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Conformal Mapping for the efficient MFS of Poisson equation

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Methods based on Radial Basis Functions (RBF) have been widely used for scattered data interpolation in higher dimension. In this article, we focus on using the RBF method for interpolating two dimensional functions with some degree of localization defined on irregular domains. The objective of our work is to combine an FFT-based fast RBF and conformal mapping to handle the irregular geometry, which uses centers inside the domain and on the boundary, direct circulant matrix except for using on a reference to the calculation result, this time requires some external point. We use conformal mapping to transform harmonic Dirichlet problems of Poisson equation which are defined in simply-connected domains into harmonic Dirichlet problems that are defined in the disk. We then solve the resulting harmonic Dirichlet problems efficiently using the method of fundamental solutions (MFS) and the method of the particular solution (MPS) in conjunction with fast Fourier transforms (FFTs). Finally four numerical examples in 2D are given to demonstrate circulant matrix and conformal mapping for the efficient Poisson solution.

Keywords: RBF, MFS, Poisson equation, conformal mapping, circulant matrix