

Project 1 for Parallel Computation

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This file is to further explain the C file for the final project of Parallel Computation. The problem was to solve a non-linear PDE:

$$-\nabla^2 u + u^3 = f$$

The region for the problem was: $x, y, z \in [-\pi, \pi]$. The boundary condition for the problem was periodic boundary condition. Since the PDE was non-linear, we used iterations to solve the problem. We solved:

$$-\nabla^2 u_{n+1} + u_n^3 = f$$

We were required to write a parallel function for fft (because we were not allowed to use fft packages), and use this function to solve the problem. However, when using fft to solve the problem, the constant (frequency was 0) after the fft couldn't be specified, and since the PDE was non-linear, the constant was crucial for next step. I used the following way to specify the constant. Supposed the constant was 0, and we used ifft to get an 'fake solution' u , which had a difference of a constant with the real solution, then we used:

$$\int_V f dV = \int_V (u + C)^3 dV$$

to get the constant C by solving a cubic equation.