Robust control design for connected automated vehicles

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Connected cruise controllers that utilize the information on the motion of vehicles ahead have high potential to improve active safety, passenger comfort, and traffic efficiency of the road transportation system. Uncertainties, however, that arise from the dynamics of vehicles have significant effect on the performance of the connected vehicle system. In particular, we consider the uncertainties arising from the feedback gains and reaction time delays of the human drivers. The control gains of the connected cruise controller that ensure the string stability for the uncertain vehicle parameters are called robust control gains. In this presentation we utilize the structured singular value analysis in order to calculate the robust string stability boundaries for various configurations of connected vehicle systems. We present the formulation of the M-Δ interconnection structure, the approximation of the uncertain time delay by the Rekasius's substitution and the computation of the structured singular values. We demonstrate through two case studies how parameters in the connected cruise controller can be selected and validate the performance of a robust string stable design using experimental data.