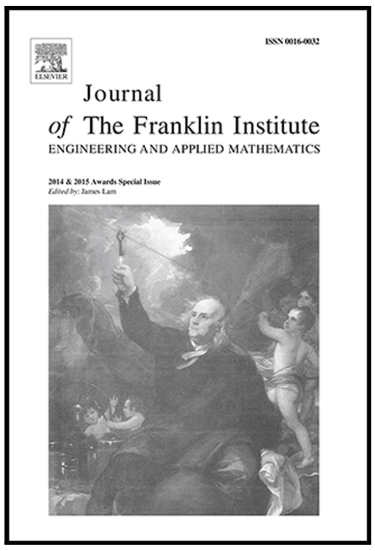

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Data-based Modeling and Estimation of Vehicle Crash Processes in Frontal Fixed-barrier Crashes

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Abstract

As a complex process, vehicle crash is challenging to be described and estimated mathematically. Although different mathematical models are developed, it is still difficult to balance the complexity of models and the performance of estimation. The aim of this work is to propose a novel scheme to model and estimate the processes of vehicle-barrier frontal crashes. In this work, a piecewise model structure is predefined to represent the accelerations of vehicle in frontal crashes. Each segment in the model is corresponding to the energy absorbing component in the crashworthiness structure. With the help of Ensemble Empirical Mode Decomposition (EEMD), a robust scheme is proposed for parameter identification. By adjusting the model structure and parameters according to the initial velocity, crash processes in different conditions are estimated effectively. The estimation results exhibit good agreement with finite element (FE) simulations in three different cases. It is shown that, the proposed model keeps low complexity. Furthermore, the structure information of vehicle is involved in improving the accuracy and ability of crash estimation.

Keywords: vehicle crash, crashworthiness structure, piecewise model, crash process estimation, Ensemble Empirical Mode Decomposition(EEMD)

1. Introduction

Vehicle crashes are the main traffic accidents and cause great casualties all over the world. Although some manufacturers are developing new active safety technologies, such as automatically steering [1] and advanced driver assistance systems [2], the passive safety, especially the crashworthiness design, is still serving as the base of vehicle safety and therefore widely concerned by vehicle engineers and researchers.

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