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Architecture - Performance Relationship in GPU Computing - Composite Process Flow Modeling and Simulations

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Abstract : Current developments in computing have shown the advantage of using one or more Graphic Processing Units (GPU) to boost the performance of many computationally intensive applications but there are still limits to these GPU-enhanced systems. The major factors that contribute to the limitations of GPU(s) for High Performance Computing (HPC) can be categorized as hardware and software oriented in nature. Understanding how these factors affect performance is essential to develop efficient and robust applications codes that employ one or more GPU devices as powerful co-processors for HPC computational modeling. This research and technical presentation will focus on the analysis and understanding of the intrinsic interrelationship of both hardware and software categories on computational performance for single and multiple GPU-enhanced systems using a computationally intensive application that is representative of a large portion of challenges confronting modern HPC. The representative application uses unstructured finite element computations for transient composite resin infusion process flow modeling as the computational core, characteristics and results of which reflect many other HPC applications via the sparse matrix system used for the solution of linear system of equations. This work describes these various software and hardware factors and how they interact to affect performance of computationally intensive applications enabling more efficient development and porting of High Performance Computing applications that includes current, legacy, and future large scale computational modeling applications in various engineering and scientific disciplines.

Keywords : graphical processing unit, software development and engineering, performance analysis, system architecture and software performance
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