International HPC Summer School 2018: Performance analysis and optimization

VI-HPS Overview

VI-HPS Team
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Virtual Institute – High Productivity Supercomputing

- **Goal**: Improve the quality and accelerate the development process of complex simulation codes running on highly-parallel computer systems
- Start-up funding (2006–2011) by Helmholtz Association of German Research Centres
- Activities
  - Development and integration of HPC programming tools
    - Correctness checking & performance analysis
  - Academic workshops
  - Training workshops
  - Service
    - Support email lists
    - Application engagement

HELMHOLTZ ASSOCIATION

http://www.vi-hps.org

VI-HPS partners (founders)

Forschungszentrum Jülich
- Jülich Supercomputing Centre

RWTH Aachen University
- Centre for Computing & Communication

Technische Universität Dresden
- Centre for Information Services & HPC

University of Tennessee (Knoxville)
- Innovative Computing Laboratory

VI-HPS partners (additional members)

2018

Leibniz-Rechenzentrum der Bayerischen Akademie der Wissenschaften








- Barcelona Supercomputing Center
  - Centro Nacional de Supercomputación
- Lawrence Livermore National Lab.
  - Center for Applied Scientific Computing
- Technical University of Darmstadt
  - Laboratory for Parallel Programming
- Technical University of Munich
  - Chair for Computer Architecture and Parallel Systems
- University of Oregon
  - Performance Research Laboratory
- University of Stuttgart
  - HPC Centre
- University of Versailles St-Quentin
  - LRC ITACA
- Allinea Software Ltd (Now part of ARM)

BSC Barcelona Supercomputing Center Centro Nacional de Supercomputación

Lawrence Livermore National Laboratory

TECHNISCHE UNIVERSITÄT DARMSTADT

TECHNISCHE UNIVERSITÄT MÜNCHEN

UNIVERSITY OF OREGON

Universität Stuttgart

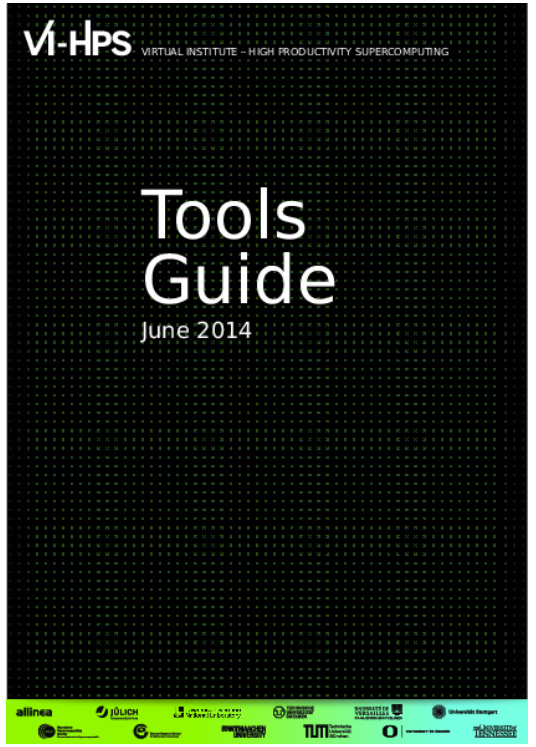
UNIVERSITÉ DE VERSAILLES ST-QUENTIN-EN-YVELINES

allinea

Productivity tools

- MUST & ARCHER
  - MPI usage correctness checking & OpenMP race detection
- PAPI
  - Interfacing to hardware performance counters
- Periscope Tuning Framework
  - Automatic analysis via an on-line distributed search
- Scalasca
  - Large-scale parallel performance analysis
- TAU
  - Integrated parallel performance system
- Vampir
  - Interactive graphical trace visualization & analysis
- Score-P
  - Community-developed instrumentation & measurement infrastructure

For a brief overview of tools consult the VI-HPS Tools Guide:



Productivity tools (cont.)

- DDT/MAP/PR: Parallel debugging, profiling & performance reports
- Extra-P: Automated performance modelling
- JuBE: Benchmark set creation, execution & evaluation framework
- Kcachegrind: Callgraph-based cache analysis [x86 only]
- MAQAO: Assembly instrumentation & optimization [x86-64 only]
- mpiP: MPI profiling tool and analysis viewer
- Open MPI Memchecker: Integrated memory checking
- Open|SpeedShop: Integrated parallel performance analysis environment
- Paraver/Dimemas/Extrae: Event tracing and graphical trace visualization & analysis
- Rubik: Process mapping generation & optimization [BG only]
- SIONlib/Spindle: Optimized native parallel file I/O & shared library loading
- STAT: Stack trace analysis tools

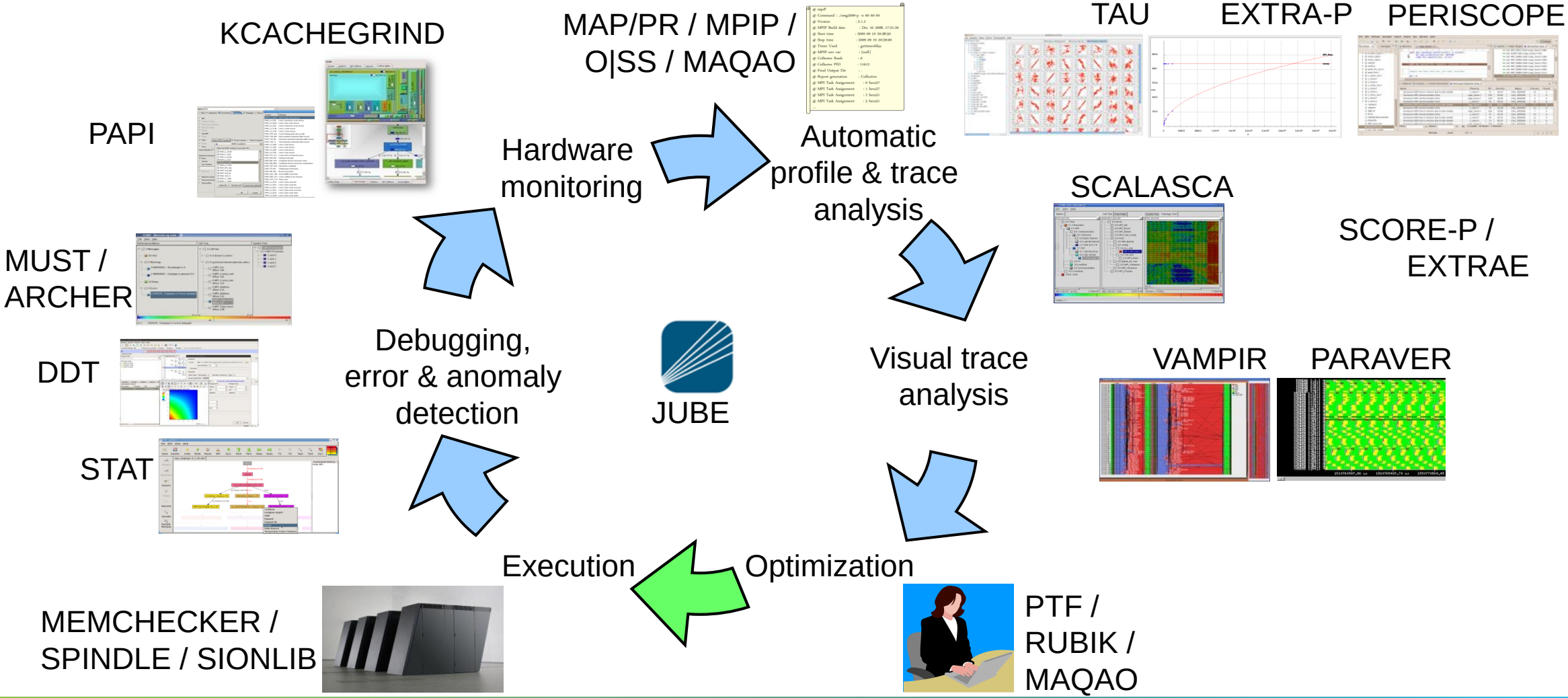
Non VI-HPS performance tools

- HPC Toolkit (Rice University): http://hpctoolkit.org/
- PerfExpert (TACC): https://www.tacc.utexas.edu/research-development/tacc-projects/perfexpert
- Likwid (University of Erlangen-Nuremberg): https://github.com/RRZE-HPC/likwid/wiki
- …

Commercial tools:

- CrayPat (Cray)
- Intel VTune Amplifier XE: https://software.intel.com/en-us/intel-vtune-amplifier-xe
- …

Technologies and their integration



Disclaimer

Tools will ***not*** automatically make you, your applications or computer systems more productive.

However, they can help you understand ***how*** your parallel code executes and ***when / where*** it's necessary to work on correctness and performance issues.

Workshops/Tutorials

- Tuning Workshop Series
  - Three to five days *bring-your-own-code* workshops at HPC centres
  - Usually free of charge
  - http://www.vi-hps.org/training/tws/

- Tutorials at various conferences
  - E.g., ISC18

Performance Audits/Plans/Proof-of-concepts

- Performance Optimisation and Productivity (POP)
  - Offers performance optimisation and productivity services
  - Time-limited offer/project
  - Using VI-HPS tools
  - Funded by European Unions Horizon 2020 research and innovation programme
  - https://pop-coe.eu/services

- They help you fix your code, for free!!!