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Assessment of the probability of trail derailment under earthquake excitation

Goulielmos Floros, Ioannis Kalogeris, and Bissarion Papadopoulos
NATIONAL TECHNICAL UNIVERSITY OF ATHENS, CIVIL ENGINEERING, WATER RESOURCES, Greece (goul.floros@gmail.com)

Modern cities focus on developing advanced infrastructure systems in order to address the transportation requirements set by the increasing number of their citizens. These requirements relate to the efficiency, reliability and sustainability of mass transit, indicating the use of railway systems as a promising option. High-speed trains (i.e. HighSpeed 1, HighSpeed 2) are being increasingly utilized by developed countries (i.e. UK, USA, Japan) due to the significantly reduced travel time and the capacity of passengers they can service. Within this context, it is essential to address safety issues and particularly natural phenomena that in most cases are uncontrollable such as earthquakes and floods. The aim of this research is to predict the probability of a high-speed train to be derailed in case an earthquake occurs during its travel. This presentation is structured as follows: firstly, relevant work in the probability of train derailment due to a seismic phenomenon is briefly analyzed and then the proposed methodology is presented. More specifically, a set of artificial timeseries is produced for the purposes of a Monte Carlo analysis, which are then inserted as excitations into the motion equations of the train. Next, these equations are solved using the Finite Element method and the exceedance of derailment criteria is monitored. Lastly, the estimation of the probability of train derailment is straightforwardly obtained through the statistical processing of the results. The conclusions of this study are further discussed and future research opportunities are proposed.

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