Modeling the Wind-blown Sand Impacts on High-speed Train

†Guang-jun Gao[1,2,3], Ya-ni Zhang[1,2,3] , *Chen Jiang[1,2,3]

[1]1Key Laboratory of Traffic Safety on Track of Ministry of Education, School of Traffic & Transportation Engineering, Central South University, Changsha 410075, China

[2]Joint International Research Laboratory of Key Technology for Rail Traffic Safety, Central South University, Changsha 410075, China

[3]National & Local Joint Engineering Research Center of Safety Technology for Rail Vehicle, Changsha 410075, China

*Presenting author: jiangchen2007@hotmail.com

†Corresponding author: gjgao@csu.edu.cn

Abstract

This study is aim to model the wind-blown sand effect on the high-speed train. To simulate the air-sand phases in this process, unsteady incompressible RANS equation and the SST k–ω model coupled with the discrete phase model (DPM) are utilized. However, in current implementation, the massive particle impacts to bluff body are often ignored. These dynamic effects are vital to the safety of operating high-speed train in the sand-wind weather of desert regions. In this study, the impacts of sand on train surfaces are modeled as a large quantity of events that tiny sphere impacts on a massive body separately. The Hertzian impact theory, respect to those physic processes, is implied to estimate the sand particle impact forces on the train surfaces. Due to the secondary importance and the significant number of particles, collisions between particles are not considered. Therefore, more comprehensive and realistic over-turning forces and moment of the running high-speed train in a typical sand storm weather is estimated by our new model. Present aerodynamic forces and moments are useful to guide the aerodynamic design of high-speed train with better performance and more safe under wind-blown sand weather.

Keywords: Wind-blown sand, Hertzian impact, High-speed train, Granular flows, Discrete phase model