

# Tyler H. Chang – CV

## Mathematics and Computer Science Division, 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 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)

### 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

<b>Mathematical Skills:</b>	numerical optimization, scientific machine learning, approximation theory, computational geometry
<b>Computing Skills:</b>	high-performance computing, open source software design, data structures & algorithms
<b>Languages (expert):</b>	Python, Fortran
<b>Languages (proficient):</b>	C, C++, Java, Matlab
<b>Libraries (expert):</b>	BLAS, jax, LAPACK, numpy, OpenMP, scipy
<b>Libraries (proficient):</b>	CUDA, CvxPy, keras, matplotlib, MPI, pandas, plotly/dash, pytorch, scikit-learn
<b>Tools/Workflow:</b>	CI/CD, GitFlow, GitHub Actions, kernprof, perf, pytest, qsub, slurm, sphinx

### 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<sup>1</sup>      Primary Prog. Lang: **Python 3**  
**git:** https://github.com/parmoo/parmoo
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
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

<sup>1</sup>= DOE SULI (undergraduate intern) at Argonne in my supervision

## SELECTED PUBLICATIONS (FROM 32 INDEXED ON SCHOLAR)

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4. 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>
3. 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
2. 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
1. 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

## FUNDING AND AWARDS

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### Research Funding

3. Mar 2024 - Present. **Key contributor**, \$400K/y for 1 year. *High performance computing for development of critical thermodynamic inputs for next generation thermal barrier coatings*, external grant
2. Mar 2023 - Sep 2023. **Co-PI**, \$50K/y for 1 year. *A Scalable Multi-Physics Optimization Framework for Particle Accelerator Design*, institutional seed funding (LDRD 2023-0246)
1. Jun 2019 - Dec 2019. **Primary awardee**, \$3K/mo for 6 months. *An Adaptive Weighting Scheme for Multiobjective Optimization*, DOE award for PhD students (DE-SC0014664)

### Research Fellowships

5. Aug 2016 - May 2020. Cunningham Doctoral Fellowship, Virginia Tech, Graduate School, guaranteed research funding
4. Aug 2019 - May 2020. Davenport Leadership Fellowship, Virginia Tech, College of Engineering, \$4k supplemental award
3. Aug 2018 - May 2019. Pratt Fellowship, Virginia Tech, College of Engineering, \$4k supplemental award
2. Aug 2017 - May 2018. Pratt Fellowship, Virginia Tech, College of Engineering, \$4k supplemental award
1. Aug 2016 - May 2017. Davenport Leadership Fellowship, Virginia Tech, College of Engineering, \$4k supplemental award

### Awards and Accomplishments

4. Jan 2021. Nominee for Outstanding Dissertation Award, Virginia Tech, Graduate School
3. Apr 2016. Outstanding Student in Computer Science & Mathematics, Virginia Wesleyan University
2. Feb 2016. ACM International Collegiate Programming Competition (ICPC), winning team for CNU site, VA, USA
1. Feb 2015. ACM International Collegiate Programming Competition (ICPC), winning team for CNU site, VA, USA

## LEADERSHIP AND SERVICE

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### Interns Advised

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| 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

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| Jan 2022 - Present.  | <b>Adjunct Professor: College of DuPage</b> , Dept. of Computer and Info. Science (Intro to Python)     |
| Jan 2020 - May 2020. | <b>Instructor of Record: Virginia Tech</b> , Dept. of Computer Science (Data structures and algorithms) |

### Journal / Conference 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); ICIAM (2023); Supercomputing (2021); IEEE SoutheastCon (2018–2020)

### Minisymposium Organizer

Multiobjective Optimization Software track in SIAM Conference on Optimization (2021); Geometric Methods for Machine Learning track in SIAM Conference on Computational Science and Engineering (2021)