Modeling and Simulation of MR Dampers Using COMSOL Multiphysics® Software

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Abstract

Classical hydraulic dampers are flexible devices that are used to attach a component to a mounting base. Vibration amplitude reduction can be achieved by improving the old technique of suspension by bringing in application of Magnetorheological or Electrorheological fluid in it. Due to the controllable characteristics of the material used in the classical hydraulic damper, the design and application of such devices has been area of recent interest.

Completely new design of dampers for the existing systems is a complicated process. To manufacture a new MR damper, new process needs to be developed which may become cumbersome. Considering this requirement, classical damper was modified into MR damper by using an external arrangement without any changes in the internal design of the classical damper. The required electromagnetic field was generated with the help of external permanent magnets. Such magnets were attached to movable aluminum rods so as to vary the distance and in turn, the magnetic field surrounding the damper.

The MR damper was modeled using COMSOL Multiphysics® and under varying magnetic and excitation, the results were observed using simulations. These results were validated experimentally by testing the MR damper under varying external fields using a vibration exciter. The force-velocity curves were obtained for different excitation frequencies and magnetic fields and were found to be in line with the results of simulation.