PHILIP C. ROTH

Oak Ridge National Laboratory
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EXPERIENCE

2020–present *Group Leader*
Algorithms and Performance Analysis Group
Science Engagement Section
Center for Computational Sciences
Oak Ridge National Laboratory (ORNL)
Oak Ridge, TN

Leading group of performance engineers, applied mathematicians, and domain scientists doing performance optimization and software characterization of applications targeting high performance computing (HPC) systems deployed by the Oak Ridge Leadership Computing Facility (OLCF), with special emphasis on the Frontier exascale system being deployed in 2021. Responsibilities include assessment and management of overall group health, performance management of group members, and hiring, while still conducting research and development activities such as evaluation of programming model evaluation targeting HPC systems, and liaison activities to projects with allocations on OLCF systems. Mentoring two postdocs (one of whom started before my selection as group leader).

2020 *Senior R&D Staff Member*
2018–2020 *R&D Staff Member*
Scientific Computing Group
Center for Computational Sciences
Oak Ridge National Laboratory
Oak Ridge, TN

Analyzed and optimized software running on HPC systems deployed by the OLCF and similar systems elsewhere. Evaluated programming models targeting those systems. Served as liaison to several projects with allocations on OLCF systems. Mentored one postdoc, one summer intern.

2006–2018 *R&D Staff Member*
2004–2006 *Associate R&D Staff Member*

Future Technologies Group
Computer Science and Mathematics Division (CSMD)
Oak Ridge National Laboratory
Oak Ridge, TN

Investigated techniques for performance analysis and application characterization, with emphasis on large scale parallel computation. Optimized performance for several fusion and fission SciDAC-3 and SciDAC-4 application partnership projects.
Principal investigator for:

- "An Evaluation of the Performance of Functional Programming for Extreme Scale Computing" (2014–2016), Exploratory Research for Extreme-Scale Science program of DOE Office of Advanced Scientific Computing Research (ASCR)
- ORNL Lab Director's Research and Development fund project (2005–2007) titled "Exploring Automated Performance Tools for Petascale Systems with Lightweight Compute Node Kernels"

Co-Principal Investigator for:

- Institute for Sustained Performance, Energy, and Resilience (SUPER) project (2016–2017), DOE Office of Science's Scientific Discovery through Advanced Computing (SciDAC) program
- Performance Engineering Research Institute (PERI) project (2010–2011), ASCR SciDAC program
- "Building a Community Infrastructure for Scalable On-Line Performance Analysis Tools Around Open|-SpeedShop" (2009–2011), ASCR Software Development Tools for Improved Ease-of-Use of Petascale System program
- Petascale Data Storage Institute project (2006–2010) in the ASCR SciDAC program
- "A Path to Operating System and Runtime Support for Extreme Scale Tools" (2008–2010), ASCR FASTOS program

Primary maintainer of Future Technology group's Experimental Computing Laboratory until early 2017. Mentored one postdoc, several summer interns, and visiting students. Served as CSMD representative to Computer and Computational Science Directorate's operations council 2010–2012.

1998–2004 *Research Assistant*

Paradyn Project
University of Wisconsin, Madison
Madison, WI

Focused on improving the scalability of automated performance diagnosis. Developed and evaluated the Distributed Performance Consultant, an on-line automated approach for performance diagnosis. Part of team that developed and evaluated the MRNet scalable tool infrastructure. Developed and evaluated MRNet-based scalable performance diagnosis and performance diagnosis results visualization techniques.

1994–1998 *Software Developer* — *MCSB Technology (also known as CHEN Systems Corp. and SuperComputing Intl.) Eau Claire, WI*

Developed UnixWare and Windows system administration tools for award-winning CHEN 1000 server system.

1992–1994 *Research Assistant* — *Pablo Project, University of Illinois at Urbana-Champaign, Urbana, IL*

Developed method for reducing event trace data volume using statistical data clustering. Developed new user interface components for the Pablo performance tool.

1990–1992 *Undergraduate Research Assistant* — *ECE Parallel Processing Laboratory, University of Iowa, Iowa City, IA*

Contributed to development of parallel computation simulator based on timed Petri net model.

1988–1990 *Undergraduate Research Assistant* — *Physics Department, University of Iowa, Iowa City, IA*

Assisted in deployment of high energy particle detector at Fermi National Accelerator Laboratory, Summer 1990.

EDUCATION

1998–2005 *Ph.D. in Computer Science* — *University of Wisconsin, Madison, Madison, WI*

Thesis titled "Scalable On-line Automated Performance Diagnosis" supervised by Prof. Barton P. Miller. Minor in Business. GPA 3.9/4.

1992–1996 *M.S. in Computer Science* — *University of Illinois at Urbana-Champaign, Urbana, IL*

Thesis titled "ETRUSCA: Event Trace Reduction Using Statistical Data Analysis" supervised by Prof. Daniel A. Reed. GPA 4.9/5.

1988–1992 *B.S. in Computer Science and Mathematics* — *University of Iowa, Iowa City, IA*

Degree conferred "with highest distinction." GPA 4.0/4.

PUBLICATIONS

Peer-Reviewed Conference/Workshop Papers

1. W. R. Elwasif, A. Lasa, P. C. Roth, T. R. Younkin, and M. R. Cianciosa. "Nested Workflows for Loosely Coupled HPC Simulations". In: *2019 IEEE/ACS 16th International Conference on Computer Systems and Applications (AICCSA)*. 2019, pp. 1–8.
2. P. C. Roth, K. Huck, G. Gopalakrishnan, and F. Wolf. "Using Deep Learning for Automated Communication Pattern Characterization: Little Steps and Big Challenges". In: Lecture Notes in Computer Science 11027 (2019): *Proceedings of ESPT 2017, ESPT 2018, VPA 2017, VPA 2018*. Ed. by A. Bhatele, D. Boehme, J. A. Levine, A. D. Malony, and M. Schulz, pp. 265–272.
3. P. C. Roth. "Improved Accuracy for Automated Communication Pattern Characterization Using Communication Graphs and Aggressive Search Space Pruning". In: Lecture Notes in Computer Science 11027 (2019): *Proceedings of ESPT 2017, ESPT 2018, VPA 2017, VPA 2018*. Ed. by A. Bhatele, D. Boehme, J. A. Levine, A. D. Malony, and M. Schulz, pp. 38–55.
4. P. C. Roth, H. Shan, D. Riegner, N. Antolin, S. Sreepathi, L. Oliker, S. Williams, S. Moore, and W. Windl. "Performance Analysis and Optimization of the RAMPAGE Metal Alloy Potential Generation Software". In: *Proceedings of the 4th ACM SIGPLAN International Workshop on Software Engineering for Parallel Systems (SEPS'17)*. Vancouver, British Columbia, Canada, Oct. 2017.
5. W. Xie, Y. Chen, and P. C. Roth. "Parallel-DFTL: a Flash Translation Layer That Exploits Internal Parallelism in Solid State Drives". In: *Proceedings of the 11th IEEE International Conference on Networking, Architecture, and Storage (NAS'16). Best Paper Award nominee.* Long Beach, California, USA, Aug. 2016.
6. W. Xie, Y. Chen, and P. C. Roth. "A Low-Cost Adaptive Data Separation Method for the Flash Translation Layer of Solid State Drives". In: *Proceedings of the 2015 International Workshop on Data-Intensive Scalable Computing Systems*. DISCS '15. Austin, Texas, USA, Nov. 2015.
7. M. G. Lopez, J. Young, J. S. Meredith, P. C. Roth, M. Horton, and J. S. Vetter. "Examining Recent Many-Core Architectures and Programming Models Using SHOC". In: *Proceedings of the 6th International Workshop on Performance Modeling, Benchmarking, and Simulation of High Performance Computing Systems*. PMBS '15. Austin, Texas, USA, Nov. 2015.
8. P. C. Roth, J. S. Meredith, and J. S. Vetter. "Automated Characterization of Parallel Application Communication Patterns". In: *Proceedings of the 24th International Symposium on High-Performance Parallel and Distributed Computing (HPDC '15)*. Portland, Oregon, USA, June 2015, pp. 73–84.
9. S. Sreepathi, M. L. Grodowitz, R. Lim, P. Taffet, P. C. Roth, J. Meredith, S. Lee, D. Li, and J. Vetter. "Application Characterization Using Oxbow Toolkit and PADS Infrastructure". In: *Proceedings of the 1st International Workshop on Hardware-Software Co-Design for High Performance Computing (Co-HPC 2014)*. New Orleans, Louisiana, USA, Nov. 2014, pp. 55–63.
10. J. Chen, J. Liu, P. Roth, and Y. Chen. "Using Working Set Reorganization to Manage Storage Systems with Hard and Solid State Disks". In: *2014 43nd International Conference on Parallel Processing Workshops (ICCPW)*. Los Alamitos, CA, USA, Sept. 2014, pp. 283–291.
11. P. C. Roth and J. S. Meredith. "Value Influence Analysis for Message Passing Applications". In: *Proceedings of the 28th ACM International Conference on Supercomputing (ICS '14)*. Munich, Germany, June 2014, pp. 145–154.
12. J. S. Vetter, S. Lee, D. Li, G. Marin, C. McCurdy, J. Meredith, P. C. Roth, and K. Spafford. "Quantifying Architectural Requirements of Contemporary Extreme-Scale Scientific Applications". In: (2014): *Proceedings of the 4th International Workshop on Performance Modeling, Benchmarking and Simulation of High Performance Computing Systems (PMBS 2013)*. Ed. by S. A. Jarvis, S. A. Wright, and S. D. Hammond, pp. 3–24.

13. J. Chen, P. C. Roth, and Y. Chen. “Using pattern-models to guide SSD deployment for Big Data applications in HPC systems”. In: *Proceedings of the 2013 IEEE International Conference on Big Data*. Los Alamitos, California, USA, Oct. 2013, pp. 332–337.
14. P. C. Roth. “Tracking a value’s influence on later computation”. In: *Proceedings of the 6th Workshop on Productivity and Performance (PROPER 2013)*. Aachen, Germany, Aug. 2013.
15. C. Chen, Y. Chen, and P. C. Roth. “DOSAS: Mitigating the Resource Contention in Active Storage Systems”. In: *2012 IEEE International Conference on Cluster Computing*. Beijing, China, Sept. 2012, pp. 164–172.
16. K. L. Spafford, J. S. Meredith, S. Lee, D. Li, P. C. Roth, and J. S. Vetter. “The Tradeoffs of Fused Memory Hierarchies in Heterogeneous Computing Architectures”. In: *Proceedings of the 9th Conference on Computing Frontiers (CF ’12)*. Cagliari, Italy, May 2012, pp. 103–112.
17. P. C. Roth and J. S. Vetter. “Improving Programmer Productivity on Heterogeneous GPU Computing Systems by Broadening and Strengthening the Tools Ecosystem”. In: *Proceedings of the DOE Exascale Research Conference*. Portland, Oregon, USA, Apr. 2012.
18. X. Wu, K. Vijayakumar, F. Mueller, X. Ma, and P. C. Roth. “Probabilistic Communication and I/O Tracing with Deterministic Replay at Scale”. In: *Proceedings of the 2011 International Conference on Parallel Processing*. ICPP ’11. Taipei, Taiwan, Sept. 2011, pp. 196–205.
19. Y. Chen, X.-H. Sun, R. Thakur, P. C. Roth, and W. D. Gropp. “LACIO: A New Collective I/O Strategy for Parallel I/O Systems”. In: *Proceedings of the 2011 IEEE International Parallel & Distributed Processing Symposium (IPDPS 2011)*. Anchorage, Alaska, USA, May 2011, pp. 794–804.
20. Y. Chen and P. C. Roth. “Collective prefetching for parallel I/O systems”. In: *2010 5th Petascale Data Storage Workshop (PDSW ’10)*. New Orleans, Louisiana, USA, Nov. 2010, pp. 1–5.
21. A. Danalis, G. Marin, C. McCurdy, J. S. Meredith, P. C. Roth, K. Spafford, V. Tipparaju, and J. S. Vetter. “The Scalable Heterogeneous Computing (SHOC) Benchmark Suite”. In: *Proceedings of the 3rd Workshop on General-Purpose Computation on Graphics Processing Units*. GPGPU-3. Pittsburgh, Pennsylvania, USA, Mar. 2010, pp. 63–74.
22. K. Vijayakumar, F. Mueller, X. Ma, and P. C. Roth. “Scalable I/O Tracing and Analysis”. In: *Proceedings of the 4th Annual Workshop on Petascale Data Storage (PDSW ’09)*. Portland, Oregon, USA, Nov. 2009, pp. 26–31.
23. P. C. Roth and J. S. Vetter. “Scalable Tool Infrastructure for the Cray XT Using Tree-Based Overlay Networks”. In: *Proceedings of the Cray User Group Meeting (CUG 2009)*. Atlanta, Georgia, USA, May 2009.
24. S. Alam, R. Barrett, M. Bast, M. R. Fahey, J. Kuehn, C. McCurdy, J. Rogers, P. Roth, R. Sankaran, J. S. Vetter, P. Worley, and W. Yu. “Early Evaluation of IBM BlueGene/P”. In: *Proceedings of the 2008 ACM/IEEE Conference on Supercomputing*. SC ’08. Austin, Texas, USA, Nov. 2008.
25. J. S. Vetter, V. Tipparaju, W. Yu, and P. C. Roth. “HPC Interconnection Networks: The Key to Exascale Computing”. In: *High Speed and Large Scale Scientific Computing - Selected Papers from the High Performance Computing Workshop, Cetraro, Italy, June 30 - July 4, 2008*. Ed. by W. Gentzsch, L. Grandinetti, and G. R. Joubert. Vol. 18. Advances in Parallel Computing. 2008, pp. 95–106.
26. P. C. Roth. “Characterizing the I/O Behavior of Scientific Applications on the Cray XT”. In: *Proceedings of the 2nd International Workshop on Petascale Data Storage (PDSW ’07)*. Reno, Nevada, USA, Nov. 2007, pp. 50–55.
27. R. A. Oldfield, S. Arunagiri, P. J. Teller, S. Seelam, M. R. Varela, R. Riesen, and P. C. Roth. “Modeling the Impact of Checkpoints on Next-Generation Systems”. In: *Proceedings of the 24th IEEE Conference on Mass Storage Systems and Technologies*. MSST ’07. San Diego, California, USA, 2007, pp. 30–46.
28. P. C. Roth and J. S. Vetter. “Intel Woodcrest: An Evaluation for Scientific Computing”. In: *Proceedings of the 8th LCI International Conference on High-Performance Clustered Computing*. South Lake Tahoe, CA, May 2007.

29. S. R. Alam, R. F. Barrett, J. A. Kuehn, P. C. Roth, and J. S. Vetter. "Characterization of Scientific Workloads on Systems with Multi-Core Processors". In: *Proceedings of the 2006 IEEE International Symposium on Workload Characterization*. San Jose, California, USA, Oct. 2006, pp. 225–236.
30. P. C. Roth and B. P. Miller. "On-line automated performance diagnosis on thousands of processes". In: *Proceedings of the 11th ACM SIGPLAN symposium on Principles and practice of parallel programming*. PPoPP '06. New York, New York, USA, Mar. 2006, pp. 69–80.
31. J. S. Vetter, N. Bhatia, E. M. Grobelny, and P. C. Roth. "Capturing Petascale Application Characteristics with the Sequoia Toolkit". In: *Parallel Computing: Current & Future Issues of High-End Computing, Proceedings of the International Conference ParCo 2005, 13-16 September 2005, Department of Computer Architecture, University of Malaga, Spain*. Ed. by G. R. Joubert, W. E. Nagel, F. J. Peters, O. G. Plata, P. Tirado, and E. L. Zapata. Vol. 33. John von Neumann Institute for Computing Series. 2005, pp. 917–924.
32. J. S. Vetter, S. R. Alam, J. T. H. Dunigan, M. R. Fahey, P. C. Roth, and P. H. Worley. "Early Evaluation of the Cray XT3 at ORNL". In: *Cray User Group Meeting (CUG 2005)*. Albuquerque, May 2005.
33. P. C. Roth, D. C. Arnold, and B. P. Miller. "MRNet: A Software-Based Multicast/Reduction Network for Scalable Tools". In: *Proceedings of the 2003 International Conference for High Performance computing, Networking, Storage and Analysis*. *Best Student Paper Award nominee*. Phoenix, Arizona, USA, 2003, pp. 21–36.
34. P. C. Roth and B. P. Miller. "Deep Start: A Hybrid Strategy for Automated Performance Problem Searches". In: *Proceedings of the 8th International Euro-Par Conference on Parallel Processing*. Euro-Par '02. Paderborn, Germany, 2002, pp. 86–96.
35. O. Y. Nickolayev, P. C. Roth, and D. A. Reed. "Real-Time Statistical Clustering for Event Trace Reduction". In: *The International Journal of Supercomputer Applications and High Performance Computing* 11.2 (1997): *Proceedings of the Third Workshop on Environments and Tools for Parallel Scientific Computing*, pp. 144–159.
36. D. A. Reed, P. C. Roth, R. A. Aydt, K. A. Shields, L. F. Tavera, R. J. Noe, and B. W. Schwartz. "Scalable Performance Analysis: the Pablo Performance Analysis Environment". In: *Proceedings of Scalable Parallel Libraries Conference*. Starkville, Mississippi, USA, Oct. 1993, pp. 104–113.

Journal Articles

1. A. Lasa, S. Blondel, D. Bernholdt, J. Canik, M. Cianciosa, W. Elwasif, D. Green, P. Roth, T. Younkin, D. Curreli, J. Drobny, and B. Wirth. "Integrated Model Predictions on the Impact of Substrate Damage on Gas Dynamics During ITER Burning-Plasma Operations". In: *Nuclear Fusion* (2021 (under review)).
2. D.-U. Kim, S. Blondel, D. E. Bernholdt, P. Roth, F. Kong, D. Andersson, M. R. Tonks, and B. D. Wirth. "Modeling Mesoscale Fission Gas Behavior in UO2 By Directly Coupling the Phase Field method to Spatially Resolved Cluster Dynamics". In: *Materials Theory* (2021 (under review)).
3. W. Xie, Y. Chen, and P. C. Roth. "Exploiting Internal Parallelism for Address Translation in Solid-State Drives". In: *ACM Trans. Storage* 14.4 (Dec. 2018).
4. W. Xie, Y. Chen, and P. C. Roth. "ASA-FTL: An adaptive separation aware flash translation layer for solid state drives". In: *Parallel Computing* 61 (2017): *Special Issue on 2015 Workshop on Data Intensive Scalable Computing Systems (DISCS-2015)*, pp. 3–17.
5. J. S. Meredith, P. C. Roth, K. L. Spafford, and J. S. Vetter. "Performance Implications of Non-Uniform Device Topologies in Scalable Heterogeneous Architectures". In: *IEEE Micro* 31.5 (2011), pp. 66–75.
6. Y. Chen, H. Zhu, P. C. Roth, H. Jin, and X.-H. Sun. "Global-aware and multi-order context-based prefetching for high-performance processors". In: *The International Journal of High Performance Computing Applications* 25.4 (2011), pp. 355–370.

7. B. R. de Supinski, S. R. Alam, D. H. Bailey, L. Carrington, C. Daley, A. Dubey, T. Gamblin, D. Gunter, P. D. Hovland, H. Jagode, K. Karavanic, G. Marin, J. M. Mellor-Crummey, S. Moore, B. Norris, L. Oliker, C. Olschanowsky, P. C. Roth, M. Schulz, S. Shende, A. Snavely, W. Spear, M. Tikir, J. S. Vetter, P. H. Worley, and N. J. Wright. "Modeling the Office of Science ten year facilities plan: The PERI Architecture Tiger Team". In: *Journal of Physics: Conference Series* 180.1 (2009).
8. S. R. Alam, R. F. Barrett, M. R. Fahey, J. A. Kuehn, O. B. Messer, R. T. Mills, P. C. Roth, J. S. Vetter, and P. H. Worley. "An Evaluation of the Oak Ridge National Laboratory Cray XT3". In: *The International Journal of High Performance Computing Applications* 22.1 (2008), pp. 52–80.

Dissertation/Thesis

1. P. C. Roth. "Scalable On-line Automated Performance Diagnosis". Ph.D. dissertation. University of Wisconsin, Madison, 2005.
2. P. C. Roth. "ETRUSCA: Event Trace Reduction Using Statistical Data Clustering Analysis". M.S. thesis. University of Illinois at Urbana-Champaign, 1996.

PROFESSIONAL ACTIVITIES

- Conference/Workshop Organizing Committee Roles:
  - SC: executive director 2022; SCinet physical security chair 2021; workshops chair 2020; security team member 2019; finance liaison to Technical Program 2018; executive director 2017; tutorials chair 2016; security chair 2015; signage chair 2014; birds of a feather chair 2013; awards vice chair 2012; posters co-chair 2011
  - 23rd International Workshop on High-Level Parallel Programming Models and Supportive Environments (HIPS'18) workshops co-chair
  - International Workshop on Data Intensive Scalable Computing Systems (DISCS) general chair 2015, program committee co-chair 2013–2014
  - International Conference on Parallel Processing (ICPP): proceedings chair 2021, proceedings vice chair 2019, proceedings chair 2018
  - Petascale/Parallel Data Storage Workshop (PDSW) steering committee 2010–2019
- Conference/Workshop Program Committee Roles:
  - SC: technical papers 2019, 2013, 2010, 2007, 2006; posters 2014, 2013, 2012, 2005; dissertation research showcase 2012
  - International Workshop on Performance, Portability and Productivity in HPC (P3HPC) 2019
  - International Workshop on Data Intensive Scalable Computing Systems (DISCS) 2012
  - International Conference on Supercomputing (ICS) 2014, 2013, 2011
  - International Conference on Parallel Processing (ICPP) 2021, 2010, 2007
  - International Conference on Parallel and Distributed Systems (ICPADS) 2010
  - IEEE International Conference on Cluster Computing (Cluster) 2016, 2015, 2010
  - International Parallel and Distributed Processing Symposium (IPDPS) 2012, 2011
  - International LCI Conference on Clustered Computing 2007–2010
  - International Conference on High Performance Computing and Communications (HPCC) 2007, 2006
  - Symposium on High-Performance Parallel and Distributed Computing (HPDC) 2011
  - International Workshop on High-Level Programming Models and Supportive Environments (HIPS) 2016, 2008–2010
  - International Workshop on Scalable Tools for High-End Computing (STHEC) 2008

  - Petascale/Parallel Data Storage Workshop (PDSW) program committee 2007–2009
  - Workshop on Parallel Software Tools and Tool Infrastructures (PSTI) 2013, 2011

- Editing
  - Parallel Computing, Systems & Applications, Guest Editor, 2017, 2014
  - International Journal of High Performance Computing Applications, Subject Area Editor, 2015

- Journal Reviewing
  - International Journal on High Performance Computing Applications (IJHPCA), 2019, 2016, 2006
  - Cluster Computing, 2019, 2016, 2015, 2012
  - IEEE Transactions on Parallel and Distributed Systems (TPDS), 2016, 2009
  - Journal of Parallel and Distributed Computing (JPDC), 2014
  - Concurrency and Computation: Practice and Experience, 2009, 2006
  - Parallel and Distributed Computing Practices, 2001

- Proposal Reviewing
  - DOE Small Business Innovation Research (SBIR) and Small Business Technology Transfer (STTR), 2014–2019, 2011, 2009
  - DOE Innovative and Novel Computational Impact on Theory and Experiment (INCITE) computational readiness, 2019–2021, 2007–2009
  - DOE Office of Science Graduate Fellowship (SGCF), 2012

- Member of ACM, ACM SIGHPC, and IEEE Computer Society.

AWARDS AND HONORS

- Best Paper Award nominee, IEEE NAS'16
- ORNL CSMD Award for Most Distinguished Software Released in the Last Five Fiscal Years for the Scalable HeterOgeneous Computing benchmark suite (SHOC), 2013
- Best Student Paper Award nominee, SC2003
- University of Wisconsin, Madison Graduate Student Council Vilas Travel Fellowship, 2003
- Honorable Mention, National Science Foundation Graduate Fellowship, 1992–1993
- Barry M. Goldwater Scholarship winner, 1990-1992
- University of Iowa Ernest R. Johnson Memorial Prize (awarded to College of Liberal Arts graduates with the highest and second highest GPA), 1992
- National Merit Scholar, 1988–1992
- Phi Beta Kappa

REFERENCES

Dr. Bronson Messer
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