

5.1 Vehicle dynamic responses

Car body centroid vertical and lateral accelerations of the first motor car at the windward side were displayed in Fig. 8. The maximum responses of the motor cars, varying with vehicle speeds and incoming wind directions, were shown in Figs. 9 to 11. It is found that lateral vibrations of the windward vehicle are stronger than those of the leeward vehicle, for the aerodynamic coefficients of the windward vehicle are much larger. With the speed of vehicle increasing, the dynamic responses generally increase.

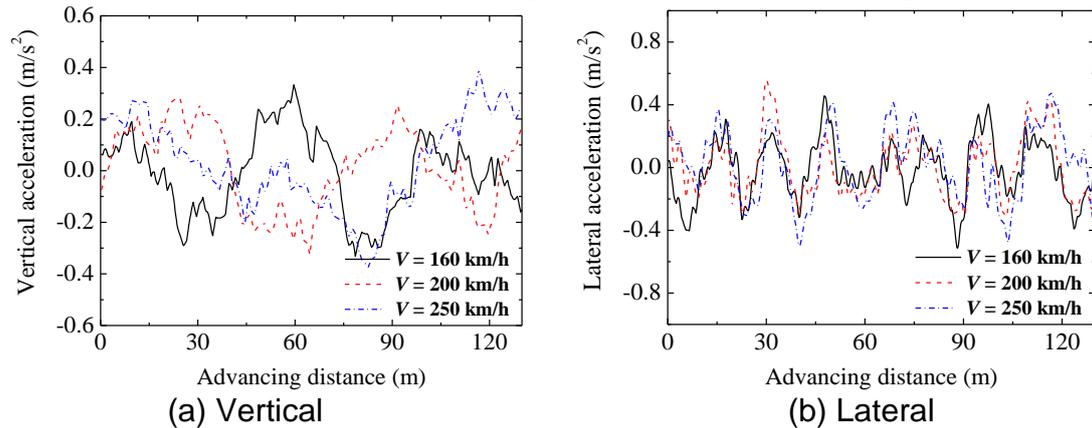


Fig. 8 Time-histories of car body centroid accelerations (Windward)

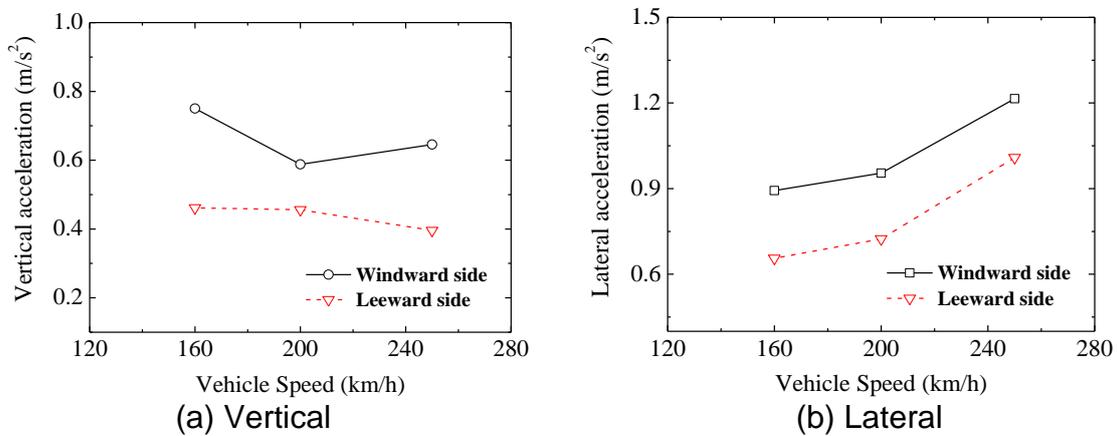


Fig. 9 Maximum car body centroid accelerations

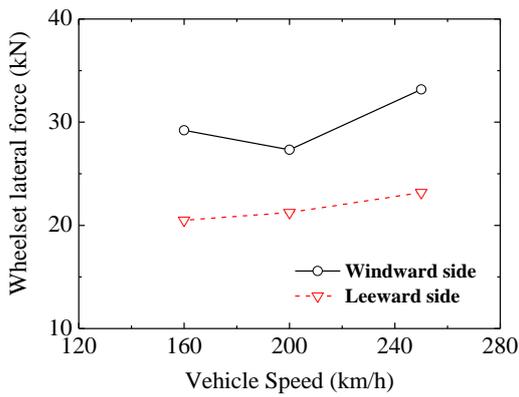


Fig. 10 Maximum wheelset lateral force

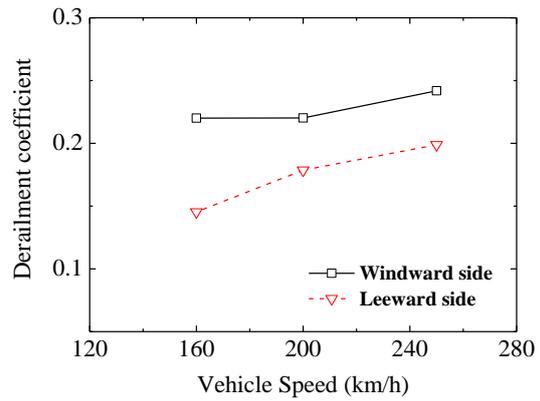
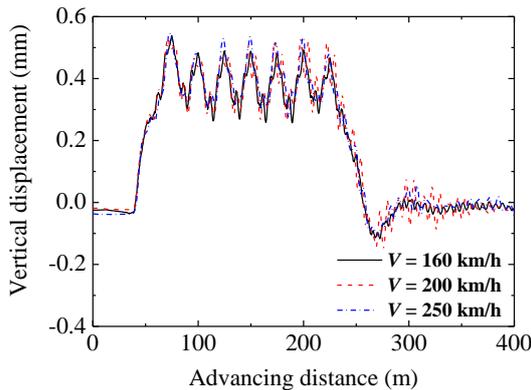


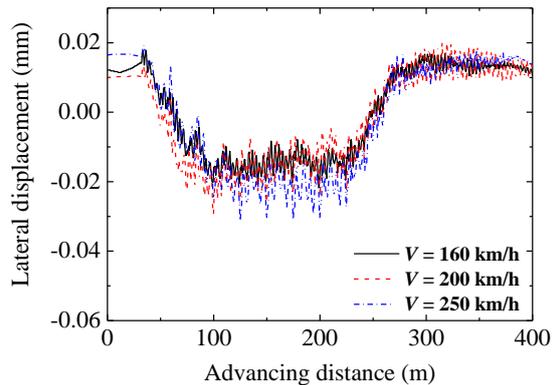
Fig. 11 Maximum derailment coefficient

5.2 Bridge dynamic responses

Figs. 12 and 13 give the time-histories of displacements and accelerations at the mid-span of 1st span (side span) in the vertical and lateral directions. It is observed that the vertical displacement of the bridge is mainly affected by the vehicle vertical loads, while the lateral displacement of the bridge is affected by both the vehicle partial loads and the wind drag loads. It is shown that the dynamic impact effects of the vehicle expand with the vehicle speed increasing.

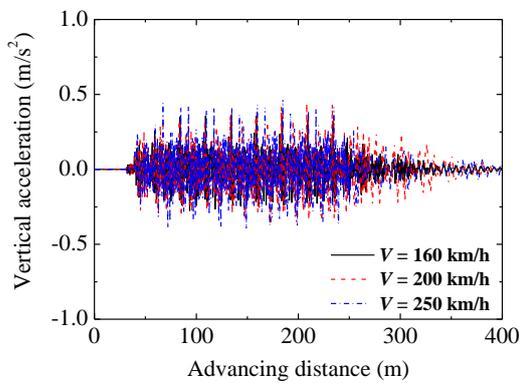


(a) Vertical

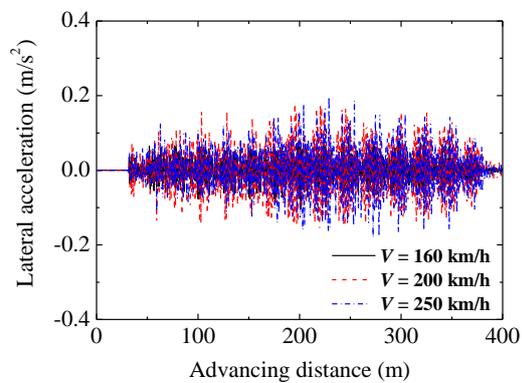


(b) Lateral

Fig. 12 Time-histories of displacements at the mid-span of 1st span (Windward)



(a) Vertical



(b) Lateral

Fig. 13 Time-histories of accelerations at the mid-span of 1st span (Windward)

6. Conclusions

In this study, the rigid-flexible coupling method, the DBC method, to conduct the simulation of the WVB system is presented. The method takes advantage of the high modeling efficiency of FE software ANSYS and the powerful wheel-rail analysis function of MBS software SIMPACK. The DBC method for the simulation of the WVB system was verified by the interactions between wind and vehicle, the interactions between wind and bridge, and the interactions between vehicle and bridge, respectively. The dummy body has negligible influences on the whole WVB coupling system.

The dynamic performances of vehicles and the double-track railway continuous bridge under strong winds were carried out, and effects of different vehicle speeds and incoming wind directions were studied. Lateral vibrations of the windward vehicle are stronger than those of the leeward vehicle, for the aerodynamic coefficients of the windward vehicle are much larger. The vertical displacement of the bridge is mainly affected by the vehicle vertical loads, while the lateral displacement of the bridge is affected by both the vehicle partial loads and the wind loads. It is shown that the dynamic impact effects of the vehicle expand with the vehicle speed increasing.

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