1D Linear Advection - Sine Wave

Problem Specification

Use Case. Linear Advection
Spatial domain: $0 \leq x < 1$ meters, periodic boundary conditions
Governing equations: 1D Linear Advection Equation

$$\frac{\partial \phi}{\partial t} = -\mathbf{u} \cdot \nabla \phi$$

Initial conditions:

$$\phi(x) = \sin(2\pi x)$$

$$\mathbf{u} = 1 \text{ m/s}$$

The Saiph's code specification can be seen at: **Click to Saiph code**

Simulation details

$\Delta x = 1$ mm
$\Delta t = 1$ ms
$nsteps = 1000$
Forward in-time integration using Euler method: $\mathcal{O}(x)$
Spatial differentiation accuracy (default): $\mathcal{O}(x^4)$

Results

Output results at three time-steps, $t = 0s$, $t = 0.5s$ and $t = 1s$ are presented in Figure 1. The L_2 norm has been computed over the ϕ variable taking the initial conditions as the analytic solution. The output simulation presents no truncation error $L_2 = 0$

The Saiph's simulation animation can be seen at: **Click to video**

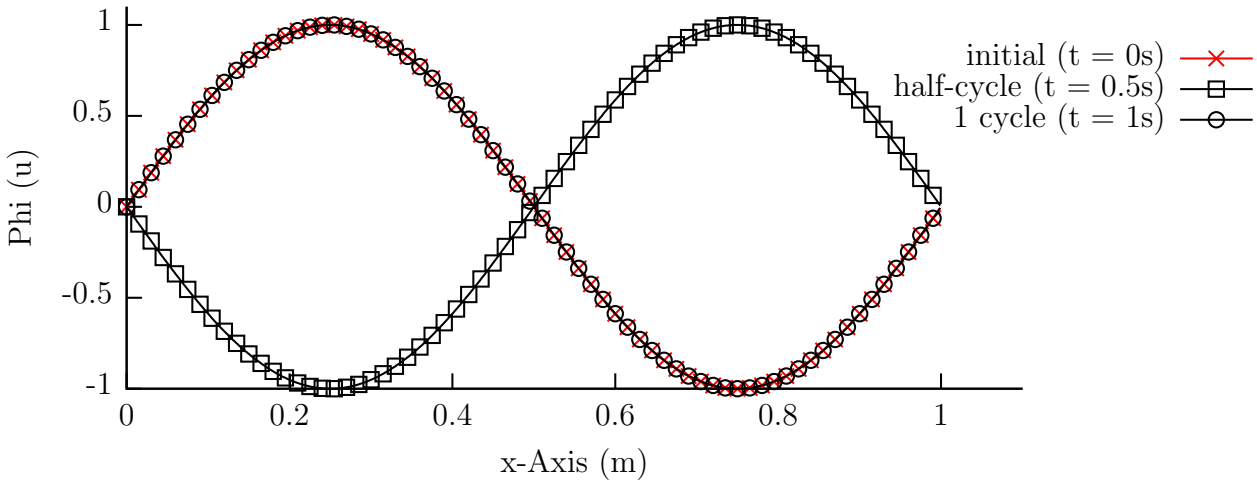

Figure 1: Phi profile at different time-steps.