Maxwell's equation in two-dimensional space

Problem: Find the magnetic fields $\mathbf{H} = (H^x, H^y)$ and the electric field E^z governed by the equation:

$$\begin{cases} \dfrac{\partial H^x}{\partial t} = -\dfrac{\partial E^z}{\partial y}, \\ \dfrac{\partial H^y}{\partial t} = \dfrac{\partial E^z}{\partial x}, \\ \dfrac{\partial E^z}{\partial t} = \dfrac{\partial H^y}{\partial x} - \dfrac{\partial H^x}{\partial y}. \end{cases} \qquad x, y \in [-1, 1],$$

with the boundary conditions $\mathbf{H} = \mathbf{H}^{interior}$ and $E^z = 0$ at the boundary, and the initial condition:

$$\begin{cases} H^x(x, y, 0) = 0, \\ H^y(x, y, 0) = 0, \\ E^z(x, y, 0) = \sin(\pi x)\cos(\pi y). \end{cases}$$

Exact solution:

$$\begin{cases} H^x(x, y, t) = -\dfrac{1}{\sqrt{2}}\sin(\pi x)\cos(\pi y)\sin(\sqrt{2}\pi t), \\ H^y(x, y, t) = \dfrac{1}{\sqrt{2}}\cos(\pi x)\sin(\pi y)\sin(\sqrt{2}\pi t), \\ E^z(x, y, t) = \sin(\pi x)\sin(\pi y)\cos(\sqrt{2}\pi t). \end{cases}$$

To run this example, go to the `~/examples/maxwell_2d` folder, run `make`, and then execute `./maxwell_2d`. To configure the running mode (CPU or GPU), edit the `~/src/config.h` file to enable or disable USE_CPU_ONLY before running `make`.

Meshes: Three versions of the mesh are included for this example: coarse, fine, and super fine.

Run times of dg-on-cuda: Comparison of the CPU (serial) execution on Nvidia Jetson Xavier NX (Carmel ARMv8.2 64-bit 6MB L2 + 4MB L3) with the GPU execution (Volta GPU with 384 CUDA cores) on the coarse mesh (16 elements) is shown below. The GPU executions are all timed with block size