Extended Abstract

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Tire-suspension HILS system with additional degree of freedom for heaving motion

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The tire-suspension HILS system is a testing system composed of a 6-DOF motion platform, a tire rotating machine, and a tire-suspension subsystem of an actual vehicle for one wheel (Fig. 1) [1]. In this system, the behavior of a whole vehicle is analyzed by the numerical simulation, in which the measurement data in the testing system is used as the simulation input. The analysis result is used for the control of the motion platform. Therefore, this testing system is a kind of hardware-in-the-loop simulation system, and the real-time vehicle dynamics calculation is required to control the actuator. The tire-suspension subsystem in the testing system can be modified according to the testing purpose. In this study, a subsystem for an experimental trailer for road profile measurement shown in Fig. 2 is investigated.

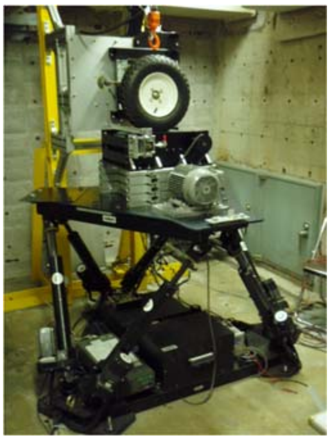


Fig. 1: Tire-suspension HILS system

Fig. 2: Experimental trailer for road profile measurement

Recently the tire-suspension HILS system was updated with an addition degree of freedom for the heaving motion (Fig. 3). In previously developed system, the suspension subsystem was fixed to the wall and the 6-DOF motion platform was controlled in order to realize the relative motion between the vehicle body and the road that can be obtained in real-time vehicle dynamics analysis. However, the time delay of the motion platform causes low accuracy especially when a high-frequency input of the road profile is considered. In order to solve this problem, an actuator with high response is added for the heaving motion of the vehicle body which is controlled based on the real-time vehicle dynamics analysis. Hence, the control of the motion platform can be separated from the simulation loop. As a result, it is possible to compensate the time delay of the motion platform by time shifting.

Figure 4 shows the experimental results of the previous system and the newly developed system. The vertical road input and the suspension stroke are shown in this figure. In the figure of the road input, the comparison of the command value and measurement result is indicatred. It is shown that by adding the actuator for heaving motion, the compensation of the time delay of the motion platform was achieved, which caused the difference of the behavior of the actual tire-suspension subsystem.

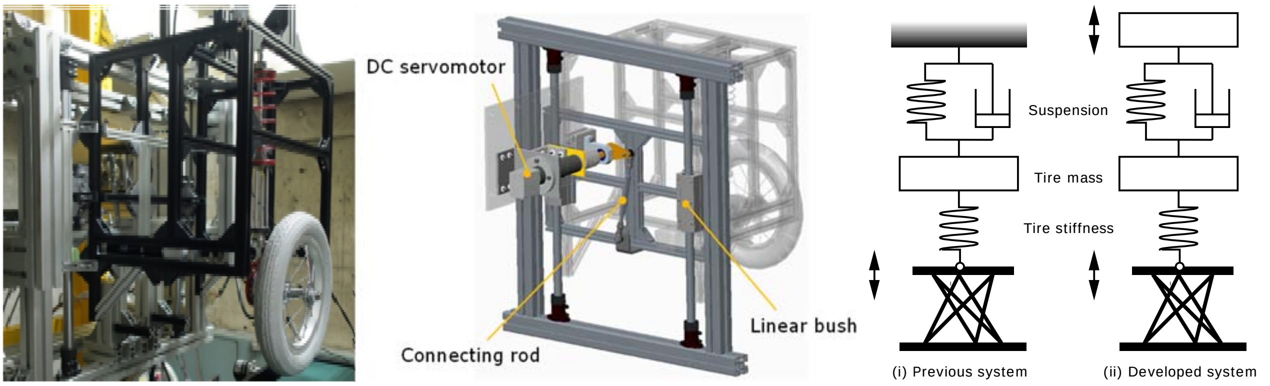
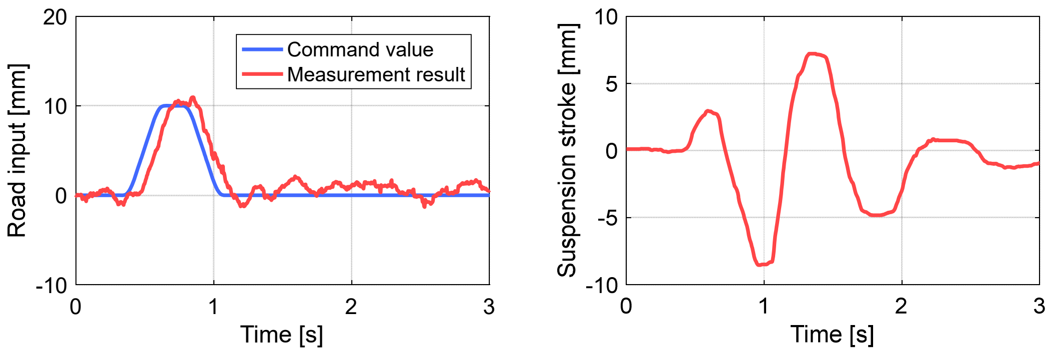
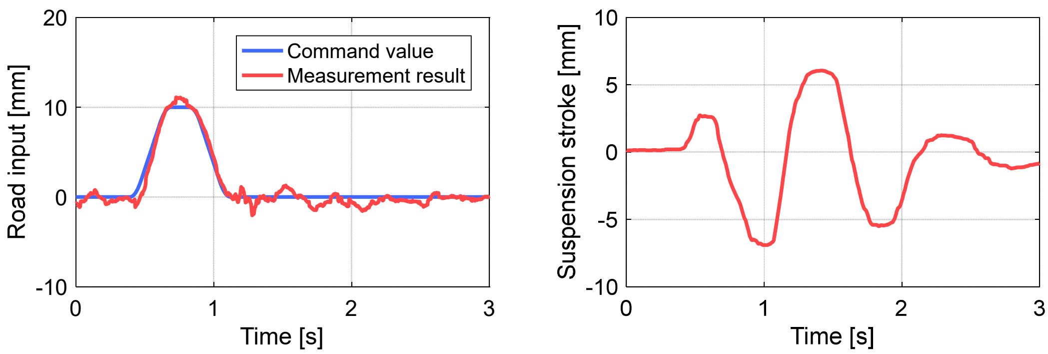


Fig. 3: Developed tire-suspension HILS system with heaving motion



(i) Previous system



(ii) Developed system

Fig. 4: Experimental results

References

[1] T. Hoshida, T. Shiiba, and Y. Matsumoto, “Improving the Computational Efficiency of Tire-Suspension HILS System with Matrix Library” in *ASME 2012 5th Annual Dynamic Systems and Control Conference joint with the JSME 2012 11th Motion and Vibration Conference*, 2012.