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CALCULATIONS OF EIGENFREQUENCIES OF 2D ELASTIC FINITE PERIODIC STRUCTURES USING BOUNDARY ELEMENT METHOD

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The boundary element method (BEM) is applied to analyses of frequency-banded natures of elastic finite periodic structures. For finite periodic structures, the so-called periodic boundary conditions based on the Bloch theorem cannot be applied. Hence, the entire system has to be discretized to have the eigenfrequencies and to perform the elastic wave transmission analyses, and the size of the system matrix becomes too large for a large number of periodic structures. For a periodic part of the system matrix, a transfer matrix can be obtained based on the BEM discretization. The unknowns of this periodic part can be eliminated perfectly in advance through some algebraic operations, which yields a size-reduced matrix. The eigenvalue problem for the resulting system of linear algebraic equations becomes a nonlinear one [1] since the wave number is included in the components of the system matrix implicitly caused by the boundary integrals of the fundamental solutions. A contour integral method, called block SS-method [2, 3, 4], is successfully utilized to extract the eigenfrequencies of this nonlinear eigenvalue problem. The distribution of the obtained eigenvalues are compared with those for the infinite periodic phononic structures. Also discussed are the elastic wave transmissions obtained by increasing the number of periodic structures in comparison with the band gaps of the infinite phononic structures.

REFERENCES

[1] H.F. Gao, T. Matsumoto, T. Takahashi, H. Isakari, Eigenvalue analysis for acoustic problem in 3D by boundary element method with the block Sakurai-Sugiura method. *Eng. Anal. Bound. Elem.*, Vol. **37**, 914–923, 2013.

[2] T. Sakurai and H. Sugiura, A projection method for generalized eigenvalue problems using numerical integration. *J. Comput. Appl. Math.*, Vol. **159**, 119–128, 2003.

[3] T. Ikegami, T. Sakurai and U. Nagashima U, A filter diagonalization for generalized eigenvalue problems based on the Sakurai-Sugiura projection method. *J. Comput. Appl. Math.*, Vol. **233**, 1927–1936, 2010.

[4] J. Asakura, T. Sakurai, H. Tadano, T. Ikegami and K. Kimura, A numerical method for nonlinear eigenvalue problems using contour integrals. *JSIAM Lett,* . Vol. **1**, 52–55, 2009.