:::PLUTO:::
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PLUTO solves mass, momentum and energy conservation equations with induction equation (for MHD module). Equations are given in userguide.pdf (page-50/51).

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evince $PLUTO_DIR/Doc/userguide.pdf
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Rayleigh Taylor Instability (RTI) ::
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We will study Rayleigh Taylor Instability (RTI) using PLUTO.

The initial condition consists of an interface separating two fluids with different densities in hydrostatic balance:

density condition: i) RHO = ETA for y>=0 ii) RHO = 1 for y<0 [here RHO = mass density, y = vertical height]

Pressure : P = P0 + RHO*y*g [here, P0 = value of the pressure at the interface, g = (constant) gravity pointing in the negative y direction]

The value of P0 is chosen in such a way that the sound speed in the light fluid is 1. The horizontal extent of the computational domain defines the unit length: Lx=1.

For magnetized setups, the magnetic field is purely horizontal:

B = (CHI* B_c,0,0) here B_c = ((ETA-1)*Lx*|g|)**0.5

where B_c is the critical magnetic field above which perturbations parallel to the magnetic field are suppressed.

Task 1 :- Hydro RTI

STEP :: 0a ===> STEP :: 1A.Ia. ===> STEP :: 1A.II. ===> STEP :: 2 ===> STEP :: 3 ===> STEP :: 4

Task 2 :- MHD RTI

(STEP :: 0a ===>) STEP :: 1A.Ib. ===> STEP :: 1A.II. ===> STEP :: 2 ===> STEP :: 3 ===> STEP :: 4

Task 3 :- OWN RTI

(STEP :: 0a ===>) STEP :: 1B. (===> STEP :: 1A.II.) ===>
STEP :: 2 ===> STEP :: 3 ===> STEP :: 4

//****STEPS****\\\
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STEP :: 0 Basic requirements :
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STEP :: 00 To run pluto:

Edit ~/.bashrc to source the following path:
source /data1/student/cpbera/mag_work2015/magws_bash
(This editing has been done, reediting is not required.)

STEP :: 0a Working Directory:
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cd ~/MHD/Rayleigh_Taylor

****
STEP :: 1 Problem setup:
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STEP :: 1A. QUICK setup
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A few HD and MHD Raleigh Taylor Instability (RTI) setups are already
there in the folder "~/MHD/Rayleigh_Taylor". Copy any of the
following two setups.

STEP :: 1A.Ia. Hydrodynamic setup :
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cp definitions_03.h   definitions.h
cp pluto_03.ini   pluto.ini

STEP :: 1A.Ib. MHD setup :
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cp definitions_07.h   definitions.h
cp pluto_07.ini   pluto.ini

STEP :: 1A.II. execute python setup :
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python $PLUTO_DIR/setup.py
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[Change makefile : Linux.mpicc.defs (for non-mpirun----> Linux.gcc.defs)]

STEP :: 1B. OWN setup
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modify a) definitions.h, b) pluto.ini, and c) init.c to create your own setup. [****use PLUTO User's Guide for better description]

a) definitions.h: This header file is created by Python script setup.py by selecting "Setup problem" option. If this header file is already there python will read given options/values which can be modified. Here one can setup the problem from different options as i) PHYSICS (HD/MHD/RHD/RMHD) ii) DIMENSIONS & COMPONENTS (1D/2D/3D) iii) GEOMETRY (CARTESIAN/CYLINDRICAL/POLAR/SPHERICAL) iv) BODY_FORCE (VECTOR/POTENTIAL) v) INTERPOLATION (FLAT/LINEAR/PARABOLIC/...) vi) TIME_EVOLUTION (EULER/RK2/RK3/....) vii) USER_DEF_PARAMETERS (number of parameters and names) and others.

Three user define parameters are i) ETA : density ratio, ii) GRAV : gravitational acceleration and iii) CHI : magnetic field strength compared to critical field strength.

b) pluto.ini : This initialization file contains different blocks associated with different fields as i) [Grid] ii) [Chombo Refinement] iii) [Time] iv) [Solver] v) [Boundary] vi) [Static Grid Output] vii) [Chombo HDF5 output] viii) [Parameters].

RTI setup will be studied for ETA=2.0 and GRAV=-1.0.

We will mainly modify following parts in 'pluto.ini'
i) for magnetic RTI the value of 'CHI' (magnetic field strength compared to critical field) in [Parameters]
ii) time interval between consecutive outputs in [Static Grid Output]. e.g. for "dbl 15.0 -1 single_file", time interval is 15.0 unit.
iii) evolution time 'tstop' in [Time], e.g. "tstop 15.0" sets the termination of the evolution at t=15.0 unit.

c) init.c : The Init() function is used to assign the initial condition as a function of the spatial coordinates.

For this problem initial values of i) mass density ii) velocity and ii) magnetic field (for MHD) are specified. Initial mass density is calculated from the value of 'ETA' and static condition is perturbed using perpendicular (to the interface) velocity component. For magnetic condition with field components (BX1,0,0), x-component of field i.e. uniform BX1 is calculated form the given 'CHI' value.

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STEP :: 2 To Create output and Executable:
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make

It will create *.o and pluto files.

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STEP :: 3 To run executable pluto:
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bsub -n32 -J wd -o out_%J -e err_%J mpirun ./pluto

If job is submitted properly it will show a message like
"Job <44xxx> is submitted to default queue <normal>."

To know the update use "tail pluto.log".

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STEP :: 4 Data visualization:
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A. GUI_pyPLUTO.py

"GUI_pyPLUTO.py" on terminal will create an interactive window which can be used to plot snapshot data files. On the left bottom, the information related data files are given (e.g. Domain, Nlast: last data file number, Loaded Nstep: the no. of data file loaded, Present time : evolution time of the loaded data). 'Load data' with the specific data file number, then Choose one of the given variables (e.g. rho, vx1, vx2, prs etc) and 1D/2D plot options. It will create 1d/2d plot which can be saved.

B. Plot magnetic field lines

C. Create Movie

D. Result quantification

//****END****\\\\\
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