

Tyler H. Chang – CV

Mathematics and Computer Science Division, Argonne National Laboratory

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INTERESTS

Blackbox optimization, scientific machine learning, approximation theory, computational geometry, and scientific software

EDUCATION

Ph.D., May 2020, Computer Science, Virginia Polytechnic Institute & State University (Virginia Tech)

- Advisor: Layne Watson
- Dissertation: Mathematical Software for Multiobjective Optimization Problems

B.S., May 2016, Computer Science & Mathematics (double-major), Virginia Wesleyan University

- Summa cum laude; 2x ACM ICPC site champion; 8x Dean's list; 4x all-ODAC (conference) for varsity tennis

RESEARCH EXPERIENCE

Jun 2020 - Present. **Postdoctoral appointee: Argonne National Laboratory**, MCS Division

- Designed and implemented a Python framework for building and deploying multiobjective optimization solvers
- Deployed solvers for particle accelerator design, autonomous material discovery, and neural-network architecture search
- Applied for grants, supervised interns, authored scientific papers, and represented Argonne at international conferences

Aug 2016 - May 2020. **Cunningham fellow: Virginia Tech**, Dept. of Computer Science

- Designed parallel algorithms and software for predictive modeling, blackbox optimization, and computational geometry
- Applied solvers to model and tune HPC systems to control performance variability
- Published papers in academic journals and conferences

Jun 2019 - Dec 2019. **US DOE SCGSR awardee: Argonne National Laboratory**, MCS Division

- Conducting research in multiobjective optimization software via DOE SCGSR program (see awards)

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)

AWARDS

2021.	Nominee for Outstanding Dissertation Award, Virginia Tech, Graduate School
2019.	Davenport Leadership Fellowship, Virginia Tech, College of Engineering
2018.	US DOE SCGSR Award, DOE Office of Science, Graduate Student Research (SCGSR) Program
2018.	Pratt Fellowship, Virginia Tech, College of Engineering
2017.	Pratt Fellowship, Virginia Tech, College of Engineering
2016.	Cunningham Doctoral Fellowship, Virginia Tech, Graduate School
2016.	Davenport Leadership Fellowship, Virginia Tech, College of Engineering
2016.	Outstanding Student in Computer Science & Mathematics, Virginia Wesleyan University

PUBLICLY AVAILABLE SOFTWARE

4. 2023. ParMOO: Python library for parallel multiobjective simulation optimization. Release: 0.3.1
Devs: **T. H. Chang** (lead), S. M. Wild, and H. Dickinson¹ Primary Prog. Lang: **Python 3**
git: <https://github.com/parmoo/parmoo>
3. 2022. VTMOOP: 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/VTMOOP>
2. 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>
1. 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 31 INDEXED ON SCHOLAR)

5. 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>
4. 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: VTMOOP: Solver for blackbox multiobjective optimization problems. *ACM Transactions on Mathematical Software* 48(3), Article 36, 34 pages. **doi**: 10.1145/3529258
2. 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
1. 2018. **T. H. Chang**, L. T. Watson, T. C. H. Lux, B. Li, L. Xu, A. R. Butt, K. W. Cameron, and Y. Hong. A polynomial time algorithm for multivariate interpolation in arbitrary dimension via the Delaunay triangulation. *In Proc. 2018 ACM Southeast Conference (ACMSE '18)*, Article 12, 8 pages. **doi**: 10.1145/3190645.3190680

GRANTS (COMPLETED)

2. Mar 2023 - Sep 2023. **Co-PI** (PI: G. Chen (ANL)), \$50K (my share: \$25K). *A Scalable Multi-Physics Optimization Framework for Particle Accelerator Design*, institutional award (3 pages + appendices). ANL LDRD: 2023 LDRD Seed (LDRD 2023-0246).
1. Jun 2019 - Dec 2019. **Primary awardee** (Advisors: J. Larson (ANL) and L. Watson (VT)), \$3K/mo stipend. *An Adaptive Weighting Scheme for Multiobjective Optimization*, DOE award for PhD students (3 pages + appendices). DOE SCGSR/ASCR: SCGSR Program 2018 Solicitation 2 (DE-SC0014664).

TEACHING

Jan 2022 - Present. **Adjunct Professor: College of DuPage**, Dept. of Computer and Info. Science

- Spring 2024. CIS 2531: Introduction to Python Programming (hybrid)
- Summer 2023. CIS 2531: Introduction to Python Programming (in-person)
- Spring 2022. CIS 2531: Introduction to Python Programming (online)

Jan 2020 - May 2020. **Instructor of Record: Virginia Tech**, Dept. of Computer Science

- Spring 2020. CS 3114: Data Structures and Algorithms (half in-person, half online)

SUMMER STUDENTS 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

¹= DOE SULI (undergraduate intern) at Argonne in my supervision

INVITED TALKS AND GUEST LECTURES

9. Jun 2024. Title pending. *The 2nd Derivative-Free Optimization Symposium (DFOS 2024)*, Padova, Italy.
8. Aug 2023. Data sampling for surrogate modeling and optimization. *The 10th International Congress on Industrial and Applied Mathematics (ICIAM 2023)*, Tokyo, Japan.
7. Jun 2023. Exploiting structures in multiobjective simulation optimization problems. *SIAM Conference on Optimization (OP 2023)*, Seattle, WA, USA.
6. Mar 2023. ParMOO: a Python library for parallel multiobjective simulation optimization. *SIAM Conference on Computational Science and Engineering (CSE 2023)*, Amsterdam, Netherlands.
5. Oct 2022. An introduction to multiobjective simulation optimization with ParMOO. *The Science Academy, Science Circle Cohort, guest speaker*, virtual event. Recording: <https://www.youtube.com/watch?v=gqha8urlehm>.
4. Sep 2022. Geometric considerations when surrogate modeling. *SIAM Conference on Mathematics of Data Science (MDS 2022)*, San Diego, CA, USA.
3. May 2022. An introduction to multiobjective simulation optimization with ParMOO. *University of Chicago, Pritzker School of Molecular Engineering, guest lecture*, virtual event.
2. Jul 2021. Surrogate modeling of simulations for multiobjective optimization applications. *SIAM Conference on Optimization (OP 2021)*, virtual event.
1. Mar 2021. Computing sparse subsets of the Delaunay triangulation in high-dimensions for interpolation and graph problems. *SIAM Conference on Computational Science and Engineering (CSE 2021)*, virtual event.

PROFESSIONAL SERVICE AND ACTIVITIES

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

Minisymposium Organizer

- SIAM Conference on Optimization (2021)
- SIAM Conference on Computational Science and Engineering (2021)

Professional Membership

- ACM (2015–Present)
- SIAM (2016–Present)
- MOS (2022–Present)

TECHNICAL SKILLS

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