The Integrated Unit Method in BEM Analysis of Spatially Periodical Structures

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Abstract

In modern engineering, spatially periodical structures are extensively used, such as the honeycomb structures and corrugated structures used in airspace engineering. Numerical analysis of this type of structures using conventional discretization and assembling techniques is very time-consuming due to a lot of thin-walled or slender components included.

In this paper, the integrated unit method is proposed for thermal and mechanical analysis of spatially periodical structural problems using boundary element method (BEM). In this method, the BEM cell equation only needs to be established for one computational cell and the integrated unit can be formed by a specified number of cells. The final system of equations can be formed by assembling the integrated unit equations.

The proposed integrated unit method inherits the variable-elimination idea of the conventional sub-structure technique and assimilates the easy assembling characteristic of the finite and boundary elements, and therefore is suitable for fast analysis of large-scale spatially periodical structural problems. As the coefficient matrices of the integrated unit only needs to be established once and the final system of equations includes much less nodal variables than the conventional methods, the computational efficiency can be improved considerably. A few numerical examples are given to demonstrate the computational accuracy and efficiency of the proposed method.

Keywords: Integrated unit, Boundary element method, Periodical structure, Fast computational algorithm.