

# README

## Description

The programme developed is responsible for generating appropriate initial conditions and solving a two-dimensional smoothed particle hydrodynamic (SPH) formulation of the Navier-Stokes equations. The files that participate in that process are:

- main-SPH.cpp
- class.cpp
- class.h
- Makefile

The running process will result in two files:

- One for the Energies at each time step
- One for the final positions of the particles

## Compiling

In order for the user to compile the programme, the command “make” has to be typed in the command line. The compiling process will result in an executable file called “SPH-SOLVER”.

## Proper execution

Upon executing “SPH-SOLVER”, the user should insert four command line arguments:

- One for the initial condition (--ic-dam-break, --ic-block-drop, --ic-droplet, --ic-one-particle, --ic-two-particles, --ic-three-particles, --ic-four-particles)
- One for time step to use (--dt)
- One for the total integration time (--T)
- One for the radius of influence of each particle (--h)

Example of running the executable for dam-break, timestep of 0.0001, total integration time of 3 seconds and a radius of influence 0.01:

```
mpiexec -np 2 ./SPH-SOLVER --ic-dam-break --T=3 --dt=0.0001 --h=0.01
```

**The code has a specific number of particles in it for each initial condition. Supposing the users would like to change the number of particles they should be very careful, since the dam-break and droplet conditions can handle only numbers of particles that are a power of 2. Also, the number of particles in block-drop initial condition is carefully chosen, so that  $dx=dy$ . These practices were used to make sure that a uniform distribution is achieved across the whole grid.**

## Possible Issues

Generally, the code responds well to the use of many processors. However, for unidentified reasons some cases provided errors, while on a different day they may have executed the same simulation without any problems. It is advised to use 5 or less processors to avoid problems