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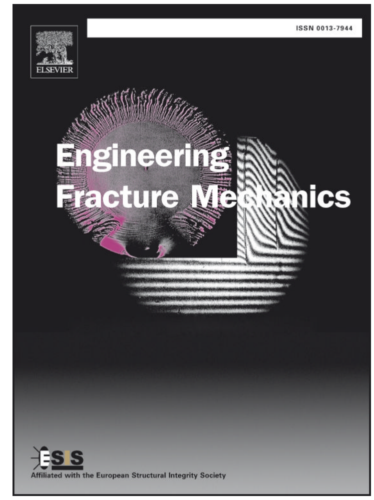

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A machine learning approach for the identification of the Lattice Discrete Particle Model parameters

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Abstract

Concrete is a composite material that is governed by complex constitutive behavior under various loading and environmental conditions. Only comprehensive computational models can represent such behavior and capture the effects of heterogeneity, crack coalescence and damage localization. Such models are usually governed by a large set of parameters that require, correspondingly, multiple experimental tests for their proper calibration. In many experimental campaigns, not all of the needed tests are performed. In this case, the uniqueness of the calibration results cannot be guaranteed.

In this research, a Machine Learning (ML) approach is proposed to solve this problem by predicting the unknown characteristics of the concrete based on a statistical interpolation of large concrete testing databases and by using these interpolated data to identify the model parameters. The ML framework is demonstrated using the Lattice Discrete Particle Model (LDPM), which is a comprehensive concrete model that successfully replicates concrete behavior under multi-axial stresses in both static and dynamic loading conditions. The ML approach consists of an initial training of an Artificial Neural Network (ANN) to reverse engineer LDPM using pilot concrete data that represent common concrete properties. Next, an adaptive updating technique is implemented to improve the parameter identification capabilities and to allow continuous learning. The paper discussed multiple validations performed by using both original and updated ANNs. The results show the excellent parameter identification capabilities of the framework and its ability

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