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EMERGING TECHNOLOGIES AND APPLICATIONS IN HIGH PERFORMANCE COMPUTING FOR RESEARCH AND INNOVATION

SUZANNE M. SHONTZ*

* University of Kansas
Lawrence, KS 66045 United States of America
shontz@ku.edu, https://people.eecs.ku.edu/~s906s230/

ABSTRACT

High performance computing (HPC) advances are important for driving research and innovation with respect to applications such as real-time medicine (e.g., the design of novel patient treatments), energy (e.g., optimal electric transmission via the power grid), and autonomous vehicle swarm (e.g., redesign of warfare). Such applications require the use of high-performance computing, as such simulations are much too computationally intensive to be run on either desktop computers or workstations.

There are several different types of parallel computing strategies available for HPC. These include utilization of both shared and distributed memory architectures, graphics processing units (GPUs), field-programmable gate arrays (FPGAs), and hybrid techniques. Indeed, researchers that employ several different parallel processing strategies are often yield excellent speedups. For example, an application may involve parallel processing of multiple CPUs across nodes (e.g., using MPI), multiple cores within a single node (e.g., using OpenMP), and utilize GPUs for acceleration (e.g., using CUDA).

There are several important trends in HPC driving research and innovation. These include but are not limited to, scalable algorithms, e.g., exascale algorithms are being developed and can be used to assess building risk to due seismic activity. In addition, artificial intelligence is being used to improve HPC and vice versa. HPC simulations and digital twins are also being used to design airplanes and develop healthcare solutions. Novel HPC applications include blockchains, quantum computing, cybersecurity, and more.

This minisymposium will bring together researchers from mathematics, computer science, engineering, and related fields to discuss research and innovation in these and other HPC technologies and applications.