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On the use of rational-function fitting methods for the solution of 2D Laplace boundary-value problems

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A B S T R A C T

A computational scheme for solving 2D Laplace boundary-value problems using rational functions as the basis functions is described. The scheme belongs to the class of desingularized methods, for which the location of singularities and testing points is a major issue that is addressed by the proposed scheme, in the context he 2D Laplace equation. Well-established rational-function fitting techniques are used to set the poles, while residues are determined by enforcing the boundary conditions in the least-squares sense at the nodes of rational Gauss–Chebyshev quadrature rules. Numerical results show that errors approaching the machine epsilon can be obtained for sharp and almost sharp corners, nearly-touching boundaries, and almost-singular boundary data. We show various examples of these cases in which the method yields compact solutions, requiring fewer basis functions than the Nyström method, for the same accuracy. A scheme for solving fairly large-scale problems is also presented.