## 11.4 Activity 1

In Activity 1, you set up, compiled and ran a 1D (1-dimensional) test problem with the PLUTO MPI code. In this activity you will test the Rayleigh-Taylor instability in 2D. The initial condition consists of an interface separating two fluids with different densities in hydrostatic equilibrium. As the fluids fall into each other an instability ensues.

At this point, it may be useful to browse the documentation for the PLUTO Test Problems: <http://plutocode.ph.unito.it/Doxygen/Test_Problems/files.html>

<http://plutocode.ph.unito.it/Doxygen/Test_Problems/_m_h_d_2_rayleigh___taylor_2init_8c.html>

username@h2ologin2: cd $PLUTO\_DIR/Test\_Problems/MHD/Rayleigh\_Taylor

username@h2ologin2: cp pluto\_01.ini pluto.ini

username@h2ologin2: cp definitions\_01.h definitions.h

username@h2ologin2: vi pluto.ini

[Static Grid Output]

uservar 0

dbl -1.0 -1 single\_file

dbl.h5 -1.0 -1

flt -1.0 -1 single\_file

flt.h5 -1.0 -1

vtk 1.0 -1 single\_file

tab -1.0 -1

ppm -1.0 -1

png -1.0 -1

log 10

analysis -1.0 -1

username@h2ologin2: python $PLUTO\_DIR/setup.py

Select Linux.mpicc.defs and Auto-update. Make pluto, remove unneeded object files, cp your old qsub file, and run job.

username@h2ologin2: make

username@h2ologin2: make clean

username@h2ologin2: cp $PLUTO\_DIR/Test\_Problems/HD/Sod/pluto.pbs .

username@h2ologin2: qsub pluto.pbs

username@h2ologin2: qstat <job>.bw

When your job completes, MPI should produce a log file for each processor (32) and 15 vtk files obtained at 1-second intervals during the simulation. We will visualize this output next time.

For now, check one of the .log files, and one of the pluto.o<job> files.

1. How long did the simulation take?
2. What was the resolution of the grid X-Y grid?
3. The simulation stopped after tstop=15.0 (these are code time units). How long (walltime) would the computation have taken for tstop=20?
4. Imagine you were to double the number of grid points in X and Y. How long (walltime) would the computation have taken for tstop=20?

We will now modify our problem, and rerun the simulation. Before we do that. Let’s save our results from before in a directory called run1.

username@h2ologin2: mkdir run1

username@h2ologin2: mv \*.out \*.log \*.vtk pluto.o\* pluto.e\* run1

username@h2ologin2: cp pluto.ini definitions.h run1

Now edit the pluto.ini file, and repeat the prior steps. You will only need to modify the Grid block and the Time block:

username@h2ologin2: vi pluto.ini

[Grid]

X1-grid 1 -0.5 512 u 0.5

X2-grid 1 -1.0 1024 u 1.0

X3-grid 1 -0.5 1 u 0.5

[Time]

CFL 0.8

CFL\_max\_var 1.1

tstop 20.0

first\_dt 1.e-3

username@h2ologin2: python $PLUTO\_DIR/setup.py

Select Auto-update.

username@h2ologin2: make

username@h2ologin2: make clean

How long (walltime) do you think this computation will take? Make sure that your walltime parameter in pluto.pbs is longer than you estimate.

username@h2ologin2: qsub pluto.pbs

username@h2ologin2: qstat <job>.bw

Now, check one of the .log files, and one of the pluto.o<job> files. How long did the simulation take? How good was your estimate?

### Optional Exercise

For the curious, you can try different methods for solving this problem. See:

<http://plutocode.ph.unito.it/Doxygen/Test_Problems/_m_h_d_2_rayleigh___taylor_2init_8c.html>

For example, try initialization 03:

username@h2ologin2: cp pluto\_03.ini pluto.ini

username@h2ologin2: cp definitions.h

Now edit the pluto.ini file, and repeat the prior steps. You will only need to modify the Grid block and the Time block:

username@h2ologin2: vi pluto.ini

[Grid]

X1-grid 1 -0.5 512 u 0.5

X2-grid 1 -1.0 1024 u 1.0

X3-grid 1 -0.5 1 u 0.5

[Time]

CFL 0.45

CFL\_max\_var 1.1

tstop 20.0

first\_dt 1.e-3

username@h2ologin2: python $PLUTO\_DIR/setup.py

username@h2ologin2: make

username@h2ologin2: make clean

Make sure that your walltime parameter in pluto.pbs is at least 30 minutes. Try using 2 nodes, 64 cores, 1 task per core.

username@h2ologin2: vi pluto.pbs

#!/bin/bash

#PBS -l nodes=2:ppn=32:xe

#PBS -l walltime=00:30:00

#PBS -N pluto

cd $PBS\_O\_WORKDIR

aprun -n 64 ./pluto

username@h2ologin2: qsub pluto.pbs

username@h2ologin2: qstat <job>.bw