Scattering of flexural wave in a thin plate with multiple circular inclusions by using indirect BIEM and addition theorem

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This paper presents the indirect boundary integral equation method combined with the addition theorem to solve analytically the multiple scattering of flexural waves in an infinite thin plate with multiple circular inclusions/coated inclusions subjected to an incident plane wave. Owing to the addition theorem, we can avoid computing principal values in the boundary integral formulation. The computation of higher-order derivatives regarding a non-local coordinate system can be done by transforming the expression of the displacement field for an infinite thin plate to a specified local coordinate system, where the continuity conditions around the inclusion are given. The proposed formulation not only makes the overall numerical results more accurate but also has no fictitious frequency that appears in the traditional boundary integral method. In this work, the near-field dynamic moment concentration factor (DMCF) around the inclusions/coated inclusions and the far-field scattering pattern are theoretically derived and numerically calculated. The former often causes fatigue failure and affects the load-carrying capacity. The latter is related to non-destructive inspection. According to the continuity conditions around the circular inclusion, an infinite series solution is obtained as an analytical model of multiple scattering of flexural waves in an infinite thin plate with multiple circular inclusions/coated inclusions. We first perform the convergence analysis of the proposed method in this work. Although no limit is imposed on the number of circular inclusions/coated inclusions in our proposed method, the numerical results considering four circular inclusions/coated inclusions are presented, and related phenomena are studied. The effects of the wave number and the angle of the incident wave, the thickness of the flexible inclusion and the separation of inclusions on the near-field DMCF and the far-field scattering pattern are comprehensively investigated.

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