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Programming and Performance Visualization Tools

International Workshops, ESPT 2017 and VPA 2017
Denver, CO, USA, November 12 and 17, 2017
and ESPT 2018 and VPA 2018
Dallas, TX, USA, November 16 and 11, 2018
Revised Selected Papers

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Preface

This volume contains the proceedings of two instances each of two workshops, held in conjuction with the International Conference on High Performance Computing, Networking, Storage and Analysis (SC). The workshops are – Workshop on Extreme-Scale Programming Tools (ESPT) and International Workshop on Visual Performance Analysis (VPA).

ESPT 2017

The 6th Workshop on Extreme-Scale Programming Tools (ESPT) was held in conjunction with the International Conference on High Performance Computing, Networking, Storage and Analysis (SC) in Denver, Colorado, USA, on Sunday, November 12, 2017. The workshop focused on how the path to exascale computing challenges HPC application developers in their quest to achieve the maximum potential that the machines have to offer. Factors such as limited power budgets, clock frequency variability, heterogeneous load imbalance, hierarchical memories, and shrinking I/O bandwidths make it increasingly difficult to create high performance applications. Tools for debugging, performance measurement and analysis, and tuning are needed to overcome the architectural, system, and programming complexities envisioned in exascale environments. At the same time, research and development progress for HPC tools faces equally difficult challenges from exascale factors. Increased emphasis on autotuning, dynamic monitoring and adaptation, heterogeneous analysis, and so on require new methodologies, techniques, and engagement with application teams.

The ESPT 2017 workshop served as a forum for HPC application developers, system designers, and tools researchers to discuss the requirements for exascale-enabled tools and the roadblocks that need to be addressed. It was the sixth instantiation of successful SC conference workshops organized by the Virtual Institute – High Productivity Supercomputing (VI-HPS), an international initiative of HPC researchers and developers focused on parallel programming and performance tools for large-scale systems. The workshop topics of interest included:

- Programming tools (e.g., performance analysis, tuning, debuggers, IDEs)
- Methodologies for performance engineering
- Tool technologies for extreme-scale challenges (e.g., scalability, resilience, power)
- Tool infrastructures and environments
- Evolving/future application requirements for programming tools and technologies
- Application developer experiences with programming and performance tools

More information can be found at: http://www.vi-hps.org/symposia/espt/espt-sc17.html.

ESPT 2017 was a full-day workshop consisting of a keynote address in the morning followed by research paper presentations and an open debate in the afternoon. All submitted research papers underwent a rigorous review process. A total of 13 papers were submitted, with three to four reviews provided for each paper. The ESPT organizers made final decisions on paper selection. A total of eight papers were accepted and each paper was allotted 30 minutes for presentation. This volume contains seven of the eight accepted papers from the ESPT 2017 proceedings.

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Special thanks: Marc-Andre Hermanns, Jülich Supercomputing Centre, Germany

ESPT 2018

The 2018 Workshop on Extreme-Scale Programming Tools (ESPT) was held in conjunction with the International Conference on High Performance Computing, Networking, Storage and Analysis (SC) in Dallas, Texas, USA, on Friday, November 16, 2018. It was the seventh instantiation of successful SC conference workshops organized by the Virtual Institute – High Productivity Supercomputing (VI-HPS), an international initiative of HPC researchers and developers focused on parallel programming and performance tools for large-scale systems.

The path to extreme computing keeps broadening: Large-scale systems toward exascale and beyond, growing many-core systems with deep memory hierarchies and massively parallel accelerators are just a few of the platforms we can expect. This trend will challenge HPC application developers in their quest to achieve the maximum potential that their systems have to offer, both on and across nodes. Factors such as limited power budgets, heterogeneity, hierarchical memories, shrinking I/O bandwidths, and performance variability will make it increasingly difficult to create productive applications on future platforms. To address these challenges, we need tools for debugging, performance measurement and analysis, and tuning to overcome the architectural, system, and programming complexities expected in these environments. At the same time, research and development progress for HPC tools faces equally difficult challenges from exascale factors. Increased emphasis on autotuning, dynamic monitoring and adaptation, heterogeneous analysis, and so on require new methodologies, techniques, and engagement with application teams.

Like its predecessors, the ESPT 2018 workshop served as a forum for HPC application developers, system designers, and tools researchers to discuss the requirements for exascale-enabled tools and the roadblocks that need to be addressed. The workshop topics of interest included:

- Programming tools (e.g., performance analysis, tuning, debuggers, IDEs)
- Methodologies for performance engineering
- Tool technologies for extreme-scale challenges (e.g., scalability, resilience, power)
- Tool support for accelerated architectures and large-scale multi-cores
- Tool infrastructures and environments
- Evolving/future application requirements for programming tools and technologies
- Application developer experiences with programming and performance tools

More information can be found at: http://www.vi-hps.org/symposia/espt/espt-sc18.html.

ESPT 2018 was a half-day workshop consisting of two keynote addresses and a session of research paper presentations. All submitted research papers underwent a rigorous review process. A total of five papers were submitted, with three to five reviews provided for each paper. The ESPT organizers made final decisions on paper selection. A total of four papers were accepted and each paper was allotted 30 minutes for presentation. This volume contains the ESPT 2018 proceedings.

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VPA 2017

The Fourth International Workshop on Visual Performance Analysis (VPA 17) was held in conjunction with the International Conference on High Performance Computing, Networking, Storage and Analysis (SC 17) in Denver, Colorado, USA, on Friday, November 17, 2017 and in cooperation with TCHPC: The IEEE Computer Society Technical Consortium on High Performance Computing.

Over the past decades an incredible amount of resources has been devoted to building ever more powerful supercomputers. However, exploiting the full capabilities of these machines is becoming exponentially more difficult with each new generation of hardware. To help understand and optimize the behavior of massively parallel simulations, the performance analysis community has created a wide range of tools and APIs to collect performance data, such as flop counts, network traffic, or cache behavior at the largest scale. However, this success has created a new challenge, as the resulting data are far too large and too complex to be analyzed in a straightforward manner. Therefore, new automatic analysis and visualization approaches must be developed to allow application developers to intuitively understand the multiple, interdependent effects that their algorithmic choices have on the final performance.

This workshop brought together researchers from the fields of performance analysis and visualization to discuss new approaches of applying visualization and visual analytics techniques to large-scale applications. The workshop topics of interest included:

- Scalable displays of performance data
- Data models to enable scalable visualization
- Graph representation of unstructured performance data
- Presentation of high-dimensional data
- Visual correlations between multiple data source
- Human–computer interfaces for exploring performance data
- Multiscale representations of performance data for visual exploration

More information can be found here: https://vpa17.github.io.

VPA 17 was a half-day workshop consisting of a keynote address by Dr. Lucy Nowell of the U.S. Department of Energy titled "Visual Performance Analysis for Extremely Heterogeneous Systems" as well as a panel discussion on "Challenges and the Future of HPC Performance Visualization." Research paper presentations were mixed into these two sessions. All submitted research papers underwent a rigorous review process. A total of six papers were submitted, with five reviews provided for each paper. The VPA workshop chairs made final decisions on paper selection. A total of three papers were accepted and each paper was allotted 25 minutes for presentation. This volume contains two of three accepted papers from the VPA 2017 proceedings.

Workshop Chairs

Fabian Beck	University of Duisburg-Essen, Germany
Abhinav Bhatele	Lawrence Livermore National Laboratory, USA
Judit Gimenez	Barcelona Supercomputing Center, Spain
Joshua A. Levine	University of Arizona, USA

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Carlos Scheidegger   University of Arizona, USA
Chad Steed   Oak Ridge National Laboratory, USA

VPA 2018

The Fifth International Workshop on Visual Performance Analysis (VPA 2018) was held in conjunction with the International Conference on High Performance Computing, Networking, Storage and Analysis (SC 2018) in Dallas, Texas, USA, on Sunday, November 11, 2018.

Over the past decades an incredible amount of resources has been devoted to building ever more powerful supercomputers. However, exploiting the full capabilities of these machines is becoming exponentially more difficult with each new generation of hardware. To help understand and optimize the behavior of massively parallel simulations, the performance analysis community has created a wide range of tools and APIs to collect performance data, such as flop counts, network traffic, or cache behavior at the largest scale. However, this success has created a new challenge, as the resulting data are far too large and too complex to be analyzed in a straightforward manner. Therefore, new automatic analysis and visualization approaches must be developed to allow application developers to intuitively understand the multiple, interdependent effects that their algorithmic choices have on the final performance.

This workshop brought together researchers from the fields of performance analysis and visualization to discuss new approaches of applying visualization and visual analytics techniques to large-scale applications. The workshop topics of interest included:

- Scalable displays of performance data
- Case studies demonstrating the use of performance visualization in practice
- Data models to enable scalable visualization
- Graph representation of unstructured performance data
- Presentation of high-dimensional data
- Visual correlations between multiple data source
- Human–computer interfaces for exploring performance data
- Multi-scale representations of performance data for visual exploration

More information can be found here: https://vpa18.github.io.

VPA 18 was a half-day workshop consisting of a keynote address by Dr. Allen Malony of the University of Oregon, USA titled "Not Your Mama's Angry Fruit Salad: Ruminations on 30 Years of Performance Visualization and Visual Performance Analysis" and research paper presentations. All submitted research papers underwent a rigorous review process. A total of five papers were submitted, with three to five reviews provided for each paper. The VPA workshop chairs made final decisions on

paper selection. A total of four papers were accepted and each paper was allotted 25 minutes for presentation. This volume contains the VPA 2018 proceedings.

Workshop Chairs

Abhinav Bhatele   Lawrence Livermore National Laboratory, USA
Katherine Isaacs   University of Arizona, USA
Kevin Huck   University of Oregon, USA

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