PROBLEMS and TECHNIQUES

The paper featured in this issue is "Logically Rectangular Grids and Finite Volume Methods for PDEs in Circular and Spherical Domains" by Donna Calhoun, Christiane Helzel, and Randy LeVeque. The topic is the numerical solution of partial differential equations (PDEs) whose domains are circles, balls, spheres, and related geometries. The main idea is to solve the PDE on a "logically rectangular" grid. This means, for instance, if the physical space is a circle, then the computational space is a square. The authors focus on hyperbolic PDEs, including Euler, acoustics, and shallow water equations, and also give an example for solving reaction-diffusion equations.

This paper is a pleasure to read. One finds lucid explanations of what can go wrong with different types of grids for circular and spherical domains, such as grid cells of widely differing sizes and extreme shapes. In contrast, the algorithms in this paper map a single rectangular block into a spherical shape; and the resulting cell sizes differ by a factor of at most two. The different mappings from computational space to physical space are presented as short, intuitive MATLAB algorithms. Many crisp pictures illustrate the uniform appearance and effectiveness of the grids.

Even those who are not PDE experts will appreciate the simplicity, elegance, and generality of the logically rectangular grids when they are combined with a discretization of the PDE by finite volume methods.

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