

PHYS 8750**HW3****Spatial filtering (Chapter 3) and staggered grid (Chapter 4)****Due October 13, 2020**

1. Refer to the code “Advection_PDE_RK_2rdSpace_LaxWen_Takacs_stability_2.m” and subroutines, modify the codes to adopt the numerical schemes with Runge Kunta 4-th order time difference, 4-th order centered-space scheme, equipped with 4th- and 6th-derivative spatial filtering, respectively. Compare the results with 3rd order and 4th Takacs’s methods.

You can do this problem by two steps as follows:

1) Repeat the results from these four different schemes for triangle and spike functions as shown during the class. Discuss what you find.

2) Change the wave functions to step function and superposition of sinusoidal waves, run the same codes and compare the results from these four different schemes. Describe what you find.

2. In the code “ShallowWater_PDE_Stagger_HW.m”, there are three numerical schemes: (i) leap-frog time and centered space, (ii) leap-frog time and centered space with staggered grid in space; and (iii) leap-frog time and centered space with staggered grids in both space and time. Use the code “ShallowWater_PDE_Stagger_HW.m” and practice the following modifications:

1) Set $Um = 0$, compare the runs using $\Delta t = 0.25$ with $\Delta t = 0.55$, comment on the differences among the three schemes.

2) Set Um to be a nonzero number, compare the model results.

3) Summarize the limitation and advantage of each scheme.