Assignment (due online on Sunday, 2020/5/10)

不用寫報告，線上繳交要求結果圖和程式碼即可（因為程式應該會寫很久）。

For this assignment, you **do not** need to write a report. Just make sure your code works, generate the required plots, and attach your code. There will be a lot of coding – extending your 1DH code to 2DH can be time-consuming!

1. Use the fourth-order central difference scheme in space and the third-order Strong Stability-Preserving Runge-Kutta (SSP-RK) scheme in time to develop a numerical solver for the 2DH LSWE. See the lecture notes for 2020/4/27 for reference.

2. Simulate the radial spreading of a wave in a constant water depth of $h(x,y) = h_0 = 10$ m. The initial conditions are

$$\begin{aligned} \eta(x,y,0) &= H \exp\Big[-18(\frac{x}{L})^2\Big] \exp\Big[-18(\frac{y}{L})^2\Big] \\ U(x,y,0) &= V(x,y,0) = 0 \end{aligned} \quad . \tag{1}$$

   where $H = 1$ m is the wave height, and $L = 100$ m is the wavelength.

   The numerical domain to consider is

$$\begin{cases} -300 \text{ m} \ \le x \le 300 \text{ m} \\ -300 \text{ m} \ \le y \le 300 \text{ m} \\ \quad 0 \text{ s} \ \le t \le 20 \text{ s} \end{cases} \quad . \tag{2}$$

3. Show three snapshots of the wave fields at $t = 0$ s (the initial condition), $t = 10$ s, and $t = 20$ s; namely, $\eta(x,y,0)$, $\eta(x,y,10)$, and $\eta(x,y,20)$. There are many different ways to plot these results, which are surfaces. Feel free to experiment with different plotting methods. My results are shown in Figure 1 for reference.

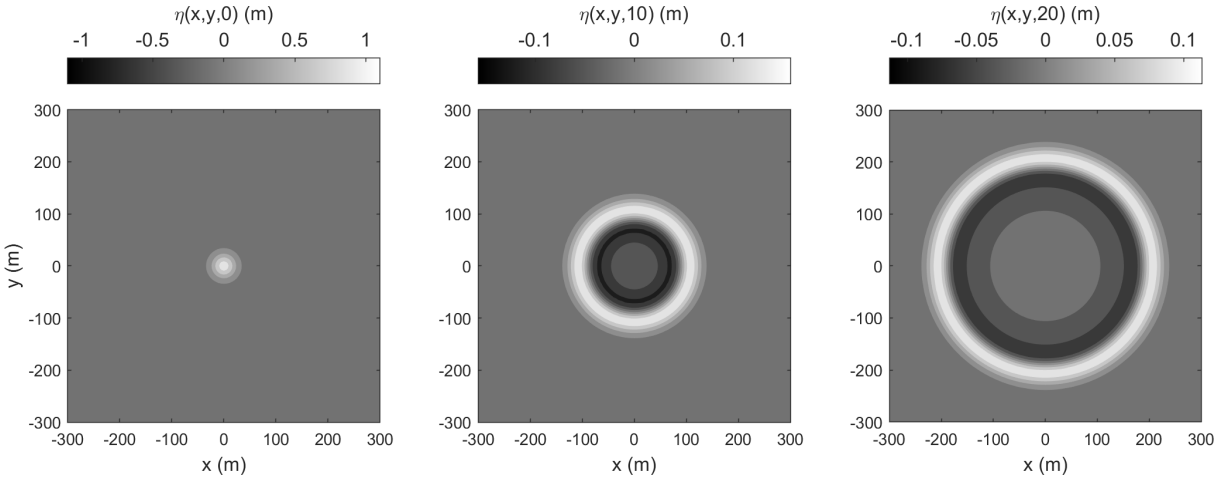

Figure 1: Snapshots of the wave fields at $t = 0$ s, $t = 10$ s, and $t = 20$ s.

Tips

1. No idea how to start? You can try

$$\Delta x = \Delta y = 5 \text{ m} , \quad \Delta t = 0.05 \text{ s}. \tag{3}$$

2. If your code takes too long to run, or you just want to test your code fast, you can reduce your numerical domain. For example, use

$$\begin{cases} -150 \text{ m} \ \leq x \leq 150 \text{ m} \\ -150 \text{ m} \ \leq y \leq 150 \text{ m} \\ \quad 0 \text{ s} \ \leq t \leq 5 \text{ s} \end{cases} \tag{4}$$

   during code development and debugging.

3. For these numerical domains, the wave will not reach the boundaries, so you don't have to worry about the boundary conditions for now. Any boundary condition, even an incorrect one, will work.

4. In MATLAB, you can choose to store the 3D results as arrays – "eta(yi,xi,ti)", or as cells – "eta{ti}(yi,xi)". Also, you can use the command "[X, Y]=meshgrid(x,y);" to generate coordinate matrices X and Y from the vectors x and y.

5. If you have extra time, try to implement and test the different boundary conditions. You can also try simulating only half (1/2) or a quarter (1/4) of the circular wave, making use of symmetry and appropriate mirror boundary conditions.