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Chapter 1 : Solve a Dirichlet Problem for the Laplace Equation: New in Wolfram Language 11

MATHEMATICS OF COMPUTATION, VOLUME 31, NUMBER JANUARY , PAGES High Order Fast Laplace Solvers for the Dirichlet Problem on General Regions.

Fedkiw, Myungjoo Kang , " Interfaces have a variety of boundary conditions or jump conditions that need to be enforced. In [3], the Ghost Fluid Method GFM was developed to capture the boundary conditions at a contact discontinuity in the inviscid Euler equations. This method was extended to treat more general discontinui This method was extended to treat more general discontinuities such as shocks, detonations, and deflagrations in [2] and compressible viscous flows in [4]. In this paper, a similar boundary condition capturing approach is used to develop a new numerical method for the variable coefficient Poisson equation in the presence of interfaces where both the variable coefficients and the solution itself may be discontinuous. This new method is robust and easy to implement even in three spatial dimensions. We develop a method for computing a nearly singular integral, such as a double layer potential due to sources on a curve in the plane, evaluated at a point near the curve. The approach is to regularize the singularity and obtain a preliminary value from a standard quadrature rule. We then add cor We then add corrections for the errors due to smoothing and discretization, which are found by asymptotic analysis. We prove an error estimate for the corrected value, uniform with respect to the point of evaluation. This approach could also be used to compute the pressure gradient due to a force on a moving boundary in an incompressible fluid. Computational examples are given for the double layer potential and for the Dirichlet problem. Show Context Citation Context To solve the Dirichlet problem inside a curve, we write the solution as a double layer potential, solving an integral equation on the curve for the dipole moment. We introduce a grid A Cartesian grid method for solving the two-dimensional streamfunction-vorticity equations in irregular regions by Donna Calhoun - J. We describe a method for solving the two-dimensional Navierâ€"Stokes equations in irregular physical domains. Geometry representing stationary solid obstacles in the flow domain is embedded in the Cartesian grid and special discretizations near the embedded boundary ensure the accuracy of the solution in the cut cells. Along the embedded boundary, we determine a distribution of vorticity sources needed to impose the no-slip flow conditions. This distribution appears as a right-hand-side term in the discretized fluid equations, and so we can use fast solvers to solve the linear systems that arise. We show that our Stokes solver is second-order accurate for steady state solutions and that our full Navierâ€"Stokes solver is between first- and second-order accurate and reproduces results from well-studied benchmark problems in viscous fluid flow. Finally, we demonstrate the robustness of our code on flow in Show Context Citation Context In this sense, our approach is also related to the capacitance matrix method, de On the accuracy of finite difference methods for elliptic problems with interfaces by J. Thomas Beale, Anita T. In problems with interfaces, the unknown or its derivatives may have jump discontinuities. Finite difference methods, including the method of A. Mayo and the immersed interface method of R. Li, maintain accuracy by adding corrections, found from the jumps, to the difference operator a Li, maintain accuracy by adding corrections, found from the jumps, to the difference operator at grid points near the interface and modifying the operator if necessary. It has long been observed that the solution can be computed with uniform O h 2 accuracy even if the truncation error is O h at the interface, while O h 2 in the interior. We prove this fact for a class of static interface problems of elliptic type using discrete analogues of estimates for elliptic equations. Various implications are discussed, including the accuracy of these methods for steady fluid flow governed by the Stokes equations. Two-fluid problems can be handled by first solving an integral equation for an unknown jump. Numerical examples are presented which confirm the analytical conclusions, although the observed error in the gradient is O h 2. This approach is to compute the solution near S as a nearly singular int A numerical method for solving variable coefficient elliptic equation with interfaces by Songming Hou, Xu-dong Liu - J. A new 2nd order accurate numerical method is proposed for solving the variable coecient elliptic equation in the presence of interfaces where the variable coecients, the source term, and hence the solution itself and its derivatives may be discontinuous. Jump conditions at interface are prescribed. The boundary and the interface are only required to be Lipschitz continuous instead of smooth, and the interface is allowed to intersect with the boundary. The method is derived from a weak formulation of the variable coecient elliptic equation [12]. Numerical experiments show that the method is 2nd order accurate in L norm. By using Fredholm integral equation of the second kind, solutions can be extended to a recta A grid-based boundary integral method for elliptic problems in three dimensions by J. Anal , " We develop a simple, efficient numerical method of boundary integral type for solving an elliptic partial differential equation in a three-dimensional region using the classical formulation of potential theory. Accurate values can be found near the boundary using special corrections to a s Accurate values can be found near the boundary using special corrections to a standard quadrature. We treat the Dirichlet problem for a harmonic function with a prescribed boundary value in a bounded three-dimensional region with a smooth boundary. The solution is a double layer potential, whose strength is found by solving an integral equation of the second kind. The boundary surface is represented by rectangular grids in overlapping coordinate systems, with the boundary value known at the grid points. A discrete form of the integral equation is solved using a regularized form of the kernel. Once the dipole strength is found, the harmonic function can be computed from the double layer potential. For points close to the boundary, the integral is nearly singular, and accurate computation is not routine. We calculate the integral by summing over the boundary grid points and then adding corrections for the smoothing and discretization errors using formulas derived here; they are similar to those in the two-dimensional case given by [J. With a total of N points, the calculation could be done in essentially O N operations if a rapid summation method is used. Similarly, fast summation could be used to produce the values of the harmonic function. Zorin , " We present a kernel-independent, adaptive fast multipole method FMM of arbitrary order accuracy for solving elliptic PDEs in three dimensions with radiation boundary conditions. The performance of the FMM is accelerated in two ways. First, we construct a piecewise polynomial approximation of the right-hand side and compute far-field expansions in the FMM from the coefficients of this approximation. Second, we precompute tables of quadratures to handle the near-field interactions on adaptive octree data structures, keeping the total storage requirements in check through the exploitation of symmetries. We present numerical examples for the Laplace, modified Helmholtz and Stokes equations. While this is a significant improvement in terms of range of applicability over classical fast solvers, these methods require a regular volume mesh on which is superimposed an irregular boundary. Boundary integral equations are an efficient and accurate tool for the numerical solution of elliptic boundary value problems. The solution is expressed as a layer potential; however, the error in its evaluation grows large near the boundary if a fixed quadrature rule is used. Our main result is a simple and efficient scheme for accurate evaluation up to the boundary for single- and double-layer potentials for the Laplace and Helmholtz equations, using surrogate local expansions about centers placed near the boundary. Klein , "

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Chapter 2 : Victor Pereyra (Author of Least Squares Data Fitting with Applications)

High Order Fast Laplace Solvers for the Dirichlet Problem on General Regions by Victor Pereyra Easy Mathematics, or Arithmetic and Algebra for General Readers Being an Elementary Treatise Addressed to Teachers, Parents, Self-Taught Students, and Adults by Oliver Lodge.

Williams, Kevin Amaratunga - J. APPL , " For example, significant compression can be achieved through the use of the DWT. A fundamental problem with the DWT, however, is the treatment of finite length data sequences. Commonly used techniques such as circular convolution and symmetric extension can produce undesirable edge effects which propagate into the interior of the transformed data as the number of DWT iterations increases. The underlying idea is to extrapolate the data at the boundaries by determining the coefficients of a best fit polynomial through data points in the vicinity of the boundary. This approach can be regarded as a solution to the problem of orthogonal wavelets on an interval. However, it has the advantage that it does not involve the explicit construction of boundary wavelets. The extrapolated DWT is designed to be well conditioned and to produce a critically sampled output. The methods we describe are equally applicable to biorthogonal wavelet bases. Knyazev - Pennsylvania State University , " We consider a family of symmetric matrices A! B; with a nonnegative definite matrix A 0 ; a positive definite matrix B; and a nonnegative parameter! For solving linear algebraic equations with the matrix For solving linear algebraic equations with the matrix A! We show that a proper choice of the initial guess makes possible keeping all residuals in the subspace Im A 0: Using this property we estimate, uniformly in! Algebraic equations of this type arise naturally as finite element discretizations of boundary value problems for PDE with large jumps of coefficients. Show Context Citation Context We have to note that the proof of the mesh extension theorem in [1] is not correct. The importance of the idea of iterative methods in a subspace is widely recognized in the theory of the domain decomposition methods, e. Preconditioned Iterative Methods for the symmetric A major problem associated with the use of wavelets in time is that initial conditions are difficult to impose. A second problem is that a wavelet-based time integration scheme should be stable. We address both of these problems. Firstly, we describe a general method of imposing initial conditions, which follows on from some of our recent work on initial and boundary value problems. Secondly, we use wavelets of the Daubechies family as a starting point for the development of stable time integration schemes. By combining these two ideas we are able to develop schemes with a high order of accuracy. Furthermore, these time integration schemes are characterized by large regions of absolute stability, comparable to increasingly high order BDF methods. In particular, Daubechies D4 and D6 wavelets give rise to A-stable time-stepping schemes. In the present work we deal with single scale formulations.

Chapter 3 : high_order_fast_laplace_solvers_for_the_dirichlet_problem_on_general_regions

*High order fast Laplace solvers for the Dirichlet problem on general regions [Pereyra Pereyra, Wlodzimierz Proskurowski, Olof Widlund] on blog.quintoapp.com *FREE* shipping on qualifying offers. This is a reproduction of a book published before*

Chapter 4 : HIGH ORDER FAST LAPLACE SOLVERS FOR THE DIRICHLET PROBLEM ON GENERAL R

Excerpt from High Order Fast Laplace Solvers for the Dirichlet Problem on General Regions Numerical experiments, see Pereyra [13] and the last section of this paper, clearly demonstrate the need for higher order accuracy at the irregular mesh points if improved solutions through Richardson extrapolation or deferred correction methods are required.

Chapter 5 : The Inverse Laplace Transform of an Exponential Function

HIGH ORDER FAST LAPLACE SOLVERS FOR THE DIRICHLET PROBLEM ON GENERAL REGIONS. Author(s): Pereyra, V. et al. Main Content Metrics Author & Article Info.

Chapter 6 : High Order Fast Laplace Solvers for the Dirichlet Problem on General Regions

Highly accurate finite difference schemes are developed for Laplace's equation with the Dirichlet boundary condition on general bounded regions in R/sup n/.

Chapter 7 : AMS :: Mathematics of Computation

High Order Fast Laplace Solvers for the Dirichlet Problem on General Regions ().