A Fast Iterative Method for a Class of Hamilton-Jacobi Equations on Parallel Systems

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Abstract

In this paper we propose a novel computational technique, which we call the Fast Iterative Method (FIM), to solve a class of Hamilton-Jacobi (H-J) equations on massively parallel systems. The proposed method manages the list of active nodes and iteratively updates the solutions on those nodes until they converge. Nodes are added to or removed from the list based on a convergence measure, but the management of this list does not entail the the extra burden of expensive ordered data structures or special updating sequences. The proposed method has suboptimal worst-case performance, but in practice, on real and synthetic datasets, performs fewer computations per node than guaranteed-optimal alternatives. Furthermore, the proposed method uses only local, synchronous updates and therefore has better cache coherency, is simple to implement, and scales efficiently on parallel architectures, such as cluster systems or graphics processing units (GPUs). This paper describes the method, the implementation on the GPU, and a performance analysis that compares the proposed method against the state-of-the-art H-J solvers.