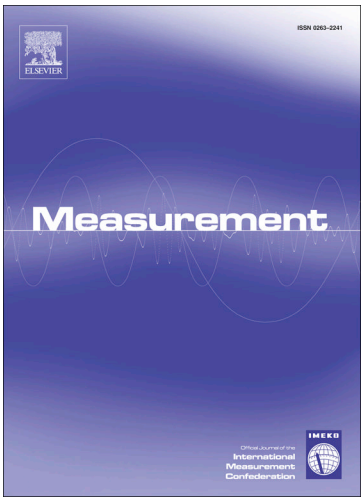

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Abstract

Uncertainty evaluation is playing an increasingly important role in assessing the performance, safety and reliability of complex physical systems in the absence of adequate amount of experimental data. This paper presents a quantification of the measurement uncertainty in whiplash test models. We researched the analysis techniques of uncertainty for the complex nonlinear systems, as well as the advantages and disadvantages of the proposed methodology. By introducing the finite element analysis, we verified the consistency between the whiplash test, the calibration test and the simulation results of them. We also studied the influential factors and their probability density functions and presented the sensitivity analysis of whiplash test model. Based on the Latin hypercube sampling, we utilized the back propagation neural network (BPNN) and the least squares support vector machine (LS-SVM) to establish the mathematical models. Furthermore, the accuracies of two models are validated. Comparing with the results acquired by the guidance of uncertainty measurement and the Bayesian method, we demonstrate that the LS-SVM-based Monte Carlo method is the most appropriate technique for the evaluation of whiplash test uncertainty.

Keywords: Measurement uncertainty evaluation; Whiplash test; Back propagation neural network; Least squares support vector machine; Monte Carlo method

1. Introduction

Whiplash-associated neck injuries [1-5] are attracting more and more attention of the vehicle safety