Instrumentation and Modeling of Performance and Power Consumption for Massively Parallel Processors

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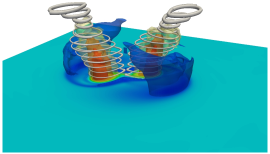
GPU Mekong Project - Simplified Multi-GPU Programming

- Aim & Objective: provide a simplified path to scale out the execution of GPU programs from one GPU to almost any number.
- Funding: Federal Ministry of Education and Research of Germany - BMBF.
- Funding period: 2017.02. – 2020.06.
- Host Institute: Heidelberg University, Germany.
  - Engineering Mathematics and Computing Lab (EMCL), Mathematics Faculty.
  - Computing Systems Group (CSG), Informatics Faculty.
- The name "Mekong".
- Project website: https://www.gpumekong.org/



Research Team

Engineering Mathematics and Computing Lab (EMCL)

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Computing Systems Group (CSG)

Holger Fröning

Lorenz Braun

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Highlight Developments within GPU Mekong Project

- Mini-Apps:
  - Finite Element method (FEM) based CPU-GPU benchmark suites.
  - Various solvers and schemes: e.g. CG, GMRES, Multi-Grid, Matrix-Free, ...
  - https://emcl-gitlab.iwr.uni-heidelberg.de/mini_apps/Mini-Apps_Public
- CUDA Flux:
  - Lightweight instruction profiler for CUDA applications.
  - PTX level.
  - LLVM compiler framework based.
  - Low Overhead.
  - https://github.com/UniHD-CEG/cuda-flux
- GPU Mangrove:
  - Performance & Power prediction model.
  - Fast and easy to use.
  - Machine learning based.
  - https://github.com/UniHD-CEG/gpu-mangrove

HiPEAC Tutorial

- Background:
  - GPU application: typical example for heterogeneous computing.
  - Predictive model can assist the scheduler.
  - **Performance** and **Power** are two main metrics for designing algorithms and compute architecture.
- Our predictive model:
  - **Simple**: only rely on features obtained with minimal overhead.
  - **Portable**: easily transported to other GPU architectures.
  - **Fast**: machine learning based model, computing time is limited.
- Toady's tutorial main content:
  - Instrumentation.
  - Predictive model for performance and power.
- Length: full day.
  - Morning: Background and methodology.
  - Afternoon: Tooling and hands-on experiments.
- Publication:
  - **A simple model for portable and fast prediction of execution time and power consumption of gpu kernels**, *ACM Trans. Archit. Code Optim.* Dec. 2020.

Program

09:30 – 09:40	Introduction	Chen Song
09:40 – 10:00	General Introduction for GPU	Holger Fröning
10:00 – 10:30	Instrumentation in general	Lorenz Braun
10:30 – 11:15	Break	
11:15 – 11:45	Instrumentation for performance & power	Lorenz Braun
11:45 – 12:15	Building predictive models	Lorenz Braun
12:15 – 12:45	Cluster, tools and exercise introduction	Yannic Emonds
12:45 – 15:00	Lunch & Keynote	
15:00 – 16:00	Exercise - performance & power measurements	L. Braun & Y. Emonds
16:00 – 16:30	Break	
16:30 – 17:30	Prediction experiments	Hands-on
17:30 – 18:00	Summary predictions & wrap-up	Lorenz Braun

Thanks for your attention

Enjoy our tutorial