A lattice-based multi-scale framework for modelling concrete fracture under dynamic loading

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ABSTRACT

Concrete is the most popular building material used in structures of all types and due to its heterogeneous nature, it requires the use of models capable of taking into account its micro structure. Moreover, dynamic loads and dynamic effects have a significant impact on the response of the structure and should be taken into account when analyzing a structure.
We propose a multi scale dynamic model which considers the dynamic behavior of structures at the macro scale and at the same time, at the microscale, it takes into account the development of cracks in the microstructure of concrete using lattice models [1]. The model is based on simple linear elastic analyses ran in such a manner as to model material nonlinearities. The microstructure is randomly generated [2][3] and contains aggregates of various shapes and size based on a grain size distribution function [4]. The link between the two used scales is done by assessing the stiffness of the cracked microstructure.
We estimated the performance of the model in terms of accuracy and required computational time. Time wise, due to the simple approach and the custom model framework, the model presents itself as an appealing option.
The multi scale dynamic model presented in this paper can be a useful tool for cases in which dynamic effects cannot be neglected. Future developments can increase the accuracy of the results and further decrease the computational needs of the model.

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