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Experimental study on a passive-active-combined suspension design methodology

Haonan He[1], Yuan Li*[1], Lindsay Clare[2], Jason Zheng Jiang*[1], Monzer Al Sakka[3], Miguel Dhaens[3], Steve Burrow[2], Simon Neild[1] and Andrew Conn[1]

[1]Department of Mechanical Engineering, University of Bristol, Bristol, UK

[2]Department of Aerospace Engineering, University of Bristol, Bristol, UK

[3]Tenneco, Sint-Truiden, Belgium

*Corresponding author: Yuan Li, E-mail: yl14470@bristol.ac.uk

Jason Zheng Jiang, Email: z.jiang@bristol.ac.uk

Abstract: Dynamic performance of a passive vehicle suspension can be improved with the help of an active actuator. However, there could be problematic actuation requirements, such as high energy consumption and large actuator forces. A novel design approach for passive-active-combined suspensions has been previously proposed by the authors to improve the trade-off between the dynamic performance and actuation requirements. To show its effectiveness in practical applications, an experimental study is carried out in this paper. First, a physical implementation of the active part of combined suspensions is proposed, which mainly includes a ball screw and a rotary brushless DC motor. Then, an experimentally verified network model of this physical implementation is developed by considering parasitic effects of the device. Taking a quarter car as an example, it is found that for the proposed setup, the inertia of the screw and motor rotor has an evident effect on suspension performance, while the friction of the ball screw, the mechanical loss and cogging torque of the motor are negligible. If the parameters of the passive part and the active controller gain are re-tuned after replacing the ideal active part with the identified network model of the proposed physical implementation, the optimal trade-off between ride comfort and actuation force can be retained or even improved. An example point on the updated trade-off has been verified via experiments, where the correlation coefficient on response matching is approximately 96%.