

Tyler H. Chang – CV

Postdoc building Optimization & Machine Learning Software at Argonne National Laboratory

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EXPERIENCE

- Jun 2020 - Present. **Postdoctoral appointee: Argonne National Laboratory**, MCS Division
- Designed and implemented a Python framework for building and deploying multiobjective optimization solvers
 - Explored trade-offs between accuracy and latency in neural network architecture search on 1000+ node HPCs
 - Reduced time and cost of material design by factor of over 100x via active learning in a wet-lab environment
- Aug 2016 - May 2020. **Research fellow: Virginia Tech**, Dept. of Computer Science
- Researching novel methods for error-bounded scientific machine learning and statistical regression
 - Designed parallel algorithms and software for machine learning, blackbox optimization, and computational geometry
 - Achieved 3x reduction in performance variability in leadership-class HPC at Argonne via above techniques
- Jun 2019 - Dec 2019. **US DOE SCGSR awardee: Argonne National Laboratory**, MCS Division
- Conducting research in multiobjective optimization software via DOE SCGSR program (see funding)
- Feb 2016 - Aug 2016. **Research assistant: Old Dominion University**, Dept. of Computer Science
- Aided in parallelizing NASA's FUN3D CFD kernel on NVIDIA GPUs using CUDA and MPI
- Dec 2015 - Jan 2016. **Intern: US Army Research Labs**, Computational Science Division
- May 2015 - Aug 2015. **Intern: US Army Research Labs**, Computational Science Division
- Accelerating software for real-time optimal control (summer) & using AR technology for info viz (winter)
- Dec 2014 - Jan 2015. **Intern: US Army Research Labs**, Guidance Technology Branch
- May 2014 - Aug 2014. **Intern: US Army Research Labs**, Guidance Technology Branch
- Using OpenCV for real-time sensing (summer) & developing software for embedded systems (winter)

EDUCATION

Ph.D., May 2020, Computer Science, Virginia Polytechnic Institute & State University (Virginia Tech)
B.S., May 2016, Computer Science & Mathematics (double-major), Virginia Wesleyan University, *summa cum laude*

TECHNICAL SKILLS

Mathematics skills:	numerical optimization, scientific machine learning & approximation theory, numerical analysis
Computing skills:	high-performance computing, open source software design, data structures and algorithms
Languages (expert):	Python, Fortran
Languages (proficient):	C, C++, Java, Matlab
Libraries (expert):	numpy, scipy, jax, OpenMP, BLAS, LAPACK
Libraries (proficient):	pandas, scikit-learn, matplotlib, plotly/dash, pytorch, keras, MPI, CUDA
Tools/Frameworks:	pytest, sphinx, slurm, qsub, CI/CD, GitHub Actions, GitFlow
Markup:	HTML/CSS, GNU Make, TeX/LaTeX/bibTeX

PUBLICLY AVAILABLE SOFTWARE

2023. ParMOO: Python library for parallel multiobjective simulation optimization. Release: 0.3.1
Devs: **T. H. Chang** (lead), S. M. Wild, and H. Dickinson Primary Prog. Lang: **Python 3**
git: https://github.com/parmoo/parmoo
2022. VTMOP: Solver for blackbox multiobjective optimization problems.
Devs: **T. H. Chang** (lead) and L. T. Watson Primary Prog. Lang: **Fortran 2008**
git: https://github.com/vtopt/VTMOP
2020. DelaunaySparse: Interpolation via a sparse subset of the Delaunay triangulation.
Devs: **T. H. Chang** (lead), T. C. H. Lux, and L. T. Watson Primary Prog. Lang: **Fortran 2003**
git: https://github.com/vtopt/DelaunaySparse
2019. QAML: Quantum annealing math library.
Devs: T. C. H. Lux (lead), **T. H. Chang**, and S. S. Tipirneni Primary Prog. Lang: **Python 3**
git: https://github.com/tchlux/qaml

SELECTED PUBLICATIONS (FROM 32 INDEXED ON SCHOLAR)

1. 2023. **T. H. Chang**, J. R. Elias, S. M. Wild, S. Chaudhuri, and J. A. Libera. A framework for fully autonomous design of materials via multiobjective optimization and active learning: challenges and next steps. *In 11th Intl. Conf. on Learning Representation (ICLR 2023), Workshop on Machine Learning for Materials (ML4Materials)*. **url**: <https://openreview.net/forum?id=8KJS7RPjMqG>
2. 2023. **T. H. Chang** and S. M. Wild. ParMOO: a Python library for parallel multiobjective simulation optimization. *Journal of Open Source Software* 8(82), Article 4468, 5 pages. **doi**: 10.21105/joss.04468
3. 2022. **T. H. Chang**, L. T. Watson, J. Larson, N. Neveu, W. I. Thacker, S. Deshpande, and T. C. H. Lux. Algorithm 1028: VTMO: Solver for blackbox multiobjective optimization problems. *ACM Transactions on Mathematical Software* 48(3), Article 36, 34 pages. **doi**: 10.1145/3529258
4. 2020. **T. H. Chang**, L. T. Watson, T. C. H. Lux, A. R. Butt, K. W. Cameron, and Y. Hong. Algorithm 1012: DELAUNAYSPARSE: Interpolation via a sparse subset of the Delaunay triangulation in medium to high dimensions. *ACM Transactions on Mathematical Software* 46(4), Article 38, 20 pages. **doi**: 10.1145/3422818

LEADERSHIP AND SERVICE

Interns Advised

- Jun 2022 - Aug 2022. Manisha Garg (UIUC), NSF MSGI (PhD student intern) at Argonne
Jun 2022 - Aug 2022. Hyrum Dickinson (UIUC), DOE SULI (undergraduate intern) at Argonne

Teaching

- Jan 2022 - Present. **Adjunct Professor: College of DuPage**, Dept. of Computer Science (Intro to Python Programming)
Jan 2020 - May 2020. **Instructor of Record: Virginia Tech**, Dept. of Computer Science (Data Structures & Algorithms)

Service

Journal Referee: INFORMS Journal on Computing (2023–Present); ACM Transactions on Mathematical Software (2021–Present); Quantum Information Processing (2021–Present); The Visual Computer Journal (2021); MDPI: Mathematical and Computer Applications (2021); Journal of Machine Learning Research (2019)

Conference Reviewer: Int. Congress on Industrial and Applied Mathematics (ICIAM) 2023; Int. Conf. for HPC, Networking, Storage, and Analysis (Supercomputing) 2021; IEEE SoutheastCon 2020; IEEE SoutheastCon 2019; IEEE SoutheastCon 2018

Minisymposia Organized: *Multiobjective Optimization Software* track, SIAM Conference on Optimization (2021); *Geometric Methods for Machine Learning* track, SIAM Conference on Computational Science and Engineering (2021)

AWARDS AND ACCOMPLISHMENTS

Research Funding

1. Mar 2023 - Sep 2023. **Co-PI (optimization thrust lead)**, \$50K/y for 1 year. *A Scalable Multi-Physics Optimization Framework for Particle Accelerator Design*, institutional seed funding (LDRD 2023-0246)
2. Jun 2019 - Dec 2019. **Student awardee**, \$3K/mo for 6 months. *An Adaptive Weighting Scheme for Multiobjective Optimization*, US DOE Office of Science, Graduate Student Research Program award (DE-SC0014664)

Other Awards

1. Jan 2021. Nominee for Outstanding Dissertation Award, Virginia Tech, Graduate School
2. Aug 2016 - May 2020. Cunningham Doctoral Fellowship, Virginia Tech, Graduate School
3. Aug 2016 - May 2020. Various Supplemental College-Level Scholarships, Virginia Tech, College of Engineering
4. Feb 2016 & 2015. 2x ACM International Collegiate Programming Competition (ICPC) site champion for CNU location

RECENT INVITED TALKS

1. Aug 2023. Data sampling for surrogate modeling and optimization. *The 10th International Congress on Industrial and Applied Mathematics (ICIAM 2023)*, Tokyo, Japan
2. July 2023. Toward interpretable machine learning via Delaunay interpolation – challenges and next steps. *Argonne National Laboratory, LANS Seminar Series*, Lemont, IL, USA
3. Jun 2023. Exploiting structures in multiobjective simulation optimization problems. *SIAM Conference on Optimization (OP 2023)*, Seattle, WA, USA
4. Mar 2023. ParMOO: a Python library for parallel multiobjective simulation optimization. *SIAM Conference on Computational Science and Engineering (CSE 2023)*, Amsterdam, Netherlands
5. Sep 2022. Geometric considerations when surrogate modeling. *SIAM Conference on Mathematics of Data Science (MDS 2022)*, San Diego, CA, USA