Collocation Trefftz methods for the stokes equations with singularity

李子才, 李明恭, 蔣依吾
Leisure and Recreation Management
Tourism
mglee@chu.edu.tw

Abstract

This study explores the boundary methods for the 2D homogeneous Stokes equations and investigates the particular solutions satisfying the Stokes equations. Smooth solutions for Stokes equations are provided by explicit fundamental solutions and particular solutions in this study, and singular corner solutions are also provided from linear elastostatics given in Li et al. (EABE(34):533-648, 2009). A new singularity model with an interior crack is proposed and solved by the collocation Trefftz method (CTM). The proposed method achieves highly accurate solutions with the leading coefficient having 10 significant digits. These solutions may be employed as a benchmark for testing results obtained by other numerical methods. Error bounds are derived for the CTM solutions using the particular solutions. For a general corner, the exponent ν_k in r^{ν_k} can only be obtained by numerical solutions of a system of nonlinear algebraic equations. Therefore, the combined methods using many fundamental solutions plus a few singular solutions are inevitable in most applications. For singularity problems, combining a few singular solutions with the fundamental solutions is an advanced topic successfully implemented in Lee et al. (EABE(24):632-654, 2010). However, combining a few singular solutions with the smooth particular solutions fails to converge in the first leading coefficient. As a result, the aforementioned method is not applicable to the singularity problems addressed in this paper. With the help of particular and singular solutions, the hybrid Trefftz method with Lagrange multipliers can be developed for the Stokes equations.