

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

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| 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

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|-------------------|---|
| Languages: | Python, Fortran, C/C++, Java, Matlab |
| OS: | MacOS, Unix/Linux |
| Markup: | HTML/CSS, GNU Make, TeX/LaTeX/bibTeX |
| Libraries: | numpy, pandas, scipy, matplotlib, keras, sklearn, MPI, OpenMP, CUDA, BLAS, LAPACK |
| Tools/Frameworks: | pytest, sphinx, slurm, CI/CD, GitHub Actions, GitFlow |