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GROUP THEORY BASED METHOD FOR THE DYNAMIC ANALYSIS OF PERIODIC STRUCTURES

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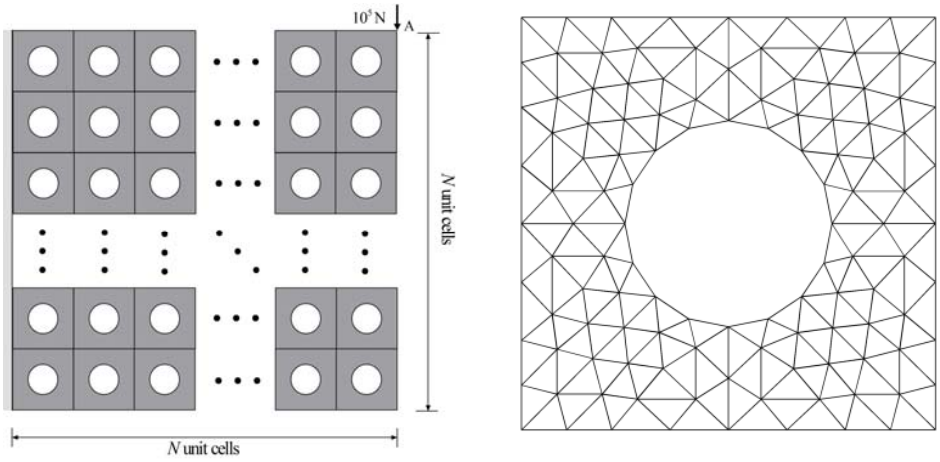
Based on the group theory, an efficient algorithm for computing the dynamic responses of periodic structures is proposed. When applying a numerical method, such as Newmark or generalized α method, for the large-scale dynamic systems, the key issue is to solve a system of linear algebraic equations efficiently. By using the symmetric property of the periodic structure, the group theory and the Woodbury formula, the linear algebraic equations corresponding to the periodic structures for the numerical method can be decoupled into block forms and so can be solved efficiently. The proposed algorithm has the same precision as the original numerical method, but is more efficient and memory saving.

A plane stress problem with periodic space domain shown in Fig. 1(a) is simulated. It consists of N^2 of the unit cells and was clamped on the left boundary. The FEM mesh used for each unit cell is given in Fig. 1(b). Fig. 2 gives the CPU times used by the proposed and Newmark methods. It shows that the proposed method is very much more efficient than the Newmark. For example, when $N = 47$, the DOF of the structure is about four hundred and fifty thousand, the CPU time used by the Newmark method is about 4.5 times than the proposed method. For structures with $N = 48$, the Cholesky factorization used in Newmark method caanot be finished due to the limitation of menory size.



(a) The periodic structure (b) The FEM mesh of the unit cell

Figure 1 A plane stress problem with periodic space domain

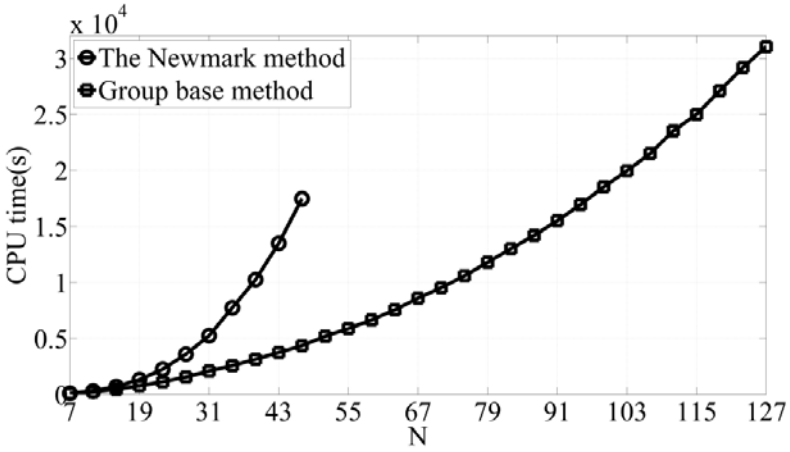


Figure 2 CPU times for the proposed and Newmark methods