Instructions for Downloading, Compiling, and Running MHDCLAW by J.A. Rossmanith

DISCLAIMER:

Step 1. Download CLAWPACK source code (first-time users please register):

http://www.amath.washington.edu/∼claw/

Detailed instructions can be found at

http://www.amath.washington.edu/∼claw/doc/clawuser.pdf

Step 2. Download MHDCLAW source code:

http://www.math.wisc.edu/∼rossmani/MHDCLAW/

Step 3. Configure and compile MHDCLAW main library:

- Create a path to MHDCLAW. For example in bash you would modify your .bashrc file by adding a line of the following form:

  export MHDCLAW = /XXXX/YYYYY/MHDCLAW

  where XXXX and YYYY need to be replaced by the correct sub-directories.
- Move into MHDCLAW library directory: cd $MHDCLAW/lib/
- Compile by typing: make

Step 4. Compile and run one of the examples:

- Change directories to one of the examples. For example type:

  cd $MHDCLAW/2d/rotor/

- Compile by typing: make
- Run by typing: ./xclaw
- After completion the code will have created several output files in the current directory

Step 5. Plot the results. For each example MATLAB scripts from the `CLAWPACK` `matlab` directory can used to visualized the results. If MATLAB (`http://www.mathworks.com`) is available to you:

- Open MATLAB and move into the correct `MHDCLAW` example directory.
- For 1D erxamples execute the plotting script by typing: `plotclaw1`
- For 2D erxamples execute the plotting script by typing: `plotclaw2`

NOTE: the MATLAB scripts will only execute after you have downloaded the `CLAWPACK` software packages and have set the correct MATLAB path according to the `CLAWPACK` instructions:

`http://www.amath.washington.edu/~claw/doc/clawuser.pdf`.

Step 6. Modify the input files. There are two main input files that can be modified for your specific problem:

`claw2ez.data` – Set number of points, CFL number, ... (see `CLAWPACK` instructions for more details)

`setprob.data` – Set parameter values. All the included examples have the parameters described below. Some examples have additional parameters (see specific examples for more details).

1. `gamma`: (sets the gas constant for the MHD fluid)
2. `meth`: an integer that when set to 0 will use `CLAWPACK` without constrained transport, otherwise it will use constrained transport.
3. `limi`: sets the limiter to be used in the constrained transport step (0 - no limiter, 1 - minmod limiter, 2 - superbee limiter, 3 - van Leer limiter, and 4 - monotonized centered limiter). See `CLAWPACK` instructions for more details.
4. `model`: this should be set to 1 if solving the shallow water MHD equations (currently no examples of this are included in the distribution) and 2 if solving the MHD equations.
5. `pressure_fix`: on can either have

   OPTION 1: $E^\star = E^{n+1}$ (keep energy the same in unconstrained and new time step)
   OPTION 2: $p^\star = p^{n+1}$ (keep pressure the same in unconstrained and new time step)

   The first option guarantees exact energy conservation, the second does not. However, the second is very useful in some applications including in low beta plasma flows. In such applications option 2 is significantly more stable. Set `pressure_fix = 0` if you want option 1 and set `pressure_fix = 1` if you want option 2.

For more information we refer you to the article:

J.A. Rossmanith, An unstaggered, high-resolution constrained transport method for magnetohydrodynamic flows. *SIAM J. Sci. Comp.*, Volume **28**:1766–1797, 2006.