

# International HPC Summer School 2022: Performance analysis and optimization

## VI-HPS Overview

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VI-HPS Team

Ilya Zhukov – Jülich Supercomputing Centre

# Virtual Institute – High Productivity Supercomputing

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- **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

allinea



## VI-HPS partners (cont.)



### Friedrich-Alexander-Universität

- Erlangen Regional Computing Center (RRZE)



### Technical University of Munich

- Chair for Computer Architecture



### University of Oregon

- Performance Research Laboratory



### University of Stuttgart

- HPC Centre



### University of Versailles St-Quentin

- Li-Parad

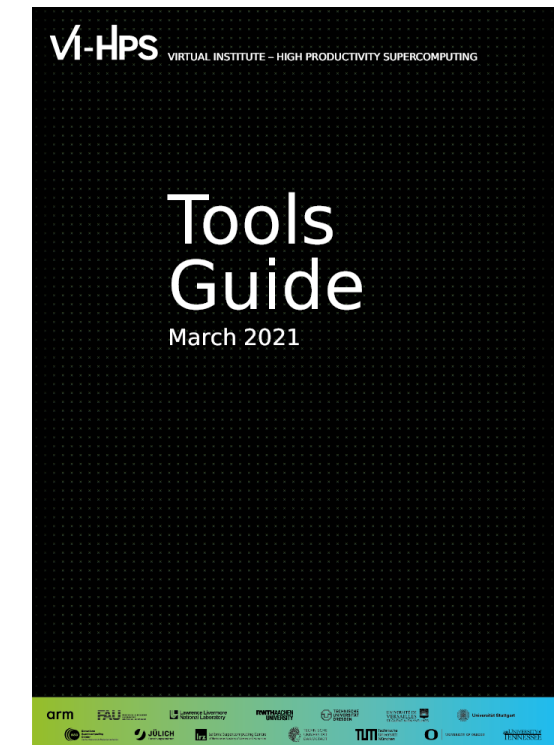


# Productivity tools

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- **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
- **Paraver/Dimemas/Extrae:**
  - Event tracing, graphical trace visualization & analysis
- **Scalasca**
  - Large-scale parallel performance analysis
- **Score-P**
  - Community-developed instrumentation & measurement infrastructure
- **TAU**
  - Integrated parallel performance system

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

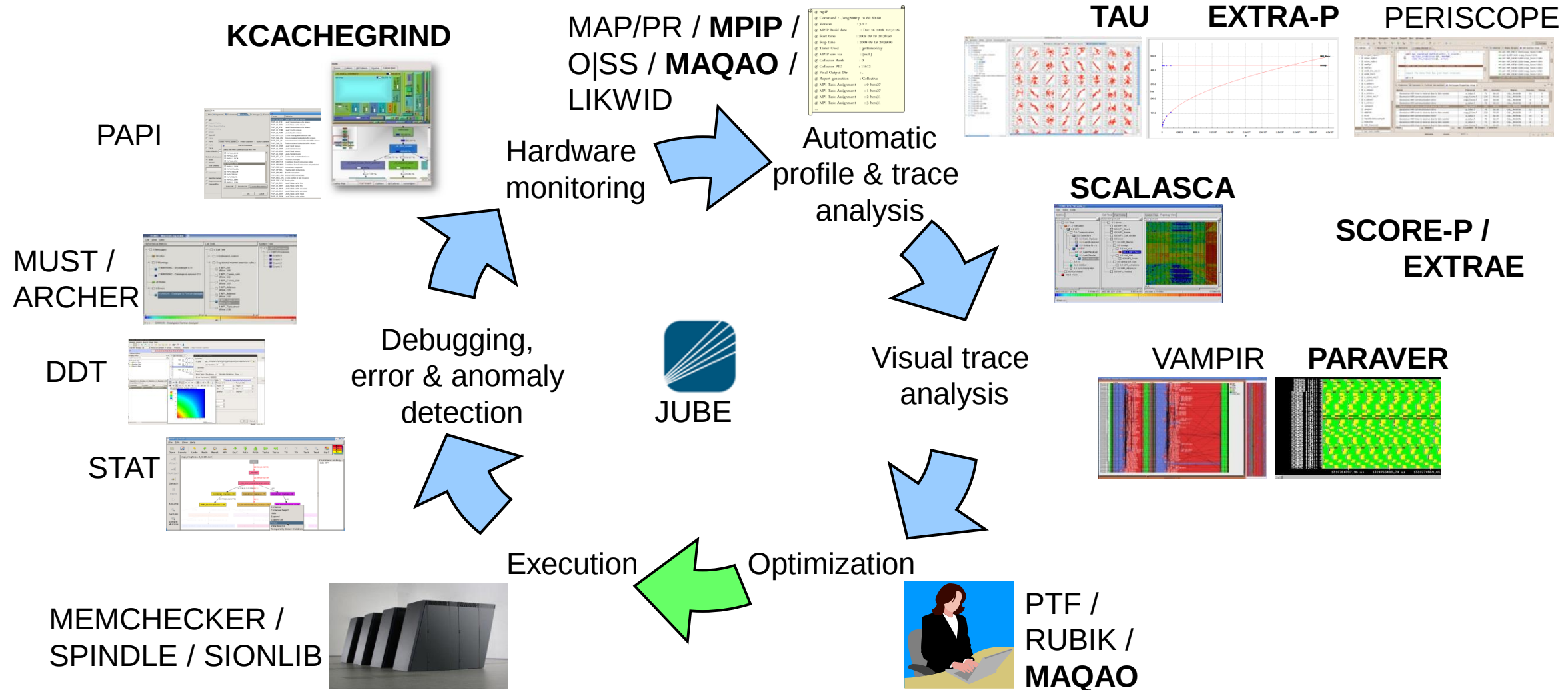


## Productivity tools (cont.)

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- **FORGE DDT/MAP/PR**: Parallel debugging, profiling & performance reports
- **JUBE**: Workflow execution environment
- **LIKWID**: Command-line performance tools suite
- **MUST & Archer**: MPI & OpenMP usage correctness checking
- **Open MPI**: Integrated memory checking
- **Open|SpeedShop**: Integrated parallel performance analysis environment
- **PAPI**: Interfacing to hardware performance counters
- **Periscope Tuning Framework**: Automatic analysis and Tuning
- **Rubik**: Process mapping generation & optimization [BG only]
- **SIONlib/Spindle**: Optimized native parallel file I/O & shared library loading
- **STAT**: Stack trace analysis tools
- **Vampir**: Interactive graphical trace visualization & analysis

# Technologies and their integration



## Disclaimer

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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

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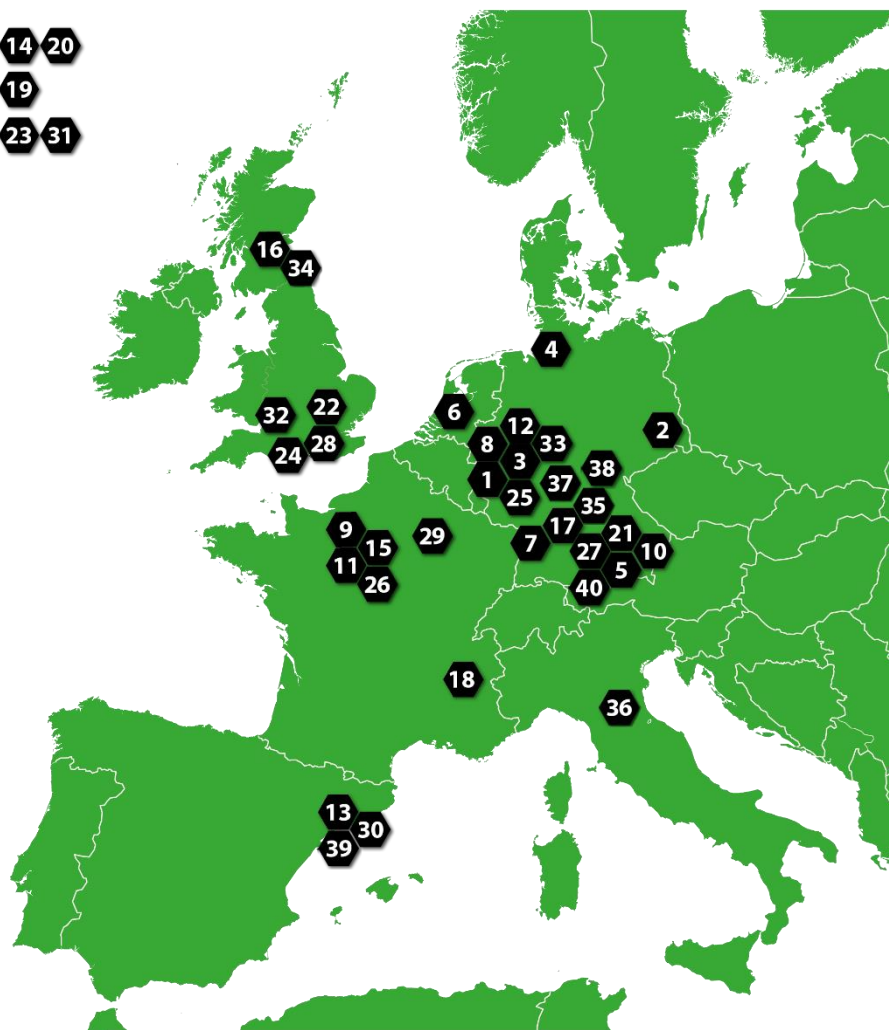
- Goals
  - Give an overview of the programming tools suite
  - Explain the functionality of individual tools
  - Teach how to use the tools effectively
  - Offer hands-on experience and expert assistance using tools
  - Receive feedback from users to guide future development
- For best results, bring & analyze/tune your own code(s)!
- VI-HPS Hands-on Tutorial series
  - SC'08-11/13/14/15/16/17/19, ICCS'09, Cluster'10, EuroMPI'12/14, XSEDE'13, ISC-HPC'15-19
- VI-HPS Tuning Workshop series
  - 2008 (x2), 2009 (x2), 2010 (x2), 2011 (x2), 2012 (x2), 2013 (x2), 2014(x4), 2015(x3)
  - 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](#), Knoxville/USA, [Bristol/UK](#), [Jülich/Germany](#))
  - 2020 ([EPCC/Scotland](#) / [Online](#), [HLRS/Germany](#) / [Online](#), CINECA/Italy / [Online](#), CSC/Germany / [Online](#))
  - 2021 (NHR@FAU/Germany / [Online](#), POP CoE / [ONLINE](#))
  - 2022 (JSC/Germany / [Online](#), POP CoE / [ONLINE](#))





# VI-HPS Tuning Workshop series

JP 14 20  
CL 19  
US 23 31



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
31. 2019/04/09+4: UTK-ICL, Knoxville/TN, USA
32. 2019/04/24+3: Uni. Bristol, England
33. 2019/06/24+5: JSC, Jülich, Germany
34. 2020/07/28+3: EPCC, Scotland / ONLINE
35. 2020/09/14+5: HLRS, Germany / ONLINE
36. 2020/09/30+3: CINECA, Italy / ONLINE
37. 2020/12/07+5: CSC, Germany / ONLINE
38. 2021/03/01+3: NHR@FAU, Germany / ONLINE
39. 2021/04/19+3: POP CoE / ONLINE
40. 2021/06/14+4: LRZ, Germany / ONLINE
41. 2022/02/07+4: JSC, Germany / ONLINE
42. 2022/05/17+2: POP CoE / ONLINE

## Upcoming events

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- 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](http://www.vi-hps.org/training) for announced events
- Contact us if you might be interested in hosting a training event

# Using AWS Instances for Hands-on

- Reserve an instance at <https://e4s.io/tutorial>
- If you have reserved tut032, please launch a browser at:  
<https://tut032.supercontainers.org:8443/#e4s>  
login: tutorial password: HPCLinux12!
- Please login, you may need to press space bar and re-enter the password
- Please launch the gnome-terminal from the desktop

