NUMERICAL SOLUTION OF THE CAUCHY PROBLEM FOR 3D POISSON EQUATION USING FINITE DIFFERENCE METHOD

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In this paper, we will solve the ill-posed Cauchy problem for the three-dimensional Poisson equation with the data given on the part of the boundary (a continuation problem) using Finite difference method in a unit cube. It is a known fact that finite difference schemes are used to discretize the PDEs resulting in a broad and sparse system of linear equations. Several studies involving iterative methods were proposed against direct methods for solving any linear system of equations to speed up the convergence rate due to the wide range of linear systems. To solve the linear system more effectively by using the iterative methods, efficient splitting of the coefficient matrices are required.

In this work, Jacobi, Gauss-Seidel and SOR(α_{opt}) iterative methods are presented. Some convergence results are derived using MATLAB software when the coefficient matrices are irreducible and diagonal dominant. The SOR(α_{opt}) method has been shown to be much faster than the Jacobi and Gauss-Seidel iterative methods which is due to the less number of iterations and the overall lower computational time. Finally, a numerical example is presented to illustrate the reliability and efficiency of the proposed method. Numerical example with a graphical behavior of the spectral radius of the corresponding iteration methods are discussed. This approach is relatively promising and will help in the determination of a numerical solution of boundary value problems.

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