One dimensional adaptive mesh refinement

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1 Introduction

Berger-Oliger style adaptive mesh refinement [BO84], with implementation of delayed solution technique of [PC06] to also solve ordinary differential equation constraints along with PDE.

A lot of the basic implementation ideas come from the AMRD/PAMR library written by Frans Pretorius (with addtions by Will East and Branson Stevens).

As it stands, the code can handle one dimensional PDE, with only one refinement grid per level. The code can also handle excision, and be configured to run with fixed mesh refinement.

2 Basic algorithms

The basic algorithm. See also [BO84, PC06].

Algorithm 1 Evolve grid hierarchy (recursive)

```
1: procedure EVOLVE(grid,times)
2:     for t ← 1, times do
3:         grid.time ← grid.time + 1
4:         if time to regrid then
5:             REGRID_ALL_FINER_GRIDS(grid)
6:         end if
7:         if grid is interior then
8:             INTERPOLATE_BOUNDARY_CONDITIONS(grid.parent, grid)
9:         end if
10:        SOLVE_PDE_STEP(grid)
11:        if not finest grid then
12:            EVOLVE(grid.child, refinement)
13:        end if
14:    end for
15:    if not coarsest grid then
16:        COMPUTE_TRUNCATION_ERROR(grid.parent, grid)
17:        INJECT(grid.parent, grid)
18:    end if
19: end procedure
```

References

[BO84] Marsha J. Berger and Joseph Oliger. Adaptive Mesh Refinement for Hyperbolic Partial Differential Equations. *J. Comput. Phys.*, 53:484, 1984.

[PC06] Frans Pretorius and Matthew W. Choptuik. Adaptive mesh refinement for coupled elliptic-hyperbolic systems. *J. Comput. Phys.*, 218:246–274, 2006.