

**Statistical Characterization of Vehicle and Track
Interaction Using Rail Vehicle Response and Track
Geometry Measurements**

by

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This study evaluates the dynamic interaction between rail vehicles and the track on which they travel. The measurements were analyzed in the time and frequency domain. The effects of external parameters such as the vehicle design, subgrade stiffness, and degree of curvature were analyzed and compared for both the vehicle response and the track geometry data.

This study was conducted in close cooperation with the Transportation Technology Center, Inc. (TTCI) in Pueblo, Colorado. The track and vehicle response data was collected on the High Tonnage Loop at TTCI over a span of approximately ten years. For the purpose of this study, TTCI provided this data to the Advanced Vehicle Dynamics Laboratories (AVDL) at Virginia Tech.

The analysis of the data was first completed for the vehicle response and track geometry measurements separately. In this manner, the effects of the subgrade stiffness, the degree of curvature, and the vehicle design could be evaluated for each of the measurements. The analysis of the track and rail vehicle response was successfully completed, and the results from this analysis are presented in the following chapters.

The analysis showed that the subgrade stiffness had a significant effect on the vertical wheel loads, the track crosslevel, and the track gauge. For an increase in the degree of curvature, the variation of the crosslevel increased. The dynamic response of the vertical and lateral wheel loads showed a significant dependence on the alignment of the rails. Improvements for future studies of the interaction between the track and rail vehicles have been recommended.

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