AMATH 581: Homework 3

November 5, 2018

Problem 1

A is a numerical approximation to the Laplacian: $\partial_x^2 + \partial_y^2$.

- use the five point stencil (second-order central difference)
- $\Delta x = \Delta y = (10 - (-10))/n = 20/8$.
- A is $N \times N$, where $N = 8 * 8 = 64$.
- For derivation: see notes page 36-38. Code sample: page 55-56.

Problem 1

B is an approximation to the operator: ∂_x, C approximates ∂_y.

- use the second-order approximation:

$$\frac{\partial \omega}{\partial x} = \frac{\omega(x + \Delta x, y) - \omega(x - \Delta x, y)}{2\Delta x}$$

$$\frac{\partial \omega}{\partial y} = \frac{\omega(x, y + \Delta y) - \omega(x, y - \Delta y)}{2\Delta y}$$

- B and C are 64×64.
- Derivation: notes page 60-61.

Problem 2

- Fmat is a Fourier matrix of size 400×400.
- Only the center piece (80×80) should be permuted back. The center $\text{Fmat}(161:240, 161:240)$ is divided into 16 blocks of size 20×20.
- Use the permutation vector to permute these 16 blocks. i.e. place the 7^{th} block in the location of the first block, place the 11^{th} block in the location of the second block, etc.
- Take the absolute value of the permuted Fmat and save as A4.dat

Problem 2

- Use ifftshift to shift the permuted matrix (without absolute value) from center to corners.
- Use ifft2 to perform inverse Fourier transform.
- Take the absolute value of the transformed matrix and save as A5.dat
- To visualize, use uint8(abs(transformed matrix)).