



CHRISTIAN ENGELMANN, PH.D.

SENIOR COMPUTER SCIENTIST & RESEARCH GROUP LEADER

EXTREME-SCALE COMPUTING | FAULT RESILIENCE | HW/SW CO-DESIGN TOOLS
COMPUTING CONTINUUM | AUTONOMOUS INSTRUMENTS | SELF-DRIVING LABORATORIES

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SUMMARY

Dr. Christian Engelmann is a Senior Computer Scientist and leads the Intelligent Systems and Facilities research group at Oak Ridge National Laboratory. He has more than 22 years experience in software research and development for extreme-scale high-performance computing (HPC) systems. His research solves computer science challenges in HPC software, such as scalability, dependability, and interoperability. Dr. Engelmann's primary expertise is in HPC resilience, i.e., efficiency and correctness in the presence of faults, errors, and failures. His secondary expertise is in system software for the instrument-to-edge-to-Cloud-to-center computing continuum, enabling science breakthroughs with autonomous experiments, self-driving laboratories, smart manufacturing, and artificial intelligence (AI) driven design, discovery and evaluation. He further has expertise in lightweight simulation of future-generation extreme-scale supercomputers, studying the impact of hardware/software properties on performance and resilience for application-architecture co-design. Dr. Engelmann is also an expert in operating system and runtime software for parallel and distributed systems.

ACCOMPLISHMENTS

14 Research grants: \$31.51M in total research funding \$9.48M with 6 grants as lead investigator	114 Peer-reviewed articles and papers: 13 Peer-reviewed journal articles 56 Peer-reviewed conference papers 45 peer-reviewed workshop papers	4,811 Publication citations: H-index: 34 i10-index: 72 Erdős number: 3
1 Co-advised Ph.D. thesis	13 Peer-reviewed posters	183 Committees at 48 conferences
8 Co-advised M.Sc. theses	61 Invited talks and seminars	62 Reviews for 18 journals/publishers
6 Mentored postdoctoral research associates		

AWARDS

EARLY CAREER AWARD – US DEPARTMENT OF ENERGY 8/2015

RECENTLY IN THE NEWS

- ORNL CCSD News: *INTERSECT demo introduces autonomous labs* 2/6/2023
- DOE ASCR: *New Approach to Fault Tolerance Means More Efficient High-Performance Computers* 3/30/2021
- HPCwire: *What's New in HPC Research: GPU Lifetimes, the Square Kilometre Array, Support Tickets & More* 1/4/2021
- HPCwire: *What's New in HPC Research: Thrill for Big Data, Scaling Resilience and More* 11/19/2018

PROFESSIONAL EXPERIENCE

GROUP LEADER, INTELLIGENT SYSTEMS AND FACILITIES – OAK RIDGE NATIONAL LABORATORY 10/2020-PRESENT

- Address system software research challenges for scientific instruments and facilities

SENIOR R&D STAFF – OAK RIDGE NATIONAL LABORATORY 4/2018-PRESENT

- Architect a federated instrument-to-edge-to-Cloud-to-center scientific computing ecosystem
- Prototype rOpenMP, a resilient parallel programming model for heterogeneous systems
- Early Career Award: Create design patterns, models and tools for resilience in supercomputers
- Establish a taxonomy, a catalog, and models of faults, errors and failures in extreme-scale systems

R&D STAFF – OAK RIDGE NATIONAL LABORATORY 9/2009-3/2018

- Develop resilient operating system and runtime software for extreme-scale scientific HPC
- Investigate resilient Monte Carlo solvers with natural fault tolerance for exascale HPC
- Implement performance/resilience modeling and simulation tools for HPC hardware/software co-design
- Prototype soft-error injection tools and study the vulnerability of scientific applications
- Create a HPC system software framework for monitoring, fault prediction, and proactive fault avoidance
- Design a HPC storage virtualization solution for checkpoint/restart
- Investigate the feasibility of and prototype transparent MPI-level computational redundancy
- Develop a light-weight simulation of extreme-scale HPC architectures with ~100,000,000 MPI processes

R&D ASSOCIATE – OAK RIDGE NATIONAL LABORATORY

5/2004-8/2009

- Create fault-tolerant MPI solutions: Scalable group membership, job pause, and process migration
- Develop a 99.9997% high availability solution for HPC system services, such as Torque and PVFS MDS
- Ph.D. thesis research: Create symmetric active/active high availability solutions for HPC system services
- Implement virtual system environments for “plug-and-play” HPC using hypervisors, such as Xen
- Enhance scientific application development via a common view across platforms, the Harness Workbench

POST-MASTER’S RESEARCH ASSOCIATE – OAK RIDGE NATIONAL LABORATORY

6/2001-4/2004

- Prototype the pluggable, lightweight, and fault tolerant Harness distributed virtual machine
- Develop a light-weight simulation of extreme-scale HPC architectures with ~1,000,000 MPI processes

SOFTWARE DEVELOPER – OAK RIDGE NATIONAL LABORATORY

8/2000-1/2001

- M.Sc. thesis research: Develop distributed peer-to-peer control for Harness, a fault-tolerant runtime

SOFTWARE DEVELOPER – HEWLETT-PACKARD, GERMANY

10/1998-9/1999

- Product R&D: Architect a graphical user interface server for an embedded mobile patient monitor

EDUCATION

PH.D. IN COMPUTER SCIENCE – UNIVERSITY OF READING, UK

12/2008

M.SC. IN COMPUTER SCIENCE – UNIVERSITY OF READING, UK

7/2001

DIPL.-ING. (FH) IN COMPUTER SYSTEMS ENGINEERING – UNIVERSITY OF APPLIED SCIENCES BERLIN, GERMANY

2/2001

HIGHLY CITED PEER-REVIEWED PUBLICATIONS

- [1] A. Nagarajan, F. Mueller, C. Engelmann, and S. Scott. **Proactive fault tolerance for HPC with Xen virtualization**. In *Intl. Conf. on Supercomputing (ICS)*, 2007. doi: 10.1145/1274971.1274978. Accept. rate 23.6%. 512 citations.
- [2] M. Snir et al. **Addressing failures in exascale computing**. *Intl. J. of High Performance Comp. Applications (IJHPCA)*, 28(2), 2014. doi: 10.1177/1094342014522573. 491 citations.
- [3] D. Fiala, F. Mueller, C. Engelmann, K. Ferreira, R. Brightwell, and R. Riesen. **Detection and correction of silent data corruption for large-scale high-performance computing**. In *Intl. Conf. on High Performance Comp., Networking, Storage and Analysis (SC)*, 2012. doi: 10.1109/SC.2012.49. Accept. rate 21.2%. 364 citations.
- [4] C. Wang, F. Mueller, C. Engelmann, and S. Scott. **Proactive process-level live migration in HPC environments**. In *Intl. Conf. on High Performance Comp., Networking, Storage and Analysis (SC)*, 2008. doi: 10.1145/1413370.1413414. Accept. rate 21.3%. 237 citations.
- [5] J. Elliott, K. Kharbas, D. Fiala, F. Mueller, K. Ferreira, and C. Engelmann. **Combining partial redundancy and checkpointing for HPC**. In *Intl. Conf. on Dist. Comp. Systems (ICDCS)*, 2012. doi: 10.1109/ICDCS.2012.56. Accept. rate 13.8%. 200 citations.

LATEST PEER-REVIEWED PUBLICATIONS

- [1] C. Engelmann, O. Kuchar, S. Boehm, M. Brim, T. Naughton, S. Somnath, S. Atchley, J. Lange, B. Mintz, and E. Arenholz. **The INTERSECT open federated architecture for the laboratory of the future**. In *Communications in Comp. and Information Science (CCIS): Accelerating Science and Engineering Discoveries Through Integrated Research Infrastructure for Experiment, Big Data, Modeling and Simulation. Smoky Mountains Computational Sciences & Engineering Conf. (SMC)*, volume 1690, 2022. doi: 10.1007/978-3-031-23606-8_11. Accept. rate 32.4%.
- [2] E. Agullo et al. **Resiliency in numerical algorithm design for extreme scale simulations**. *Intl. J. of High Performance Comp. Applications (IJHPCA)*, 36(2), 2022. doi: 10.1177/10943420211055188.
- [3] M. Kumar and C. Engelmann. **RDPM: An extensible tool for resilience design patterns modeling**. In *Lecture Notes in Comp. Science: European Conf. on Par. and Dist. Comp. (Euro-Par) Workshops: Workshop on Resiliency in High Performance Comp. (Resilience) in Clusters, Clouds, and Grids*, volume 13098, 2021. doi: 10.1007/978-3-031-06156-1_23. Accept. rate 66.7%.
- [4] M. Kumar, S. Gupta, T. Patel, M. Wilder, W. Shi, S. Fu, C. Engelmann, and D. Tiwari. **Study of interconnect errors, network congestion, and applications characteristics for throttle prediction on a large scale HPC system**. *J. of Parallel and Distributed Comp. (JPDC)*, 153, 2021. doi: 10.1016/j.jpdc.2021.03.001.
- [5] S. Hukerikar and C. Engelmann. **PLEXUS: A pattern-oriented runtime system architecture for resilient extreme-scale high-performance computing systems**. In *Pacific Rim Intl. Symp. on Dependable Comp. (PRDC)*, 2020. doi: 10.1109/PRDC50213.2020.00014. Accept. rate 40.9%.

OTHER IMPORTANT PROFESSIONAL ACTIVITIES

- Conference program committee (PC) member: *ARES, ICS, IPDPS, SC, PDP* Present
- PC chair: *SC Workshop on Latest Advances in Scalable Algorithms for Large-Scale Heterogeneous Systems* 2010-Present
- Chair/PC chair: *Euro-Par Workshop on Resiliency in High Performance Computing in Clusters, Clouds, and Grids* 2008-2022
- Member: *US Department of Energy’s Technical Council on HPC Resilience* 2013-2015

PROFESSIONAL SOCIETY MEMBERSHIPS

Advanced Computing Systems Association (USENIX), Association for Computing Machinery (ACM) – Senior Member, Institute of Electrical and Electronics Engineers (IEEE) – Senior Member, IEEE Communications Society (ComSoc), IEEE Computer Society (CS), IEEE Reliability Society (RL), Society for Industrial and Applied Mathematics (SIAM)