Implications of Truck Platoons for Roadside and Vehicle Safety Hardware (01-006) Dataset

Dataset available at: https://doi.org/10.15787/VTT1/D9UA9N.

(This dataset supports report **Implications of Truck Platoons for Roadside Hardware and Vehicle Safety)**

This U.S. Department of Transportation-funded dataset is preserved by the Virginia Tech Transportation Institute (VTTI) in their data repository (https://dataverse.vtti.vt.edu/), and is available at https://doi.org/10.15787/VTT1/D9UA9N.

The related final report **Implications of Truck Platoons for Roadside Hardware and Vehicle Safety**, is available from the National Transportation Library's Digital Repository at https://rosap.ntl.bts.gov/view/dot/62013.

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Description:

- Project Description:
  - The research examines whether the capacity and adequacy of existing roadside safety hardware deployed at strategic locations is sufficient to resist a potential impact from a fleet of multiple truck platooning at high speed, which may occur as a result of errant truck platoons. Another objective of this research is to understand how these impacting trucks will interact with roadside safety barriers after leaving their platoon and what the occupant risks associated with such impacts are. For this study, the Manitoba Constrained-Width, Tall Wall Barrier (Test No. MAN-1, FHWA B-268) and the Vertical Faced Concrete Median Barrier (Test No. TL5CMB2, FHWA B-182) tested at Midwest Roadside Safety Facility (MwRSF) were selected as representative concrete bridge rail and concrete median barrier respectively. Hybrid-III and THOR dummy models were selected to evaluate tractor-trailer occupant injury risk.
- **Accelerometer Data:**
  - Data Scope: As a part of the research methodology, at first, barrier and tractor-trailer finite element models were developed and computer simulations were performed to analyze the barrier strength and vehicle stability. Acceleration and

angular displacement data were collected from the finite element models during all impact simulations. For the first impact simulation, acceleration and angular displacement data were compared between the test and simulation according to Sprague and Geers (S&G) metrics and variance (ANOVA) metrics. Comparisons of vehicle behavior between the first and following simulation impacts, using the collected accelerometer data, were also performed to understand the barrier capacity and risk involved on the event of multiple impacts due to an errant truck platoon. The accelerometer data collected from the five consecutive Manitoba barrier impact simulations (run1 through run5) and four consecutive Concrete Median barrier impact simulations (run1 through run4) are provided. The provided cabin and rear-axle accelerometer data are collected from accelerometers modeled at locations same as the locations where accelerometers were installed in the respective full-scale crash tests. It was assumed that only the first and last trucks of errant trailer-tractor platoon have occupants. To investigate numerically the injury risks of these occupants in impact simulations, the interior parts of the trailer-tractor model were developed. Additionally, the cabin was detached from the trailer and its kinematics was prescribed based on the displacement time histories of eight cabin nodes recorded in the full tractor-trailer-to-barrier simulations. Both Hybrid-III and THOR dummy models were seated and restraint models were added. The occupant injury risk were evaluated based on the dummy signals recorded in the FE simulations of cabin only model with occupant dummy model inside. Then, the injury risk of occupants were calculate based on the Occupant Injury Measure which include the most important body region criteria. This injury data are provided along with original cabin-only FE simulation setup files and all results files.

  - Data Specification: The data provided is in LS-Dyna R9.1.0 output format. The data provided for each simulation includes data from cabin and rear-axle accelerometer. For each accelerometer, *.txt files for angular velocity (rx-roll, ry-pitch & rz-yaw) and acceleration (x, y & z) are provided. The units of the data in the text files are sec for time, rad/sec for angular velocity and millimeter/sec^2 for acceleration. Test Risk Assessment Program (TRAP) file with *.trp extension, that uses the text files as input, is also provided. TRAP file converts the raw data from text files to roll, pitch and yaw data in units of degrees as well as provides occupant risk parameters. *.csv file that reports the vehicle roll, pitch and yaw in units of degrees is also included. The cabin-only simulation setup files for occupant injury risk evaluation are provided by LS-Dyna .k files. The simulation results files are d3plots files and binout files from LS-Dyna. Corresponding injury criteria files are provided by .csv files and .png files for data/figure.

- **GLSTAT Energy Data:**
  - Data Scope: As a part of the research methodology, at first, barrier and tractor-trailer finite element models were developed and computer simulations were performed to analyze the barrier strength and vehicle stability. The total energy of the system at any point during the simulation is the sum of kinetic energy, internal

energy, sliding interface energy and hourglass energy. So, at any time during the simulation the total energy of the system should be equal to the kinetic energy of the vehicle at the beginning of the impact. GLSTAT energy data collected from the five consecutive Manitoba barrier impact simulations (run1 through run5) and four consecutive Concrete Median barrier impact simulations (run1 through run4) are provided. The energy data plots showing the energy distribution at each point of time during the impact simulations are also provided.

  - Data Specification: The GLSTAT energy data files are provided in LS-Dyna R9.1.0 output format. The data provided for each simulation includes a *.txt file for hourglass energy, internal energy and kinetic energy, and another *.txt file for total sliding energy. The units of the data in the text files are seconds for time and percent-of-total for energy. The energy data plots showing the energy distribution at each point of time during each impact simulation are provided in *.xlxs files.

- **Vehicle Roll Comparison Graphs:**
  - Data Scope: As a part of the research methodology, at first, barrier and tractor-trailer finite element models were developed and computer simulations were performed to analyze the barrier strength and vehicle stability. Acceleration and angular displacement data were collected from the finite element models during all impact simulations. For the first impact simulation, acceleration and angular displacement data were compared between the test and simulation according to Sprague and Geers (S&G) metrics and variance (ANOVA) metrics. Comparisons of vehicle behavior between the first and following simulation impacts, using the collected accelerometer data, were also performed to understand the barrier capacity and risk involved on the event of multiple impacts due to an errant truck platoon. Vehicle roll comparison graphs using accelerometer data collected from cabin accelerometer and rear-axle accelerometer for the five consecutive Manitoba barrier impact simulations (run1 through run5) and four consecutive Concrete Median barrier impact simulations (run1 through run4) are provided. The cabin and rear-axle accelerometer data are collected from accelerometers modeled at locations same as the locations where accelerometers were installed in the respective full-scale crash tests.
  - Data Specification: The data and graphs are provided in Microsoft Excel files. Roll_Comparison_Cabin.xlsx file provides the Impact Time (sec.) and Roll Angle (deg.) data from cabin accelerometer for each impact simulation for both Manitoba and Concrete Median barrier, and shows the comparison graphs. Roll_Comparison_RearAxle.xlsx file provides the Impact Time (sec.) and Roll Angle (deg.) data from rear-axle accelerometer for each impact simulation for both Manitoba and Concrete Median barrier, and shows the comparison graphs.
- Videos:
  - Data Scope: As a part of the research methodology, at first, barrier and tractor-trailer finite element models were developed and computer simulations were performed to analyze the barrier strength and vehicle stability. Simulations videos for the five consecutive Manitoba barrier impact simulations (run1 through run5)

and four consecutive Concrete Median barrier impact simulations (run1 through run4) are provided.
    - Data Specification: Videos from multiple angles are provided for each impact simulation in *.wmv format.

Subject: Engineering; Other
Keyword: Accelerometer, angular velocity, acceleration, angular displacement, validation, finite element analysis, truck platooning, vehicle roll, validation, Impact simulation, simulation video, GLSTAT energy, total energy, hourglass
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Dataset description:
This dataset contains 6 files with an overall size of 16.1 GB. To access this dataset and see the file list please visit https://doi.org/10.15787/VTT1/D9UA9N.

National Transportation Library (NTL) Curation Note:
As this dataset is preserved in a repository outside U.S. DOT control, as allowed by the U.S. DOT's Public Access Plan (https://doi.org/10.21949/1503647) Section 7.4.2 Data, the NTL staff has performed ***NO*** additional curation actions on this dataset. NTL staff last accessed this dataset at https://doi.org/10.15787/VTT1/D9UA9N on 2022-05-26. If, in the future, you have trouble accessing this dataset at the host repository, please email NTLDataCurator@dot.gov describing your problem. NTL staff will do its best to assist you at that time.