International HPC Summer School 2017: Performance analysis and optimization Tools 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

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 (cont.)

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

University of Oregon
- Performance Research Laboratory

University of Stuttgart
- HPC Centre

University of Versailles St-Quentin
- LRC ITACA

Allinea Software Ltd

Productivity tools

- ## MUST
  - MPI usage correctness checking
- ## PAPI
  - Interfacing to hardware performance counters
- ## Periscope Tuning Framework
  - Automatic analysis and Tuning
- ## **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:
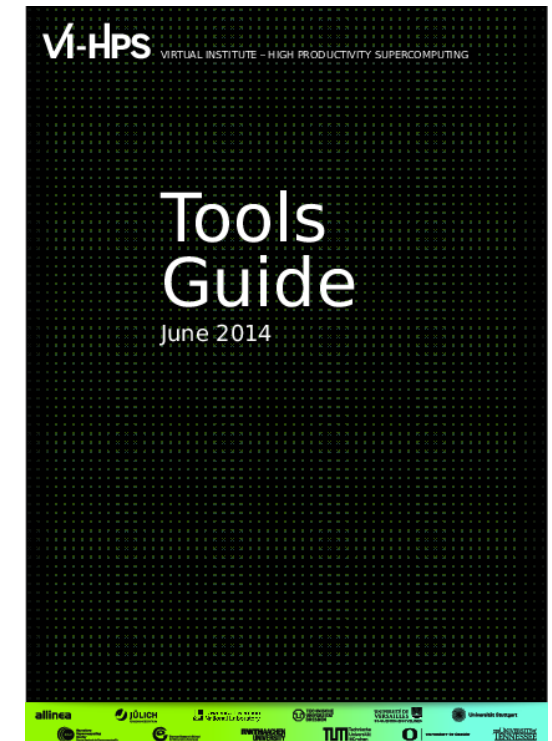
Productivity tools (cont.)

- **DDT/MAP/PR**: Parallel debugging, profiling & performance reports
- **Extra-P**: Automated performance modelling
- **Kcachegrind**: Callgraph-based cache analysis [x86 only]
- **MAQAO**: Assembly instrumentation & optimization [x86-64 only]
- **mpiP/mpiPview**: MPI profiling tool and analysis viewer
- **Open MPI**: 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
- **SysMon**: Batch system monitor plugin for Eclipse PTP

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
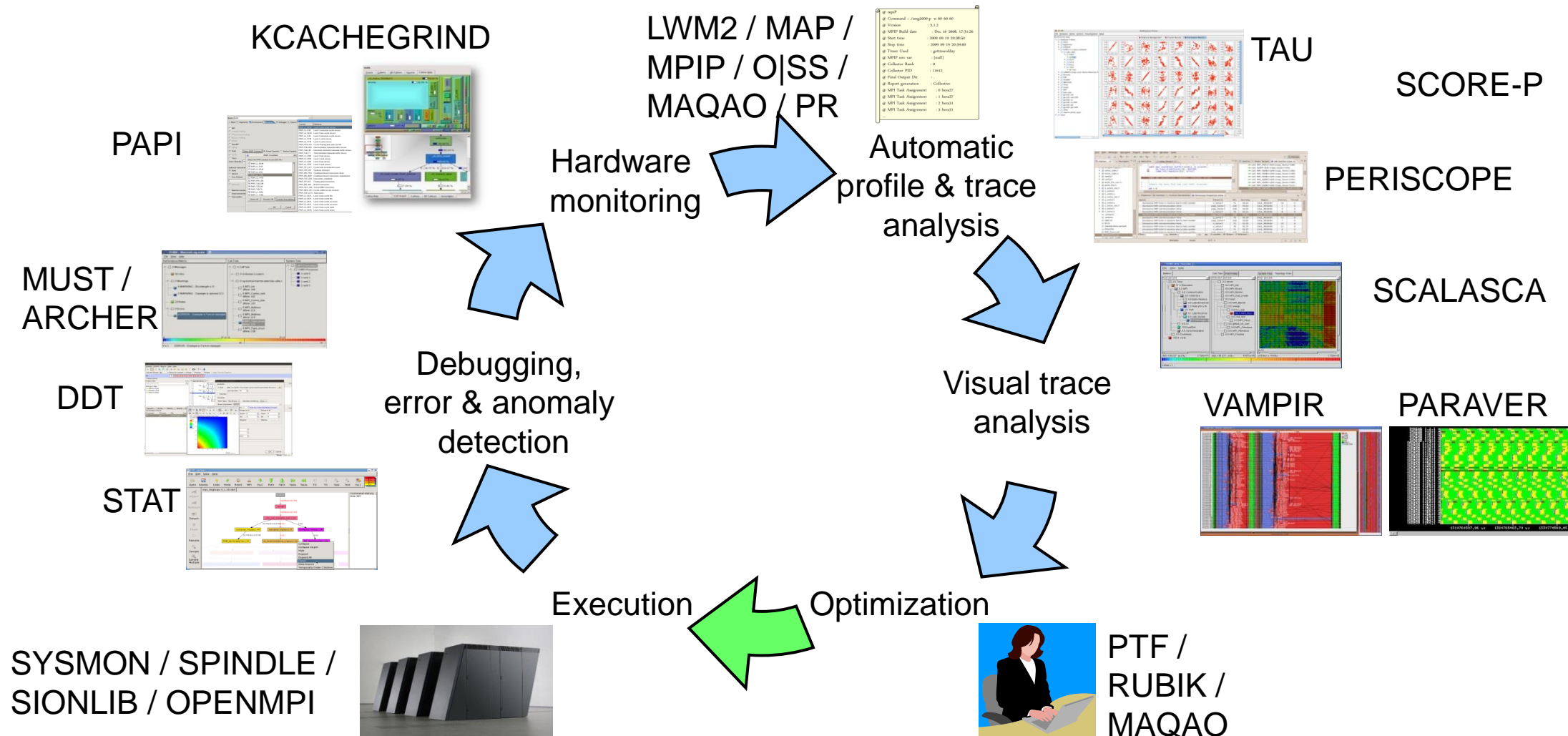
Workshops/Tutorials

- 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., SC17: Hands-on Practical Hybrid Parallel Application Performance Engineering

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!!!