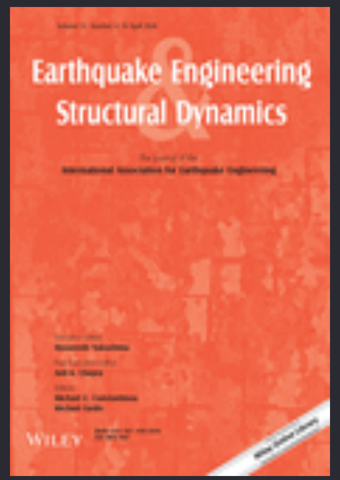

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ARTICLE

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RESEARCH ARTICLE

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A multi-level approach to predict the seismic response of rigid rocking structures using artificial neural networks

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Abstract

This paper explores the use of Artificial Neural Networks (ANN) for the rocking problem. The paper adopts rigid rocking blocks of different sizes and slenderness, which undergo rocking motion without sliding and bouncing when subjected to recorded earthquakes. This research focuses on the cases where the blocks overturn or safely return to their initial (rest) position at the end of the ground shaking. An ANN model is trained to efficiently categorise the response into overturning or safe rocking using the structural parameters, ground motion characteristics, and the coefficient of restitution as input. The results show the substantial contribution of velocity and frequency characteristics of the ground motion to overturning. In addition, ANN is used to predict the response amplitude and identify the most critical input variables that govern safe rocking. The analysis reveals that rocking amplitude is governed by a combination of duration, frequency, and intensity characteristics of the ground excitation. Interestingly, the maximum incremental velocity (MIV), a novel intensity measure for the rocking literature, shows a substantial correlation with the rocking amplitude. In this context, this paper proposes closed-form expressions using the most influential input variables to provide a quick, yet adequately accurate, response prediction. Finally, this study pays special attention to the contribution of the coefficient of restitution, which, in general, is less critical to the peak safe rocking response, while it becomes more important to the overturning response.

KEYWORDS