Physics 555b Assignment #3 (version 1.0)

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1 Description of the application

The task is to write a parallel program using the PAMR infrastructure. The program can solve either the wave equation

$$\frac{\partial^2 \Psi}{\partial t^2} = v^2 \frac{\partial^2 \Psi}{\partial x^2} \tag{1}$$

or the advection equation

$$\frac{\partial \Psi}{\partial t} + v \frac{\partial \Psi}{\partial x} = 0 \ . \tag{2}$$

Use finite difference approximation for the wave equations and finite volume (HRSC) for the advection equation. As a bonus you can try to solve these equations in 2D. Output the grid function Ψ (in SDF format) and also calculate the integral $\int \Psi dx$ in regular intervals. For the wave equation use trapezoidal rule to perform the numerical integration. For the advection equation simply sum the cell averages multiplied by the volume elements. Use the MPI_REDUCE function to collect the results from all processors. Allow for periodic boundary conditions or Dirichlet boundary conditions for the wave equations (specified by some flag). For the advection equation use periodic or outgoing boundary conditions.

Create the program in such way that the initialization and stepping subroutines are written in FORTRAN.