

Collocation Trefftz Methods for the Stokes Equations with Singularity

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Abstract

For the homogeneous Stokes equations in 2D, the boundary methods as in \cite{LLHC2008} are explored in this paper. The first issue is to seek the particular solutions satisfying the Stokes equation. The explicit fundamental solutions (FS) and particular solutions (PS) are provided for smooth solutions, and the singular solutions of corner are developed from linear elastostatics in \cite{CrackPaper2009,LYLC2010}. A new singularity model with interior crack is proposed and solved by the collocation Trefftz method (CTM). The highly accurate solutions and the leading coefficient with 10 significant digits are achieved, that may be used for testing against the results obtained by employing other numerical methods. Since for a general corner, the powers ν_k in r^{ν_k} can only be obtained by numerical solutions of a system of nonlinear equations, so that the combined methods using many fundamental solutions plus a few singular solutions are inevitable in application \cite{Li98}. From singularity problems, combining a few singular solutions with the fundamental solutions is advanced and successful as in \cite{LYLC2010}. However, combining a few singular solutions with the continuous particular solutions fails to converge in the most important leading coefficient, so it is invalid in application of singularity problems. Besides, with the help of the particular and singular solutions, the hybrid Trefftz method with multiplier in \cite{LiHyb2009} can also be developed for the Stokes equation in the future.

Keyword : Stokes equations, Singularity, Collocation Trefftz Method, Dirichlet Conditions