Design of a Dissipative Semi-Active Suspension by A Frictional (Non Viscous) Method

V. Nikzad S.
Sharif University of Technology

ABSTRACT

A new approach to control a simple quarter car model using semi-active controller is presented. In this regard, different optimal control strategies are proposed and compared with each other. Linear Quadratic Regulator (LQR) and Dynamic Programming (DP) optimal control strategies are compared with each other as semi active controllers, while LQR, DP and Calculus of Variation (CV) methods are examined as active controller and compared with semi active strategies. The semi-active strategies are based on correspond active system, which is considered to be turned on whenever correspond active system tries to dissipate energy from suspension system. In the other case that correspond active system should inject energy into the suspension system, semi active controller is turned off. The dynamic model is a simple quarter car model (SQC). A rack and pinion with a frictional disk clutch is proposed as the mechanism of system.

It is shown that although LQR could not able to prepare itself against road irregularities, the speed of operation of LQR is more than gain variable methods due to its constant gains. The variable gain methods use a predictor to sense the future road conditions. So, they have much better response in comparison with LQR, while their controllers are more expensive and slower than conventional LQR. Simulation results show that gain variable controllers could yield much better response in comparison with constant gain method (LQR). But the speed of operation of LQR is more than gain variable methods due to its constant gains.

Mechanical studies show that the amount of dissipative energy needed for semi-active controllers can be produced with a simple cheap mechanism and available materials. Since the relevant studies are shown in MECHANICAL ANALYSIS part of this thesis, the operation of these controllers from the viewpoint of more rapidity to have fewer effects on the dynamic response of real vehicle needs more researches.

Key Words:
Ride Model, Simple Quarter Car Model (SQC), Optimal Control, Dynamic Programming, Vehicle Dynamics, Semi-Active Suspension, Suspension Design