

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

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```
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```

Step 1. Download CLAWPACK (version 4.3) source code:

<http://depts.washington.edu/clawpack/clawpack-4.3/>

Detailed instructions can be found at

<https://depts.washington.edu/clawpack/users/index.html>

Step 2. Download MHDCLAW source code:

<http://dogpack-code.org/clawpack/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 be used to visualize the results. If MATLAB (<http://www.mathworks.com>) is available to you:

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

<https://depts.washington.edu/clawpack/users/index.html>.

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 - monotized 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`: one can either have

OPTION 1: $E^* = E^{n+1}$ (keep energy the same in unconstrained and new time step)

OPTION 2: $p^* = p^{n+1}$ (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. Rossmannith, An unstaggered, high-resolution constrained transport method for magnetohydrodynamic flows. *SIAM J. Sci. Comp.*, Volume **28**:1766–1797, 2006.