Numerical solution of PDEs — homework

Choose **one** of the following assignments:

1 1D wave equation

Write a code that solves a one-dimensional wave equation:

$$\frac{\partial^2 u}{\partial t^2} = c^2 \frac{\partial^2 u}{\partial x^2}$$

using finite-difference method. The initial conditions are $u_0(x) = 1$ except for a spike $u_0(x_{\text{center}}) = 10$ in the center of the domain. Use boundary conditions of your choice.

For integration in time, use either 4-th order Runge-Kutta or a predictor-corrector scheme. You can write the code in any programming language (fortran, C, python, ...), although you have to write the integrator yourself (i.e. no calling of library function `rk4`).

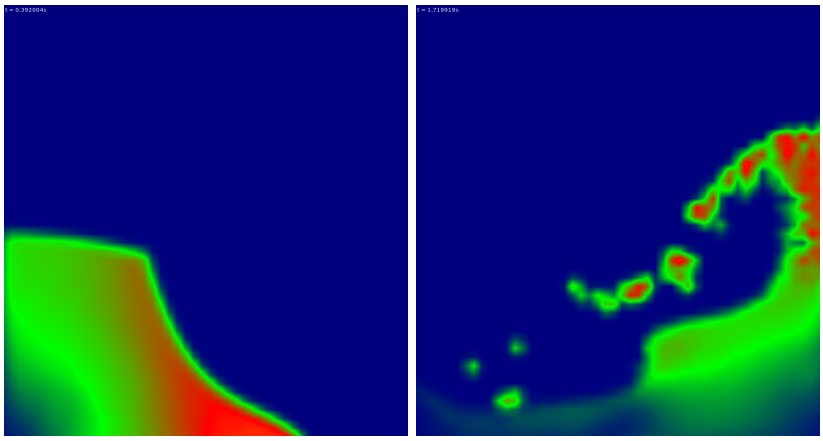
2 SPH interpolation

Use the example SPH code from:

`https://gitlab.com/sevecekp/pdesolvers/tree/master/sph`

In the code, replace the visualization routine (in file `sph/MainWindow.h`). Instead of drawing individual particles, draw a smooth velocity field by interpolating the velocities computed at grid points.

The result should look something like this:



Notes:

- You can use the grid class from `fdm/Grid.h` and copy the corresponding drawing function from `fdm/MainWindow.h`. You then only have to fill the `Grid` class with velocity values.
- Do **not** worry about the performance. Code has to be correct, speed is not relevant.