AMR for Multiphysics Applications

Ann Almgren
Senior Scientist; Computational Research Division – Lawrence Berkeley National Laboratory

Adaptive mesh refinement (AMR) is one of several techniques for adapting the spatial resolution of a simulation in particular regions of the spatial domain. Block-structured AMR specifically refines the mesh by defining locally structured regions with finer spatial, and possibly temporal, resolution. This combination of locally structured meshes within an irregular global hierarchy is in some sense the best of both worlds in that it enables regular local data access while enabling greater flexibility in the overall computation.

Originally, block-structured AMR was designed for solving hyperbolic conservation laws with explicit time-stepping; in this case the changes to solution methodology in transforming a single-level solver to an AMR-based solver are relatively straightforward. AMR has come a long way, however, and the more complex the simulation, the more complex the changes to effectively use AMR. In this talk I will give an overview of block-structured AMR and focus on a few key exemplars for how to think about adaptivity for multiphysics simulations. In addition, I will give an overview of the AMReX software framework and discuss how it enables application developers to efficiently move from prototype to parallel, portable, GPU-ready code.

Bio: Ann Almgren is a senior scientist in the Computational Research Division of Lawrence Berkeley National Laboratory and the Group Lead of the Center for Computational Sciences and Engineering. Her primary research interest is in computational algorithms for solving PDE’s in a variety of application areas. Her current projects include the development and implementation of new multiphysics algorithms in high-resolution adaptive mesh codes that are designed for the latest hybrid architectures. She is a SIAM Fellow and the Deputy Director of the ECP AMR Co-Design Center, and serves on the editorial boards of CAMCoS, IJHPCA and SIREV.