Computational Topics on the Solution of Integral Equations

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Declaration

I, Srinath Kailasa, confirm that the work presented in this thesis is my own. Where information has been derived from other sources, I confirm that this has been indicated in the thesis.

Abstract

Integral equation methods are a powerful technique for the solution of the boundary value problems that arise from electromagnetic and acoustic scattering. This because they reduce problems defined over unbounded domains into ones defined by a boundary integral. The principle drawback of such methods is the dense linear matrices that must be either applied or inverted in the resulting linear system upon discretisation, depending on whether one is solving the forward or inverse problem. The past three decades have seen the development of techniques that allow for an accelerated forward and inverse application of these operator matrices, the initial innovation being the fast multipole method (FMM), which in the optimal case accelerates the forward application to $O(N)$. More recently, so called 'fast direct solvers' have emerged to calculate the operator inverse, again with a best case complexity of $O(N)$. The unification of software for the forward and backward application of these operators in a single set of open-source libraries is severely lacking, and is the central concern of this thesis. Where implementations exist they are fragmented, with a focus on a specific algorithm or problem area, with portions of code parallelised and compatible with distributed computing systems, with other portions being restricted to a single-node. This thesis aims to unify recently developed techniques for the accelerated forward and inverse application of the boundary integral operators in a unified set of fully distributed software libraries that are able to scale

Contents

Introduction

1.1 First Section

This is a reference [1].

Bibliography

[1] Denis Zorin Lexing Ying George Biros. "A kernel-independent adaptive fast multipole algorithm in two and three dimensions". In: *Journal of Computational Physics* 196.2 (2004), pp. 591–626. DOI: http://dx.doi.org/10.1016/j.jcp.2003.11.021.