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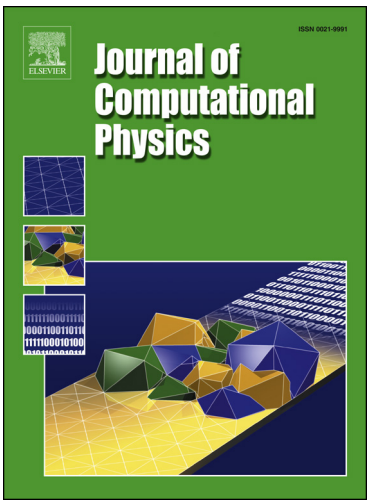

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Christopher R. Anderson

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High Order Expanding Domain Methods for the Solution of Poisson's Equation In Infinite Domains

Christopher R. Anderson[a,1]

[a]*Department of Mathematics, University of California,Los Angeles, Los Angeles, CA. 90095-1555*

Abstract

In this paper we present a discrete Fourier transform based procedure to evaluate the infinite domain solution of Poisson's equation at points in a rectangular computational region. The numerical procedure is a modification of an "expanding domain" type method where one obtains approximations of increasing accuracy by expanding the computational domain. The modification presented here is one that leads to approximations that converge with high order rates of convergence with respect to domain size. Spectrally accurate approximations are used to approximate differential operators and so the method possesses very high rates of convergence with respect to mesh size as well. Computational results on both two and three dimensional test problems are presented that demonstrate the accuracy and computational efficiency of the procedure.

Keywords: Poisson's Equation, infinite domain, spectral

1. Introduction

In this paper we present a numerical technique for the evaluation of the solution of Poisson's equation

$$\Delta u = f \qquad x \in \mathrm{R}^{\mathrm{N}} \qquad N = 2, 3 \tag{1}$$

at the grid points of a uniform discretization of a rectangular subregion $\Omega_0 \subset \mathrm{R}^{\mathrm{N}}$. It is assumed that f vanishes outside of Ω_0.

Email address: anderson@math.ucla.edu (Christopher R. Anderson)