

SEMI-ACTIVE CONTROL OF HUNTING MOTION OF LOCOMOTIVE BASED ON MAGNETORHEOLOGICAL DAMPER

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ABSTRACT. *In this paper the simplified dynamical equations for hunting motions of locomotives are firstly established. Then the dynamical behavior of the semi-active suspension of the locomotive with magnetorheological (MR) damper is investigated, where the MR model is obtained based on experimental results. In order to compare the performance of the semi-active suspension with MR damper, the passive control suspension, the semi-active on-off control suspension and the active suspension are also discussed. The simulation results show that the semi-active suspension of the locomotive with MR damper could lower the vibration of the locomotive effectively almost as the active control. Based on the control strategy presented here, not only the angular acceleration of the locomotive body could be lowered, which reduces the possibility of hunting motion, but also the yaw angles of the frontal and back bogies would be lowered, which improves the security of operation.*

Keywords: Locomotive, Hunting, Semi-active control, Magnetorheological damper

1. Introduction. The semi-active control could provide better performance than the passive control, which has been verified in many applications by many researchers, see for example, [1-5, 8]. Compared to the active control, the semi-active control has many advantages, such as lower energy consumption, higher reliability and simpler structure. So a lot of semi-active control strategies, such as the semi-active on-off control, the semi-active continuous control and the sub-optimal semi-active control, etc, have been applied in many fields, including locomotive engineering and civil engineering. And some smart dampers, such as magnetorheological (MR) damper, electrorheological (ER) damper are also used as the control component in semi-active control. Because it has many advantages [6], such as lower energy requirement and insensitivity to the temperature and circumstance, the MR damper has been used on many occasions.

Along with the development of high-speed vehicles, it becomes important to control the hunting motion of the locomotive body. In this paper the semi-active control with a MR damper is applied in locomotive engineering, which is used to control the hunting motion of the locomotive body. Firstly the simplified dynamical equations for the hunting motion of the locomotive are established, where a three-degree-of-freedom model is adopted and the round sway of the wheel-set is regarded as the external excitation to the locomotive system. Subsequently the semi-active control strategy with MR damper is obtained, which