A novel MR device with variable stiffness and damping capability

Shiyu Zhao[1], *Huaxia Deng[1], Jin Zhang[1], Shuaishuai Sun[2] and *Weihua Li[2]

[1]School of Instrument Science and Opto-electronics Engineering, HeFei University of Technology, Hefei, China.
[2] School of Mechanical, Materials & Mechatronic Engineering, University of Wollongong, Wollongong, Australia

*Corresponding author: hxdeng@hfut.edu.cn and weihuali@uow.edu.au

Abstract

- This paper proposes a novel device based on the Magnetorheological (MR) fluid which has the capability to change stiffness and damping under control. MR fluid is a type of smart material whose properties could be controlled by the external magnetic field. Most of MR devices are MR dampers, which normally are used as variable damping devices. The presented device consists of two hydro-cylinder-spring structures and one MR valve linking these two structures. The rheological characteristics of MR fluid in the fluid flow channels of MR valve are controlled by the strength of magnetic fields, which directly affect the link conditions. The equivalent stiffness and damping coefficients of the device thus varies with the rheological characteristics of MR fluid simultaneously. A mathematical model is established to describe the properties of the proposed device based on the Bouc-wen model. ADAMS is employed to simulate the dynamic performance of the device. The mathematical model the simulation results indicate that the proposed device can control both the stiffness and damping which has potential to be applied for restrain vibration mitigation efficiently.

Keywords: MR valve, Vibration mitigation, Smart Material