The generalized finite difference method for the inverse Cauchy problem in linear elasticity

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Abstract

In this study, the generalized finite difference method (GFDM) is utilized to accurately and stably solve two-dimensional inverse Cauchy problems in linear elasticity, governed by the Navier equations. In inverse Cauchy problems, over-determined boundary conditions are imposed on parts of the boundary, while there are no boundary conditions on some parts of boundary. It is well-known that for Cauchy problems the conventional numerical methods generally cause highly ill-conditioned matrices and result in unstable solutions. Beside, little noise added in the boundary conditions will significantly enlarge the computational errors. The GFDM, one of most-promising meshless methods, is adopted in this study to stably solve the two-dimensional Cauchy problems. The GFDM, developed from the classical finite difference method, can avoid numerical quadrature and time-consuming tasks of mesh generation. By using the moving-least squares approximation in the GFDM, the spatial derivatives at every node can be computed by linear combinations of nearby function values with different weighting coefficients. In this study, several numerical examples are provided to illustrate the consistency and accuracy of the presented meshless numerical scheme. In addition, the stability of the presented scheme for inverse Cauchy problems is proved by adding noise into the boundary conditions.

Keywords: **Meshless method**, **Generalized finite difference method**, I**nverse Cauchy problem**, **Linear elasticity**.