Task-based Radiative Transfer Methods in the DISPATCH Code Framework

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Abstract

We have recently introduced a high-performance simulation framework that allows semi-independent, task-based updates of a collection of 'patches' in space-time (MNRAS 477, 624, 2018). A hybrid MPI/OpenMP execution model is adopted, where OpenMP threads on each compute node are assigned tasks by a rank-local 'dispatcher', which selects tasks that are ready for updating from a set of tasks generally much larger than the number of hardware threads. Mesh refinement may be static or dynamic, and patches may be stationary or moving. A feature of decisive importance for the overall performance of the framework is that time steps are determined and applied locally; this allows potentially large reductions in the total number of updates required in cases when the signal speed varies greatly across the computational domain.

In this talk I will focus on describing the various radiative transfer methods that have been implemented in the DISPATCH framework. One class of methods uses long characteristics inside patches, with rays along the principal axes, face diagonals, and space diagonals, while another class of methods uses short characteristics, allowing arbitrary ray directions. All methods allow multi-bin solutions, with opacities and source functions supplied by lookup-tables, optimized by using loop vectorization.

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