 7-degree-of-freedom vehicle model considering external unknown disturbance is established to complete the target construction. Then, the objective problem is designed. The objective function contains the deviation of the vehicle speed from the target, the deviation of the vehicle trajectory from the target, and energy consumption. These objectives have different weight values, generated by a fuzzy logic controller. The constraints of the MPC problem include the limitation of longitudinal and lateral location, speed, acceleration, and their increments. Moreover, the vehicle will drive on a rough road and the maximum height of the bump is 5mm. According to the simulation results, the vertical body acceleration, pitch angle, and roll angle are affected sharply by the jitter of the speed curve. Hence, the range of vertical body acceleration, pitch angle, and roll angle should also be restricted. We converted those quantities to variable constraints as a feedback compensator. When vertical body acceleration, pitch angle, and roll angle become larger, the constraints should be restricted more seriously. The MRMPC algorithm is conducted through MATLAB/Simulink. We compared our MRMPC algorithm with the PID method and the simulation results show that the maximum tracking error of lateral location and speed has reduced to a much lower level and the value of objective index became smaller.**

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