Design and Testing of Electrorheological Fluid Damper

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ABSTRACT

Intelligent vehicle has become one of the most important research topics for the next generation transportation. Among the related technologies, driving safety and comfort involving the incorporation of active suspension system is the unavoidable option. This thesis focuses on the development of the electrorheological fluid damper, which is the key object for the smart suspension system. The theoretical formulation of ER fluid flowing through an annular orifice is first studied. The influence of the design variables such as dimensions of the orifice, applied electric field strength, and the property of the ER fluid etc. are investigated. The results of this theoretical modeling with annular orifice are compared with those with parallel-plate orifice. The discrepancy between these two modeling is insignificant for usual case. However, for the flow with large flow rate and small yield stress, the discrepancy of the results between these models enlarges. On the other hand, an experimental study on the pressure drop and the damping force for the electrorheological fluid damper under the operation of different piston velocities and controlled electric field strengths is conducted to verify the accuracy of the proposed model. It is found that with higher electric field, higher piston velocity, smaller electrode gap height and longer electrode length, both the pressure drop across the orifice and damping force increase accordingly. Nevertheless, as the piston velocity increases further, the rate of increment in the pressure drop and damping force becomes smoother. This study demonstrates that the damping force of the electrorheological fluid damper can be effectively tuned via the adjustment of the applied electric field.

Keywords : Intelligent vehicle ; semi-active suspension system ; electrorheological fluid damper

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