

Hydropad Manual

Version 1

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1. Installation

The installation procedure in Hydropad uses the GNU auto-tools (`autoconf`, `automake` and `libtools`) and `Makefile` to help the user to compile and install properly the application. The auto-tools generate a `configure` shell script that automatically check if the computer contains all the necessary programs and libraries to compile the application. At this point of development Hydropad was tested only in a x86 platform with a Linux environment.

Hydropad computational code is written in Fortran 90 while the kernel is written in C language. To be able to compile Hydropad the host machine needs to have these two compilers installed. Hydropad uses the library FFTW, in the gravitational task, to compute the discrete Fourier transform. The `configure` script check if this library is installed in the host machine. If this is not the case the package contains a x86 version of the library.

Hydropad application is composed of three executable files: `hydropad_seq`, `hydropad_gs`, `hydropad_smart`. The first file is the original Hydropad application, it executes the computation sequentially in a local computer. The other two executables use the GridRPC protocol to compute the different tasks of Hydropad in a Grid environment. The difference between the two files is that the `hydropad_gs` uses the standard middleware GridSolve while the `hydropad_smart` utilises SmartGridSolve middleware that introduces new extensions in GridRPC. The last two executables need to be compiled with the GridSolve and SmartGridSolve libraries, if the host machine does not contain these libraries only the sequential executable will be generated. The configure shell script will automatically check the presence of these libraries.

The various computational tasks, to be used inside GridSolve or SmartGridSolve, need to be compiled using the special GridSolve problem compiler. The problem compiler, to include a task inside the Grid environment, need the libraries that contain the code of the task and a `gsIDL` file that describe the task. The Hydropad package contains the libraries and `gsIDL` file necessary to do this operation furthermore it contains a specific `makefile` command to simplify this operation.

The installation procedure is composed of the following steps:

1. Retrieve the package `hydropad-1.tar.gz` from the hcl website repository (`hcl.ucd.ie`) and unpack the files in a local directory with the shell command:

```
$cd /path/local/  
$tar xzfv hydropad-1.tar.gz
```

2. Execute the configure shell script to generate the makefile:

```
$. /configure --prefix=/path
```

With the argument `-prefix=/path` is possible to choose the directory where to install Hydropad. The default location is `/usr/local`, the user need to have the right to write in this directory to install the application. The GridSolve and SmartGridSolve libraries have to be installed in the machines to generate the respective executables. If the configure script find the libraries it will print the following message:

```
checking for grpc.h... yes
checking for GridSolve library... yes
checking for GridSolve... yes
checking for gs_smart_clib.h... yes
checking for SmartSolve library... yes
checking for SmartSolve... yes
```

3. Compile the application with the command:

```
$make
```

4. Install the Hydropad libraries and executables with the command:

```
$make install
```

To run the application, the directory that contain the executables file need to be included in the environment variable “\$PATH” while the directory that contains the libraries has to be included in the variable “\$LD_LIBRARY_PATH”.

5. Compile the tasks problems to include the Hydropad tasks inside GridSolve or SmartGridSolve with the command:

```
$make services
```

Other than the three version of the Hydropad executable, the package contains also another application, *grafic*. This application is used to generate the initial computational value and it is utilised by the task *usegrafic*. To be able to run Hydropad with GridSolve/SmartGridSolve, the *grafic* file need to be executable in each server included in the Grid environment. Consequently for each server the *grafic* file has to be installed and the directory that contains it has to be inserted in the environment variable “\$PATH”. After this procedure the Hydropad application is ready to be executed sequentially or with GridSolve/SmartGridSolve.

2. Execution

The Hydropad application needs a specific input file that contains the initial value of some of the physics variables used in the simulation. The name of this file is passed at command line by using the specific argument “*-input*”. Table 1 shows an example of the input file. The most important values are the third and forth one. The Third value indicate the number of particles utilised in the dark matter *N-Body* method while the fourth value indicate the number of cells for grid used for the

Table 1. Input file used in Hydropad

```
LCDM # Cosmological model
Michele Guidolin # Owner of the simulation
64 # Numper of particles, Nparmax = Np^3
64 # Ng Grid sides size, X Y Z
30.0 # Box size (Mpc/h)
0.71 # Huble parameter
0.226 # Omega dark matter
0.044 # Omega baryonic matter
0.73 # Cosmological constant
0.01 # Present BM average temperature
0.75 # Hydrogen mass fraction
0.948 # Long-wave spectral index
0.772 # Desired normalization
314159265 # Random number seed (9-digit integer)
```

baryonic matter in the simulation. Bigger are these two values and more precise is the simulation but more memory is used and the computation take more time.

Hydropad cannot work with any values for these two variables. The values have to be even and the number of particles does not have to be more than double the number of cell for side grid. Table 2 shows an example of acceptable value and the quantity of memory used to run the application.

Table 2. Example of input values and problem sizes for Hydropad

Np	Ng	Data Size
120	60	73MB
140	80	142MB
160	80	176MB
140	100	242MB
160	100	270MB
180	100	313MB
200	100	340MB
220	120	552MB
240	120	624MB

Hydropad uses other arguments in the command line to change the behaviour of the application. The arguments are:

- input** chose the input file;
- notsc** use faster CIC for interpolation instead of the slower triangular shaped clouds;
- nmap** number of SmartGridSolve map;
- cycles** number of cycles for SmartGridSolve map or total number of cycles in the simulation.

The following example execute a local sequential computation of Hydropad with the input file of table 1 and 10 cycles of evolution in the simulation.

```
$hydropad_seq --input input.in --cycles 10
```