

**Summary of
Optimizing Performance of Parallel Programs
on
Emerging Multi-Core Processors & GPUs
(OPECG-2009)**

Centre for Development of Advanced Computing (C-DAC), Pune and Indian Institute of Technology (IIT), MADRAS, Chennai are jointly conducting five-day technology workshop titled "Optimizing Performance of Parallel Programs on Emerging Multi-Core Processors & GPUs (**OPECG-2009**)" held at IIT Madras, Chennai during the period June 1-5, 2009.

One of the objectives of **OPECG-2009** is to understand software multi-threading on Multi-Core Processors, GPU Computing using CUDA Programming, and GPGPU-Stream Accelerators, Hybrid Computing and Multi-Core Processor Clusters. The second objective is aware of performance enhancements through software multithreading on Multi-Core Processors, GPU computing, and GPGPU – Stream Computing for solving large-scale problems in Scientific and Engineering and Commercial domains. The five-day workshop provides an opportunity for interaction among the various participants from different academic institutes and research organizations in the country and leading IT company experts who are working in the area of emerging parallel processing platforms.

OPECG-2009 proceedings, and Hands-on (CD) soft-copy is developed in order to impart a sense of unity to this expanding and exciting field of emerging parallel processing technologies. The **OPECG-2009** Hands-on session programs provide foundation for application user to write good parallel algorithms to extract performance of large-scale applications and libraries on Multi-Core Processor platforms and computing systems with GPU Accelerators. By understanding the presentation material covered and the programs in the Hands-on softcopy CD as building blocks, scientists and engineers could piece together more complicated software tools that are tailored specifically for their needs, emerging parallel processing platforms using Multi-Core Processors, and GPGPUs / GPU Computing.

The **OPECG-2009** workshop proceedings covers current trends in Multi-Core processors, performance enhancement through software multi-threading, performance analysis tools, keynote address talks from academic institutes and from IT company sponsors (AMD, Intel, HP, NVIDIA) on Multi-Core Processors, GPU computing – CUDA Programming, GPGPU, and GPU-Stream computing, application perspective. Special sessions have been arranged to demonstrate performance analysis tools on Multi-Core Processors, Intel Threading Building Blocks (TBB), GPU computing-CUDA, GPGPU- Stream Computing and Hybrid computing based on mixed programming.

The **OPECG-2009** workshop participants will get an opportunity to use several Multi-Core Processors (Multi Socket and Multi-Core processors). The Hnds-on effectively addresses the performance and usability challenges with a suite of tools that participants found useful in measuring, understanding, and improving the performance of their parallel programs during the hands-on session.

The **OPECG-2009** workshop is organized as **TWO** modes in which participants can attend 5-day programme (Both Mode 1 & Mode 2) or exclusively Mode 2 programme. The rich set of codes is provided on various computing platforms to understand and address performance issues of different codes that are written for this workshop. This workshop will give insights into performance aspects of sequential /parallel programs using different programming paradigms. Participants will use Intel & AMD Multi-Core systems, Cluster of Multi-Core processors, GPGPUs, and GPU Computing systems. The 4th and 5th day of this workshop will cover an overview of GPU Computing, GPGPUs-Stream Accelerators, GPU Computing-CUDA programming software toolkit, and Hands-on session.

Mode 1 (Day 1-3): This session includes twelve classroom lectures on Multi-Core processors and Software Multithreading. Three keynote lectures on emerging topics of Multi-Core processors from application perspectives will be covered. Second half of each day, participants will get expose to Programming using OpenMP, Pthreads, f77/f90, MPI-2.0, use of Tuning & Performance Visualization tools, **Intel** Threading Building Blocks, Performance issues on Multi-Core processors and an overview of Transactional Memory™ on Multi-Core processor platforms. The day-1, day-2, and day-3 hands-on sessions of **OPECG-2009** workshop introduce the participants to the fundamentals of parallel programming on Multi-Core processors by letting the participant to write simple parallel programs that executes on Quad-Core processors. Also, participants will be exposed to the practical aspects of classroom lectures in the hands-on session.

Mode 2 (Day 4-5): During this session, participants will get an overview of evolving GPU Computing, Hybrid computing based on mixed programming for HPC applications. On Second half of each day, participants will get an opportunity to walk-through some of the programs specifically designed for this workshop. Software IT Companies deliver keynote talks on GPU Computing - CUDA Programming, GPGPUs - Stream Accelerators & Demonstration. : Industry experts demonstrate programming based on GPU Computing CUDA Programming, GPGPUs- Stream Accelerators on 4th and 5th day of **OPECG-2009** workshop. The 4th and 5th is focus on current and future emerging parallel processing platforms and Programming Paradigms such as GPU computing-CUDA programming, GPGPU-Stream Computing, GPU programming based on OpenGL & OpenCL Programming and Hybrid Computing based on mixed programming.

C-DAC and IIT Madras views the **OPECG-2009** workshop Proceedings (CD proceedings) and the Hands-on session softcopy presentation notes as a continuously evolving resource on parallel computing. Hand-on Session softcopy document offers the application users a great opportunity to learn about the fundamentals of writing multi-threaded programs using different programming paradigms, emphasizing on optimization techniques to extract the performance on Multi-Core Processor Platforms and systems with GPUs. Most of the articles of the notes include broad coverage of practical aspects of emerging parallel processing platforms and have been selected from several important books and web sites.