Trevor Keller, Ph. D.

1661 Linwood Drive ⋆ Wooster, Ohio 44691

Scientist and Sysadmin thriving at the intersection of mathematical models, high-performance computing, and data storage. Specializing in Linux clusters and solid-state microstructure evolution in metals. Passionate about building a better tomorrow.

Experience

National Institute of Standards and Technology

Materials Science and Engineering Division, Gaithersburg, MD

Research Engineer 2017 to Present

Maintained 70-node HPC cluster and data storage; improved research reproducibility by centralizing software builds; alleviated filesystem resource contention through workflow analysis and user education. Orchestrated democratic elections for High Performance Computing Carpentry, leading to incubation as a Carpentries Lesson Program.

Postdoctoral Associate 2015 to 2017

Implemented phase-field model for solid-state transformation in alloy systems with three components and four phases, analogous to Inconel 625, to simulate microstructure evolution during heat treatment of additively manufactured parts. Produced thermodynamic models through simplification of quantitative CALPHAD databases while retaining key phase diagram features, using computer algebra systems to accurately generate expressions and multivariable derivatives.

DayStar Technologies Materials Development Group, Clifton Park, NY

Process Engineer (part-time during M.S.) 2009 to 2011

Process Engineer 2009 to 2009

Process Technician 2006 to 2008

Achieved 72× scaleup in CdS deposition area with only 6× increase in waste generation. Researched alternatives to chemical bath deposition of CdS thin films, including nontoxic materials and novel reactor geometries. Traveled to Helsinki, Finland, to evaluate an atomic layer deposition reactor and reported back to senior management.

Education

Rensselaer Polytechnic Institute Troy, NY

Doctor of Philosophy in Materials Engineering 2011 to 2015

Thesis: Bias in Polycrystal Topology Caused by Grain Boundary Motion by Mean Curvature

Performed large-scale phase field simulations of normal isotropic grain growth on high performance computing clusters including AMOS, an IBM Blue Gene/Q supercomputer. Designed and implemented algorithms to reconstruct polyhedral grain topology (faces, edges, and vertices) from diffuse interfaces in 2D and 3D phase field datasets. Found the process of triangular face elimination responsible for biasing topology in populations of polyhedral grains in synthetic, simulated, and real metal microstructures.

Master of Science in Materials Engineering 2009 to 2011

Thesis: Effects of Magnesium(II) on Zinc Oxide Nanorod Growth From Aqueous Solution

Designed experiments to deposit ZnO on glass substrates using a novel flow-through aqueous chemical reactor. Found minor effects of Mg^{2+} ions on ZnO film stress and lattice parameters.

Bachelor of Science in Chemical Engineering 2002 to 2006

Trevor Keller, Ph. D.
1661 Linwood Drive ⋆ Wooster, Ohio 44691

Publications

HPC Carpentry: A scalable, peer-reviewed training program to democratize HPC access. A. Reid, A. O'Cais, T. Keller, W. Purwanto, and A. Alim Rasel. *Journal of Computational Science Education* **15** (2024) 32–34. DOI: 10.22369/issn.2153-4136/15/1/6.

PFHub: The Phase-Field Community Hub. D. Wheeler, T. Keller, S. DeWitt, A. Jokisaari, D. Schwen, J. Guyer, L. Aagesen, O. Heinonen, M. Tonks, P. Voorhees, and J. Warren. *Journal of Open Research Software* **7** (2019) 29. DOI: 10.5334/jors.276.

Application of finite element, phase-field, and CALPHAD-based methods to additive manufacturing of Ni alloys. T. Keller, G. Lindwall, S. Ghosh, L. Ma, B. Lane, F. Zhang, U. Kattner, J. Heigel, E. Lass, Y. Idell, M. Williams, A. Allen, J. Guyer, and L. Levine. *Acta Materialia* **139** (2017) 244–253. DOI: 10.1016/j.actamat.2017.05.003.

Comparative grain topology. T. Keller, B. Cutler, E. Lazar, and D. Lewis. *Acta Materialia* **66** (2014) 414–423. DOI: 10.1016/j.actamat.2013.11.039.

Enumeration of polyhedra for grain growth analysis. T. Keller, B. Cutler, M. Glicksman, and D. Lewis. *Proceedings of the First International Conference on 3D Materials Science* (2012) 97–106. DOI: 10.1007/978-3-319-48762-5_15.

Recognition

U.S. Department of Commerce

Bronze Medal Award 2021

"The group is recognized for leading a stakeholder community to establish benchmarks for evaluating and validating phase field simulation software useful to the design and manufacture of advanced materials. The group convened and led 10 workshops since 2015 to establish eight distinct benchmark challenges, and to determine stakeholder needs for a benchmark repository and database. The resulting digital infrastructure that the group built, PFHub, is used by scientists worldwide and is broadly recognized as the world's authoritative resource for validating phase field simulation software and results."

National Institute of Standards and Technology

Material Measurement Laboratory Accolade 2018

"For exceptional contribution to the field of metal additive manufacturing with a focus on developing integrated simulation methods to predict microstructure evolution based on phase-field models, computational thermodynamics, and finite element analysis."

Acta Materialia* and *Scripta Materialia

Outstanding Reviewer Award 2017 and 2018

Projects

GitHub Portfolio: @tkphd

Steering Committee Member, High Performance Computing Carpentry 2019 to Present

Global community of researchers building courses to teach new users foundational skills in high-performance computational science. Focused on organizing and coordinating discussions and contributions, helping the community grow and driving major curriculum improvements.

Developer, The Phase-Field Community Hub 2016 to Present

International community of phase-field researchers developing benchmarks and educational materials. Focused on website back-end development and content creation.

Developer, Mesoscale Microstructure Simulation Project 2013 to present

Open source high-performance phase-field code with a parallel distributed-memory back-end written in C++. Eliminated memory leaks and race conditions in parallel computing environments.

Trevor Keller, Ph. D.
1661 Linwood Drive ⋆ Wooster, Ohio 44691

Presentations

Invited: *T. Keller*. "Modeling additively manufactured superalloy microstructures." NIMS-SIP International Additive Manufacturing Workshop. Tsukuba, Ibaraki, Japan: January 29, 2020.

T. Keller, N. Ofori-Opoku, U. Kattner, K. Moon, M. Williams, G. Lindwall, and J. Guyer. "Phase Field Study of a Ternary IN625 Analog." MS&T Annual Meeting. Portland, OR: October 2, 2019.

Invited: *T. Keller*, G. Lindwall, U. Kattner, and J. Guyer. "Abstraction, acceleration, and analysis: Integrating CALPHAD and phase-field models for AM superalloys." SIAM Conference on Mathematical Aspects of Materials Science. Portland, OR: July 9, 2018.

T. Keller, G. Lindwall, U. Kattner, and J. Guyer. "Reversion in ternary alloys using phase-field and CALPHAD methods." TMS Annual Meeting. Phoenix, AZ: March 20, 2018.

T. Keller. "HiPerC: High performance computing strategies for boundary value problems." CHiMaD Phase Field Workshop VI. Evanston, IL: February 21, 2018.

T. Keller, G. Lindwall, U. Kattner, and J. Guyer. "Pitfalls of modeling additively manufactured materials: Case study with Inconel 625." NIST MML MSED Bag Lunch. Gaithersburg, MD: October 11, 2017.

Invited: *T. Keller*. "Mesoscale modeling of solid state reactions: Pathways toward microstructure design." Lawrence Livermore National Laboratory. Livermore, CA: April 12, 2017.

T. Keller, G. Lindwall, U. Kattner, and J. Guyer. "Pitfalls of modeling additively manufactured materials: Case study with Inconel 625." TMS Annual Meeting. San Diego, CA: February 28, 2017.

T. Keller, G. Lindwall, U. Kattner, and J. Guyer. "Arresting deleterious particle growth in Inconel 625: Phase field model description." MS&T Annual Meeting. Salt Lake City, UT: October 27, 2016.

Invited: *T. Keller*, B. Cutler, and D. Lewis. "Finite grain boundary networks from phase-field grain growth data." NIST Material Science & Engineering Division. Gaithersburg, MD: December 8, 2014.

Invited: T. Keller, B. Cutler, and *D. Lewis*. "Comparative analysis of polycrystals in simulated & experimental datasets." MS&T Annual Meeting. Pittsburgh, PA: October 15, 2014.

T. Keller, D. Crist, *D. Lewis*, Y. Tan, K. Huang, and C. Li. "Realtime prediction of grain growth during materials processing." PICS3. Marseille, France: May 2014.

T. Keller and D. Lewis. "Topological characterization of 3D microstructures with diffuse interfaces." TMS Annual Meeting. San Diego, CA: February 19, 2014.

T. Keller, D. Lewis, B. Cutler, and E. Lazar. "Topological comparison of synthetic microstructures." MS&T Annual Meeting. Montreal, QC, Canada: October 28, 2013.

T. Keller, *D. Lewis*, B. Cutler, B. Yener, S. Rock, G. Saunders, and M. Muench. "The topology of polycrystals." PICS3. Marseille, France: July 2013.

T. Keller, B. Cutler, G. Yauney, and D. Lewis. "Topological analysis of collapsing grains." MS&T Annual Meeting. Pittsburgh, PA: October 10, 2012.

T. Keller, B. Cutler, G. Yauney, and *D. Lewis*. "Polyhedral graphs & grain topology." International Conference on 3-Dimensional Materials Science (3DMS). Seven Springs, PA: July 11, 2012.