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A Sixth Order Finite Difference Computation with Multigrid Method and Extrapolation for 2D Poisson Equation

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We develop a sixth order finite difference discretization strategy to solve the two dimensional Poisson equation, which is based on the multigrid method, Richardson extrapolation and an operator interpolation scheme. Our modified multigrid algorithm, which is similar to the full multigrid method (FMG), can yield the fourth order approximate solution on both the fine grid and the coarse grid. Then we apply the Richardson extrapolation to compute a sixth order accurate coarse grid solution. The sixth order accurate fine grid solution can be computed by using an operator interpolation scheme. Numerical experiments are conducted to show the accuracy and efficiency of our new method, compared to the sixth order Richardson extrapolation compact (REC) discretization strategy using Alternating Direction Implicit (ADI) method and the standard fourth order compact difference (FOC) scheme using multigrid method.