Dynamic Green's Functions for Multiple Elliptical Inclusions With Imperfect Interfaces Using the Collocation Multipole Method

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Abstract: This paper presents a semi-analytical approach to solve anti-plane dynamic Green's functions for an elastic infinitely extended isotropic solid (matrix) containing multiple elliptical inclusions with imperfect interfaces. The multipole expansions of anti-plane displacement for the matrix and inclusion are formulated in terms of angular and radial Mathieu functions to solve the dynamic Green's functions. Instead of using the complex addition theorem, frequently used in the traditional multipole method for a multiply-connected domain problem, the multipole expansion is directly computed in each local elliptical coordinate system. A linear spring model with vanishing thickness is employed to character the imperfect interface. The imperfect interface condition is satisfied by uniformly collocating points along the inclusion boundaries. For the imperfect interface condition, the normal derivative of the anti-plane displacement with respect to a non-local elliptical coordinate system is developed without any truncation error for multiply-connected domain problems. For the limiting case when the ellipse tends to a circle, the proposed results are match well with the available published results. Extensive studies are presented to investigate the effects of the frequency of excitation, imperfect interface and separation between inclusions on the dynamic Green's functions.

Keywords: dynamic Green's function, anti-plane, elliptical inclusion, imperfect interface, collocation multipole method.

References

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