THE UNIVERSITY OF TENNESSEE KNOXVILLE

ICL INNOVATIVE COMPUTING LABORATORY

31st VI-HPS Tuning Workshop

UTK-ICL, Knoxville/TN, 9-12 April 2019

http://www.vi-hps.org/training/tws/tw31.html

Sameer Shende
University of Oregon

Frank Winkler
TU Dresden

Brian Wylie
Jülich Supercomputing Centre

Cédric Valensi & Emmanuel Oseret
UVSQ

Nick Forrington
ARM

Judit Giménez & German Llort
Barcelona Supercomputing Centre

David Böhme
LLNL

Agenda (Tuesday)

Time	Topic	Presenter
09:00	Welcome	
	Introduction to VI-HPS & overview of tools	Wylie
	Introduction to parallel performance engineering	
	Introduction to lab setup; Building and running NPB-MZ-MPI BT-MZ	
10:30	*Break*	
10:45	TAU performance system	Shende
	TAU hands-on exercises	
12:00	*Lunch*	
14:00	Hands-on coaching to apply tools to analyze your own code(s)	all
17:00	Review of day and schedule for remainder of workshop	
17:30	*Adjourn*	

Agenda (Wednesday)

Time	Topic	Presenter
09:00	Score-P instrumentation & measurement	Winkler
	CUBE profile explorer	Wylie
10:30	*Break*	
10:45	Scalasca automated trace analysis	Wylie
	Vampir interactive trace analysis	Winkler
12:00	*Lunch*	
13:00	Hands-on coaching to apply tools to analyze your own code(s)	all
17:00	Review of day and schedule for remainder of workshop	
17:30	*Adjourn*	

Agenda (Thursday)

Time	Topic	Presenter
09:00	MAQAO x86 performance analysis tools	Oseret & Valensi
	MAQAO hands-on exercises	
10:30	*Break*	
10:45	FORGE MAP & Performance Reports	Forrington
	MAP & PR hands-on exercises	
12:00	*Lunch*	
13:00	Hands-on coaching to apply tools to analyze your own code(s)	all
17:00	Review of day and schedule for remainder of workshop	
17:30	*Adjourn*	

Agenda (Friday)

Time	Topic	Presenter
09:00	BSC tracing tools	Giménez & Llort
	Paraver hands-on exercises	
10:30	*Break*	
10:45	LLNL tools	Böhme
11:45	Review of workshop	Wylie
12:00	*Lunch*	
13:00	Hands-on coaching to apply tools to analyze your own code(s)	all
17:30	*Adjourn*	

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
RESEARCH FOR GRAND CHALLENGES

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.)

Arm Ltd.

- Allinea Software

Barcelona Supercomputing Center

- Centro Nacional de Supercomputación

Lawrence Livermore National Lab.

- Center for Applied Scientific Computing

Leibniz Supercomputing Centre

Technical University of Darmstadt

- Laboratory for Parallel Programming

VI-HPS partners (cont.)

Technical University of Munich

- Chair for Computer Architecture

University of Oregon

- Performance Research Laboratory

University of Stuttgart

- HPC Centre

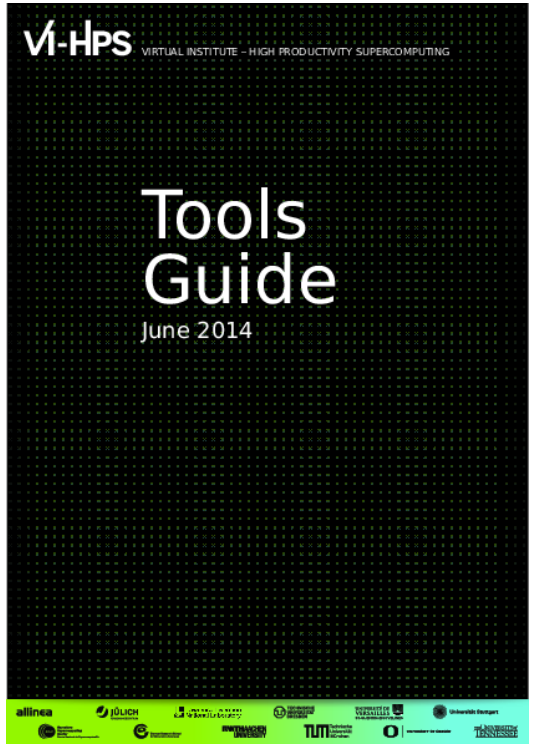
University of Versailles St-Quentin

- LRC ITACA

Productivity tools

- MUST & Archer
  - MPI & OpenMP 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:

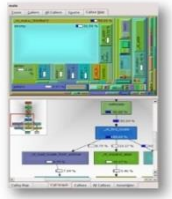


Productivity tools (cont.)

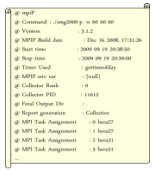
- DDT/**MAP/PR**: Parallel debugging, profiling & performance reports
- Extra-P: Automated performance modelling
- Kcachegrind: Callgraph-based cache analysis [x86 only]
- **MAQAO**: Assembly instrumentation & optimization [x86-64 only]
- mpiP/mpiPview: MPI profiling tool and analysis viewer
- Open MPI: Integrated memory checking
- Open|SpeedShop: Integrated parallel performance analysis environment
- **Paraver/Dimemas/Extrae**: Event tracing, 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

Technologies and their integration

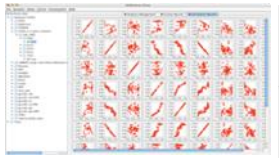
KCACHEGRIND

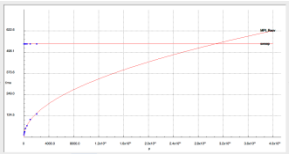


MAP/PR / MPIP / O|SS / **MAQAO**

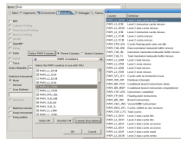


TAU EXTRA-P PERISCOPE





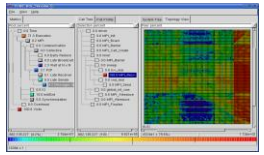
PAPI



Hardware monitoring

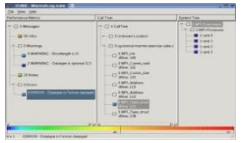
Automatic profile & trace analysis

SCALASCA

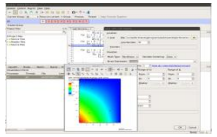


SCORE-P / EXTRAE

MUST / ARCHER



DDT

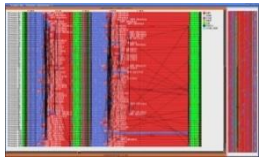


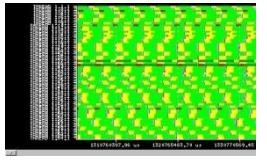
Debugging, error & anomaly detection

JUBE

Visual trace analysis

VAMPIR **PARAVER**





STAT

Execution

Optimization

MEMCHECKER / SPINDLE / SIONLIB

PTF / RUBIK / **MAQAO**

Disclaimer

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

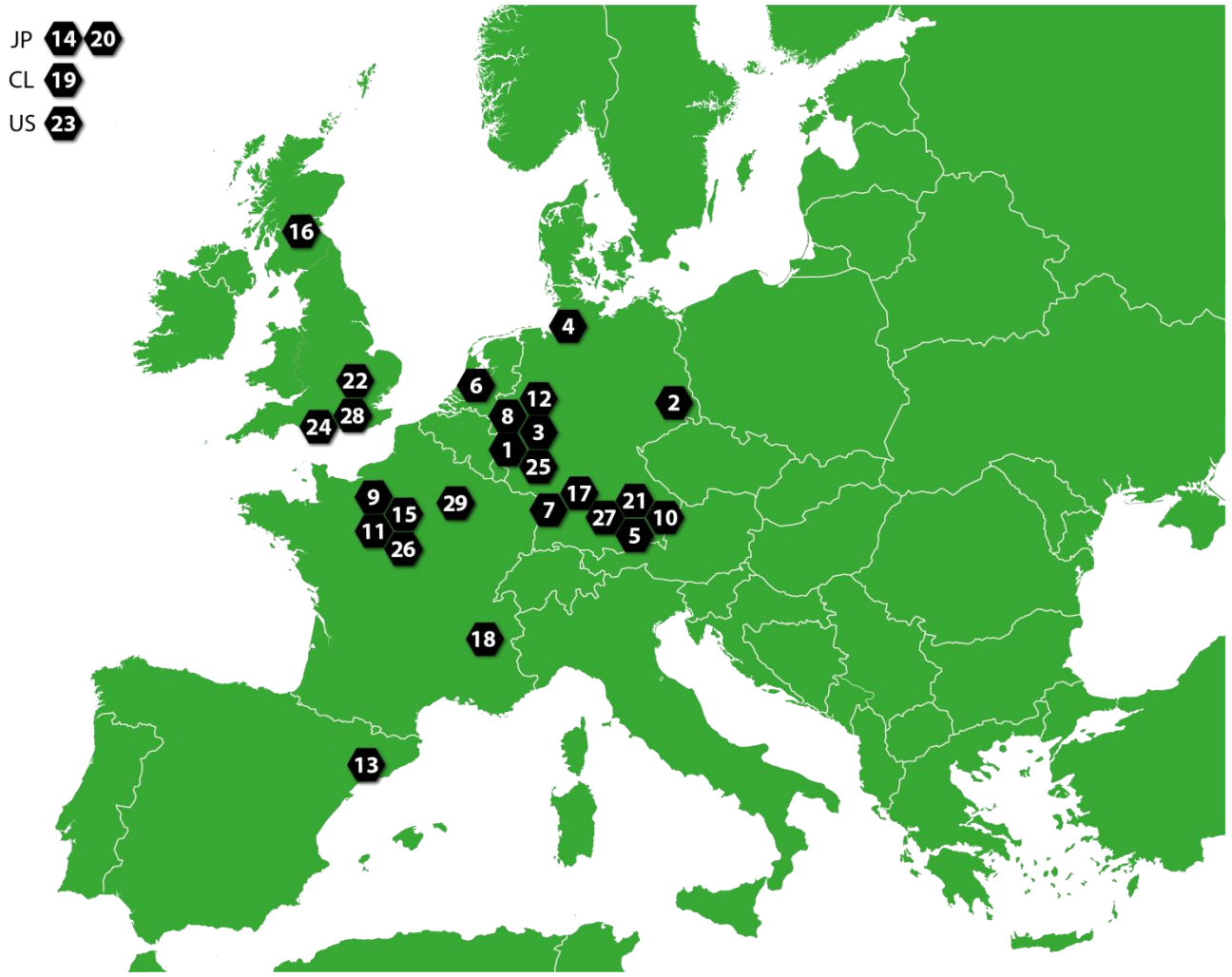
However, they can help you understand ***how*** your parallel code executes and ***when / where*** it's necessary to work on correctness and performance issues.

VI-HPS training & Tuning Workshops

- Goals
  - Give an overview of the programming tools suite
  - Explain the functionality of individual tools
  - Teach how to use the tools effectively
  - Offer hands-on experience and expert assistance using tools
  - Receive feedback from users to guide future development
- For best results, bring & analyze/tune your own code(s)!

- VI-HPS Hands-on Tutorial series
  - **SC**'08-11/13/14/15/16/17, ICCS'09, Cluster'10, EuroMPI'12/14, XSEDE'13, **ISC-HPC**'15-18
- VI-HPS Tuning Workshop series
  - 2008 (x2), 2009 (x2), 2010 (x2), 2011 (x2), 2012 (x2), 2013 (x2), 2014(x4)
  - 2015 (Stuttgart/Germany, Grenoble/France, Santiago/Chile)
  - 2016 (Kobe/Japan, Garching/Germany, Cambridge/UK, Livermore/USA)
  - 2017 (Southampton/UK, Aachen/Germany, Bruyères-le-Châtel/France)
  - 2018 (Garching/Germany, London/UK, Reims/France), 2019 (Barcelona/Spain)

VI-HPS Tuning Workshop series



1. 2008/03/05+3: RWTH, Aachen, Germany
2. 2008/10/08+3: ZIH, Dresden, Germany
3. 2009/02/16+5: JSC, Jülich, Germany
4. 2009/09/09+3: HLRN, Bremen, Germany
5. 2010/03/08+3: TUM, Garching, Germany
6. 2010/05/26+3: SARA, Amsterdam, Netherlands
7. 2011/03/28+3: HLRS, Stuttgart, Germany
8. 2011/09/05+5: GRS, Aachen, Germany
9. 2012/04/23+5: UVSQ, St-Quentin, France
10. 2012/10/16+4: LRZ, Garching, Germany
11. 2013/04/22+4: MdS, Saclay, France
12. 2013/10/07+5: JSC, Jülich, Germany
13. 2014/02/10+5: BSC, Barcelona, Spain
14. 2014/03/25+3: RIKEN AICS, Kobe, Japan
15. 2014/04/07+4: MdS, Saclay, France
16. 2014/04/29+3: EPCC, Edinburgh, Scotland
17. 2015/02/23+5: HLRS, Stuttgart, Germany
18. 2015/05/18+5: UGA, Grenoble, France
19. 2015/10/27+3: NLHPC, Santiago, Chile
20. 2016/02/24+3: RIKEN AICS, Kobe, Japan
21. 2016/04/18+5: LRZ, Garching, Germany
22. 2016/07/06+3: Uni. Cambridge, England
23. 2016/07/27+3: LLNL, Livermore, California, USA
24. 2017/02/08+3: Uni. Southampton, England
25. 2017/03/27+5: RWTH, Aachen, Germany
26. 2017/10/16+5: Lab. ECR, Ter@tec, France
27. 2018/04/23+5: LRZ, Garching, Germany
28. 2018/06/21+3: UCL, London, England
29. 2018/10/15+5: ROMEO, Reims, France
30. 2019/01/21+5: BSC, Barcelona, Spain

Upcoming events

- 32nd VI-HPS Tuning Workshop (24-26 April 2019, Uni. Bristol, UK)
  - Using ARM ThunderX2-based *Isambard* Cray XC50
  - Extrae, Paraver, Score-P, Scalasca, TAU

- 33rd VI-HPS Tuning Workshop (24-29 June 2019, Jülich Supercomputing Ctr, Germany)

- Further events to be determined
  - (one-day) tutorials: with guided exercises sometimes using a Live-ISO/OVA
  - (multi-day) training workshops: with your own applications on actual HPC systems
- Check **www.vi-hps.org/training** for announced events

- Contact us if you might be interested in hosting a training event