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A CHEBYSHEV POLYNOMIAL COLLOCATION BIEM FOR MIXED BOUNDARY VALUE PROBLEMS ON NONSMOOTH BOUNDARIES

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ABSTRACT. We propose a Chebyshev polynomial collocation method to solve systems of boundary integral equations arising from a BIE formulation of the mixed Dirichlet-Neumann boundary value problem for the Laplace equation on a nonsmooth domain. In particular, we first improve the behavior of the solution near the corners by introducing a smoothing transformation and then we apply to the new system a collocation method using Chebyshev polynomial expansions as approximants and the zeros of Chebyshev polynomials as collocation nodes. We give a complete solvability and stability analysis of the transformed integral equations by using localization and Mellin techniques. The numerical results obtained show the efficiency of the method here proposed.

1. Introduction.

Several boundary value problems for an elliptic partial differential equation over a region Ω can be reformulated as equivalent integral equations over the boundary of Ω. Such a reformulation is called a boundary integral equation (BIE) and it may be used to solve Laplace's equation and many other elliptic equations, including the biharmonic equation, the Helmholtz equation, the equation of linear elasticity and the equation for Stokes' fluid flow.

In this paper we consider the numerical solution of a BIE reformulation of Laplace's equation in two dimensions. In particular, we consider the following mixed Dirichlet-Neumann boundary value problem for the

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