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Publisher: IEEE

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Abstract:
Nowadays the most crucial challenge in High-Performance Computing (HPC) is to optimize the power consumption of resources and to couple the performance with energy efficiency. The graphics processing units (GPUs) have been used intensively due to their computational performance, which are significantly accelerate the execution of many HPC applications. A series of studies have been carried out based on GROMACS (GROningen MAchine for Chemical Simulations) package to reveal the nature of NVIDIA Tesla K40 graphical card with different frequencies and to estimate the energy efficiency from frequency viewpoint. The analyzes show that the performance of the Tesla K40 is equivalent to the performance of the 1024 cores of IBM BlueGene/P supercomputer or the 64 CPUs of HP CP4000BL nodes. In the meantime, the usage of low frequencies leads to the energy conservation up to 20-30%. It is stated that the optimal power efficiency is achieved with the low-frequency GPU.

Published in: 2018 41st International Convention on Information and Communication Technology, Electronics and Microelectronics (MIPRO)

Date of Conference: 21-25 May 2018

INSPEC Accession Number: 17880390

Date Added to IEEE *Xplore*: 02 July 2018

DOI: 10.23919/MIPRO.2018.8400158

ISBN Information:

Publisher: IEEE

Conference Location: Opatija, Croatia

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Power and energy consumption can be identified as the most recognized concern in exascale systems such as HPC or supercomputers. Hence decreasing the power consumption of large-scale HPC systems is becoming a crucial challenge in the context of increasing the performance and consuming as less energy as possible [1]–[2]. Accordingly, finding ways in energy efficiency improvements in HPC applications is a challenge [3]. In recent years, the potential for accelerating computational processes has grown significantly using multicore CPUs and general-purpose computing (GPGPUs). GPU-accelerated computing offers unprecedented application performance by offloading compute-intensive portions of the application to the GPU to handle GPGPUs, while the remainder of the code still runs on the CPU [4]. It is obvious that GPU consumes much more power than a CPU. However, the total amount of watt consumed per unit gigahertz is much lower compared to the CPU [5]. The CPU/GPU hybrid calculations lead to improvement of both the performance and the energy efficiency. The Dynamic voltage and frequency scaling (DVFS) is a power-management technique where the processor frequency is manipulated to study the supply voltage (terms known as overvolting/undervolting) [6]. The abovementioned technique makes it possible to improve the performance by switching/adapting the frequency to better suit load characteristics [7].

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