

Boundary Methods for Laplace's Equation in Circular Domains with Multiple Circular Holes

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Abstract

For Laplace's equations in circular domains with multiple circular holes, the interior field method (IFM) [1] and the collocation Trefftz method (CTM) [2] are proposed in this paper, accompanied with the explicit computational formulas. For solving Dirichlet problems, there may exist the degenerate scales, so that how to seek unique solutions is essential in numerical computation. This paper is devoted to demonstrate some theoretical results of degenerate scales for multiple circular holes. For the exterior boundary circle with radius $R = 1$, the non-singularity of the IFM algorithms is assured. To bypass the degenerate scales at $R = 1$, the CTM is recommended. Results for some new theoretical analysis of non-singularity are given for multiple circular holes for both the IFM and the CTM. Numerical experiments are carried out for the Dirichlet problem in the circular domains with three circular holes. In this paper, some comparisons are given with the IFM and CTM, the CTM has better numerical performance, including simple algorithms, better stability, and in particular, without risk of degenerate scales. This paper enhances boundary methods in the Trefftz family in [3] for multiple holes.

Keyword : Multiple holes, degenerate scales, Dirichlet problems, interior field method, collocation Trefftz method, Laplace's equation, circular domains