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A cellular automation which incorporates finite element method and meshless algorithm

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ABSTRACT

In this study, a cellular automaton (CA) is developed o combine the advantages of finite element method (FEM) and meshless method to analyze two-dimensional elastic problems. By the CA, a two-dimensional domain is discretized into a grid of nodes which are distributed randomly in the domain. For convenience, the nodes are classified into the FEM group and the meshless group. In the FEM zone that is mostly defined near the boundary of the domain, conventional FEM elements are used to establish the mechanical relationship between an arbitrary node and its adjacent nodes. In the meshless zone that is normally away from the boundary, the adjacent nodes are related by employing the concept of displacement interpolation used in FEM. However, each node, wherever it is in the FEM zone or meshless zone, is dealt with under the CA frame, that is, the unknown displacement of each node is evaluated by CA algorithm. Unlike FEM, the proposed CA solver works out the result through automatic evolution, instead of Gaussian elimination or other conventional methods. Based on the current CA algorithm, FEM and meshless can be merged seamlessly. The novelty and the correctness of the current approach are proven by numerical examples. Moreover, the present algorithm has great potential in parallel processing.