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PRINCIPAL
Dr. Vithalrao Vikhe Patil
College of Engineering
Ahmednagar

Modeling and Simulation of a Semi-active Vehicle Suspension system using PID Controller

Prashant Narwade [1*], Ravindra Deshmukh [2], Mahesh Nagarkar[3] and Milind Bankar[4]
[1] Department of Mechanical Engineering, D.V.P.C.O.E, Ahmednagar, Maharashtra
[2] Department of Mechanical Engineering, J.N.E.C, Aurangabad, Maharashtra
[3]Department of Mechanical Engineering, S.C.M.C.O.E,, Ahmednagar, Maharashtra
[4]Tata Motors Ltd., Pune, Maharashtra
E-mail:*narwadeprashant@gmail.com

Abstract. In this article, the numerical simulation of Magneto-rheological (MR) damper has been done using PID controller in Matlab-Simulink software to compare between the regular Macpherson strut and semi active suspension systems. The Magneto-rheological damper is a control device filled with Magneto-rheological fluid which changes damping force by changing property of viscosity on application of magnetic field. The results show that proportional integral derivative (PID) controller used to control damper in semi-active suspension is more efficient to reduce road disturbances than the regular suspension using Macpherson strut. Vehicle chassis displacement and acceleration can be reduced within milliseconds of time.
Keywords. Magneto-rheological (MR) Fluid,, Sedimentation, Viscosity, Semi-active Suspension, Sprung mass

Nomenclature
m_1= Sprung mass, Kg
m_2= Unsprung mass, N/m
k_1= Suspension stiffness, N/m
k_2 = Tire stiffness, N/m
c_1= Damping coefficient of suspension, Ns/m
c_2= Damping coefficient of Tire, Ns/m
x_1= Displacement of the sprung mass, m
x_2= Displacement of the unsprung mass, m
w = Road disturbance, m
ξ = Damping factor
ω_n = Natural frequency of system, rad/s
ω = Forcing frequency of unsprung mass

1. Introduction

Suspension system along with tire is an important area of concern in a vehicle, which affects ride quality of a passenger car. A superior ride quality provides a comfort to passengers sitting in the vehicle. Speed bumps, pot holes and irregular road profile are main cause of vibrations in automobile. Roughness of road, rotating components coupled to the tire and engine creates vibrations during the ride of vehicle. Many researchers revealed that vibrations affect the human health and cause loss of working efficiency. Suspension system prevents these shocks and vibrations and provides comfort to the passengers. Along with comfort suspension system also carries the total load of the vehicle.

Damper is the most important element of the suspension assembly to ensure ride comfort and good control over the car by dissipating vibration energy. The automotive damper on most suspension