ID de Contribution: **6** Type: **Non spécifié**

Volume integral equation formulation for anisotropic elastodynamic scattering: solvability, application to small-inclusion asymptotics

jeudi 4 février 2016 09:15 (35 minutes)

In contrast with the vast existing literature on the mathematical aspects of boundary integral equations and their application to scattering by impenetrable obstacles characterized by Dirichlet, Neumann or impedant boundary conditions, comparatively few studies are available regarding the mathematical properties of volume integral equation (VIE) formulations. This communication addresses the solvability of VIEs arising in elastodynamic scattering by penetrable obstacles. The elasticity tensor and mass density are allowed to be smoothly heterogeneous inside the obstacle and may be discontinuous across the background-obstacle interface, the background elastic material being homogeneous. Both materials may be anisotropic, within certain limitations for the background medium. The VIE associated with this problem is first derived, relying on known properties of the background fundamental tensor. To avoid difficulties associated with existing radiation conditions for anisotropic elastic media, we also propose a definition of the radiating character of transmission solutions. The unique solvability of the volume integral equation (and of the scattering problem) is established. For the important special case of isotropic background properties, our definition of a radiating solution is found to be equivalent to the Sommerfeld-Kupradze radiation conditions. Moreover, usefulness of this result for the derivation and justification of small-inclusion asymptotic approximations is discussed.

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