

Feedback Optimal Control of A 4WS Vehicle using Model Reference Tracking Strategy

V. Nikzad S., M.Naraghi
Amirkabir University of Technology

ABSTRACT

Rear steering control of a 4WS vehicle with Linear Quadratic Regulator (LQR) and Dynamic Programming (DP) controllers with regulation and model reference tracking strategies in single steering scheme are studied and compared with each other. In this regard, because of the nature of both controllers that is oriented with a linear dynamic model, a 3DOF linear handling car model is proposed as the controller model, while to achieve enough complexity and wide range of variable changes, a 3DOF nonlinear model with CALSPAN tire coefficients is considered for simulation results. The state variables of models are yaw rate, lateral velocity, roll and its rate. It is assumed that the vehicle remains in a quasi-static condition during longitudinal motion. Since the controllers are applied in regulation and reference model tracking strategies, they are suited for full state feed back control. The simulation is performed under lane change and steady state cornering inputs as the driver decision.

Results show that 4WS systems sensitively improve vehicle handling response with better transient situation and path trajectory. It is also shown that DP controller yields better response in comparison with LQR while its structure is not based on a pre-viewer. The proposed controller could be named as Non Previewing Dynamic Programming (NPDP) and may be used easily in 4WS systems.

Key Words:

Handling Car Model, Optimal Control, Vehicle Dynamics, Vehicle Handling, Model reference Tracking Control, Regulation Control