A Rollover Prediction Method for Multi-Trailer Articulated Heavy Vehicles

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ABSTRACT

A new method is proposed for rollover prediction for multi-trailer articulated heavy vehicles (MTAHVs). Due to multi-unit configurations, large sizes, and high center of gravities, MTAHVs exhibit poor high-speed lateral stability. The high-speed unstable motion modes, e.g., jackknifing, trailer sway and rollover, frequently lead to fatal traffic accident in highway operations. To increase the safety of MTAHV operations on highways, we explore the rollover prediction method for MTAHVs. To this end, numerical simulation is conducted to validate this method for a B-Train MTAHV roll-stability estimation. A linear 4 degrees-of-freedom (DOF) yaw-plane B-Train model and a linear 2 DOF roll-plane single vehicle unit model is generated. The roll dynamics of the second trailer of the B-train is predicted by the integral model combining the yaw-plane and roll-plane models. Since the linear integral yaw-roll model may not accurately predict the performance of the B-train in nonlinear dynamic region, a neural network trained with TruckSim® data is used to refine the estimated roll dynamics of the second trailer of the B-train. The Time-To-Rollover (TTR) of the trailer is calculated. The simulation results show that with the recurrent neural network (RNN), the roll performance measure of the trailer can be more accurately estimated than only with the linear integral yaw-roll model. Thus, more accurate TTR of the trailer can be achieved, and a reliable signal can be used for rollover warning.