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Dynamic Adaptive Runtime Systems for Advanced Multipole Method-based Science Achievement JACKSON DEBUHR, MATTHEW ANDERSON, THOMAS STERLING, BO ZHANG, Indiana University — Multipole methods are a key computational kernel for a large class of scientific applications spanning multiple disciplines. Yet many of these applications are strong scaling constrained when using conventional programming practices. Hardware parallelism continues to grow, emphasizing medium and fine-grained thread parallelism rather than the coarse-grained process parallelism favored by conventional programming practices. Emerging, dynamic task management execution models can go beyond these conventional practices to significantly improve both efficiency and scalability for algorithms like multipole methods which exhibit irregular and time-varying execution properties. We present a new scientific library, DASHMM, built on the ParalleX HPX-5 runtime system, which explores the use of dynamic adaptive runtime techniques to improve scalability and efficiency for multipole-method based scientific computing. DASHMM allows application scientists to rapidly create custom, scalable, and efficient multipole methods, especially targeting the Fast Multipole Method and the Barnes-Hut N-body algorithm. After a discussion of the system and its goals, some application examples will be presented.

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