A Fast Parallel Algorithm for the Poisson Equation on a Disk

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A parallel algorithm for solving the Poisson equation with either Dirichlet or Neumann conditions is presented. The solver follows some of the principles introduced in a previous fast algorithm for evaluating singular integral transforms by Daripa et al. [8,2]. Here we present recursive relations in Fourier space together with fast Fourier transforms which lead to a fast and accurate algorithm for solving Poisson problems within a unit disk. The algorithm is highly parallelizable and our implementation is virtually architecture-independent. Theoretical estimates show good parallel scalability of the algorithm and numerical results show the accuracy of the method for problems with sharp variations on inhomogeneous term. Finally, performance results for sequential and parallel implementations are presented.