Tyler H. Chang

Argonne National Laboratory
Mathematics & Computer Science (MCS) Division
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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

Aug 2016 - May 2020. **Cunningham fellow: Virginia Tech**, Dept. of Computer Science
- Designed parallel algorithms and software for predicive modeling, blackbox optimization, and computational geometry
- Applied solvers to model and tune HPC systems to control performance variability

Jun 2019 - Dec 2019. **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. **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

2023. **ParMOO**: Python library for parallel multiobjective simulation optimization. Release: 0.2.2
Devs: **T. H. Chang** (lead), S. M. Wild, and H. Dickinson[1] Primary Prog. Lang: `Python 3`
`git: https://github.com/parmoo/parmoo`

2022. **VTMOP**: Solver for blackbox multiobjective optimization problems.
Devs: **T. H. Chang** (sole) 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) and T. C. H. Lux 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 29 indexed on Scholar)

M. Garg[2], **T. H. Chang**, and K. Raghavan. *SF-SFD: Stochastic optimization of Fourier coefficients for space-filling designs*. . To appear in 2023 Winter Simulation Conference (WSC 2023). `url: https://arxiv.org/abs/2305.12043`

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`

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`

2023. N. Neveu, **T. H. Chang**, P. Franz, S. Hudson, and J. Larson. Comparison of multiobjective optimization methods for the LCLS-II photoinjector. *Computer Physics Communication* 283, Article 108566, 10 pages. `doi: 10.1016/j.cpc.2022.108566`

2022. **T. H. Chang**, L. T. Watson, J. Larson, N. Neveu, W. I. Thacker, S. Deshpande, and T. C. H. Lux. Algorithm 1028: VTMOP: Solver for blackbox multiobjective optimization problems. *ACM Transactions on Mathematical Software* 48(3), Article 36, 34 pages. `doi: 10.1145/3529258`

2020. **T. H. Chang**, J. Larson, and L. T. Watson. Multiobjective optimization of the variability of the high-performance Linpack solver. *In Proc. 2020 Winter Simulation Conference (WSC 2020)*, pp. 3081–3092. `doi: 10.1109/WSC48552.2020.9383875`

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`

2019. **T. H. Chang**, T. C. H. Lux, and S. S. Tipirneni. Least-squares solutions to polynomial systems of equations with quantum annealing. *Quantum Information Processing* 18(12), Article 374, 17 pages. `doi: 10.1007/s11128-019-2489-x`

[1]= DOE SULI at Argonne in my supervision
[2]= NSF MSGI at Argonne in my supervision

Funding Awarded

Mar 2023 - Sep 2023. A Scalable Multi-Physics Optimization Framework for Particle Accelerator Design.
ANL LDRD: 2023 LDRD Seed (LDRD 2023-0246).
Type: institutional award (3 pages + appendices). Budget: $50K/y.
Role: co-PI. PI: G. Chen (ANL).

Teaching

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

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

Summer Students Advised

Jun 2022 - Aug 2022. Manisha Garg (Urbana-Champaign), NSF MSGI at Argonne

Jun 2022 - Aug 2022. Hyrum Dickinson (Urbana-Champaign), DOE SULI at Argonne

Invited Talks and Guest Lectures

Jun 2024. Title pending. *The 2nd Derivative-Free Optimization Symposium (DFOS 2024)*, Padova, Italy.

Aug 2023. Data sampling for surrogate modeling and optimization. *The 10th International Congress on Industrial and Applied Mathematics (ICIAM 2023)*, Tokyo, Japan.

July 2023. Toward interpretable machine learning via Delaunay triangulations. *Argonne National Laboratory, LANS Seminar Series*, Lemont, IL, USA.

Jun 2023. Exploiting structures in multiobjective simulation optimization problems. *SIAM Conference on Optimization (OP 2023)*, Seattle, WA, USA.

Mar 2023. ParMOO: a Python library for parallel multiobjective simulation optimization. *SIAM Conference on Computational Science and Engineering (CSE 2023)*, Amsterdam, Netherlands.

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`.

Sep 2022. Geometric considerations when surrogate modeling. *SIAM Conference on Mathematics of Data Science (MDS 2022)*, San Diego, CA, USA.

May 2022. An introduction to multiobjective simulation optimization with ParMOO. *Univeristy of Chicago, Pritzker School of Molecular Engineering, guest lecture*, virtual event.

Jul 2021. Surrogate modeling of simulations for multiobjective optimization applications. *SIAM Conference on Optimization (OP 2021)*, virtual event.

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.

Technical Skills

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