Tyler H. Chang – CV

Mathematics and Computer Science Division, Argonne National Laboratory

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https://thchang.github.io https://github.com/thchang

Research 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)

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

Research Experience

Jun 2020 - Present.	**Postdoctoral appointee: Argonne National Laboratory**, MCS Division
Aug 2016 - May 2020.	**Cunningham fellow: Virginia Tech**, Dept. of Computer Science
Jun 2019 - Dec 2019.	**US DOE SCGSR awardee: Argonne National Laboratory**, MCS Division
Feb 2016 - Aug 2016.	**Research assistant: Old Dominion University**, Dept. of Computer Science
Dec 2015 - Jan 2016.	**Intern: US Army Research Labs**, Computational Science Division
May 2015 - Aug 2015.	**Intern: US Army Research Labs**, Computational Science Division
Dec 2014 - Jan 2015.	**Intern: US Army Research Labs**, Guidance Technology Branch
May 2014 - Aug 2014.	**Intern: US Army Research Labs**, Guidance Technology Branch

Teaching Experience

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
Jan 2013 - Dec 2015.	**Subject Tutor: Virginia Wesleyan University**, Learning Center

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. Dickinson[1] Primary Prog. Lang: `Python 3`
   `git:` https://github.com/parmoo/parmoo
3. 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
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

Publications

Publications In-Press

2. G. Chen, **T. H. Chang**, J. Power, and C. Jing. An integrated multi-physics optimization framework for particle accelerator design. To appear in 2023 Winter Simulation Conference (WSC 2023), Industrial Applications Track. Preprint available upon request.
1. 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). Preprint: https://arxiv.org/abs/2305.12043.

Peer-Reviewed Journal Articles

10. 2023. T. C. H. Lux, L. T. Watson, **T. H. Chang**, and W. I. Thacker. Algorithm 1031: MQSI—Monotone quintic spline interpolation. *ACM Transactions on Mathematical Software* 49(1), Article 6, 17 pages. `doi:` 10.1145/3570157
9. 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
8. 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
7. 2023. Y. Wang, L. Xu, Y. Hong, R. Pan, **T. H. Chang**, T. C. H. Lux, J. Bernard, L. T. Watson, and K. W. Cameron. Design strategies and approximation methods for high-performance computing variability management. *Journal of Quality Technology* 55(1), pp. 88–103. `doi:` 10.1080/00224065.2022.2035285
6. 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
5. 2021. L. Xu, T. C. H. Lux, **T. H. Chang**, B. Li, Y. Hong, L. T. Watson, A. R. Butt, D. Yao, and K. W. Cameron. Prediction of high-performance computing input/output variability and its application to optimization for system configurations. *Quality Engineering* 33(2), pp. 318–334. `doi:` 10.1080/08982112.2020.1866203
4. 2021. T. C. H. Lux, L. T. Watson, **T. H. Chang**, J. Bernard, B. Li, L. Xu, G. Back, A. R. Butt, K. W. Cameron, and Y. Hong. Interpolation of sparse high-dimensional data. *Numerical Algorithms* 88(1), pp. 281–313. `doi:` 10.1007/s11075-020-01040-2
3. 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
2. 2020. L. Xu, Y. Wang, T. C. H. Lux, **T. H. Chang**, J. Bernard, B. Li, Y. Hong, K. W. Cameron, and L. T. Watson. Modeling I/O performance variability in high-performance computing systems using mixture distributions. *Journal of Parallel and Distributed Computing* 139, pp. 87–98. `doi:` 10.1016/j.jpdc.2020.01.005
1. 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 (undergraduate intern) at Argonne in my supervision
[2]= NSF MSGI (PhD student intern) at Argonne in my supervision

Peer-Reviewed Conference and Workshop Papers

13. 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)*. Kigali, Rwanda. **url:** https://openreview.net/forum?id=8KJS7RPjMqG

12. 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. Orlando, FL, USA. **doi:** 10.1109/WSC48552.2020.9383875

11. 2020. **T. H. Chang**, J. Larson, L. T. Watson, and T. C. H. Lux. Managing computationally expensive blackbox multiobjective optimization problems with libEnsemble. *In Proc. 2020 Spring Simulation Conference (SpringSim '20)*, Article 31, 12 pages. Fairfax, VA, USA. **doi:** 10.22360/springsim.2020.hpc.001

10. 2020. T. C. H. Lux, L. T. Watson, **T. H. Chang**, L. Xu, Y. Wang, and Y. Hong. An algorithm for constructing monotone quintic interpolating splines. *In Proc. 2020 Spring Simulation Conference (SpringSim '20)*, Article 33, 12 pages. Fairfax, VA, USA. **doi:** 10.22360/springsim.2020.hpc.003

9. 2020. T. C. H. Lux and **T. H. Chang**. Analytic test functions for generalizable evaluation of convex optimization techniques. *In Proc. IEEE SoutheastCon 2020*, 8 pages. Raleigh, NC, USA. **doi:** 10.1109/SoutheastCon44009.2020.9368254

8. 2020. T. C. H. Lux, L. T. Watson, **T. H. Chang**, L. Xu, Y. Wang, J. Bernard, Y. Hong, and K. W. Cameron. Effective nonparametric distribution modeling for distribution approximation applications. *In Proc. IEEE SoutheastCon 2020*, 6 pages. Raleigh, NC, USA. **doi:** 10.1109/SoutheastCon44009.2020.9368295

7. 2018. **T. H. Chang**, L. T. Watson, T. C. H. Lux, S. Raghvendra, B. Li, L. Xu, A. R. Butt, K. W. Cameron, and Y. Hong. Computing the umbrella neighbourhood of a vertex in the Delaunay triangulation and a single Voronoi cell in arbitrary dimension. *In Proc. IEEE SoutheastCon 2018*, 8 pages. St. Petersburg, FL, USA. **doi:** 10.1109/SECON.2018.8479003

6. 2018. T. C. H. Lux, L. T. Watson, **T. H. Chang**, J. Bernard, B. Li, X. Yu, L. Xu, G. Back, A. R. Butt, K. W. Cameron, Y. Hong, and D. Yao. Nonparametric distribution models for predicting and managing computational performance variability. *In Proc. IEEE SoutheastCon 2018*, 7 pages. St. Petersburg, FL, USA. **doi:** 10.1109/SECON.2018.8478814

5. 2018. **T. H. Chang**, L. T. Watson, T. C. H. Lux, J. Bernard, B. Li, L. Xu, G. Back, A. R. Butt, K. W. Cameron, and Y. Hong. Predicting system performance by interpolation using a high-dimensional Delaunay triangulation. *In Proc. 2018 Spring Simulation Conference (SpringSim '18)*, Article 2, 12 pages. Baltimore, MD, USA. **doi:** 10.22360/springsim.2018.hpc.003

4. 2018. T. C. H. Lux, L. T. Watson, **T. H. Chang**, J. Bernard, B. Li, L. Xu, G. Back, A. R. Butt, K. W. Cameron, and Y. Hong. Predictive modeling of I/O characteristics in high performance computing systems. *In Proc. 2018 Spring Simulation Conference (SpringSim '18)*, Article 8, 10 pages. Baltimore, MD, USA. **doi:** 10.22360/springsim.2018.hpc.009

3. 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. Richmond, KY, USA. **doi:** 10.1145/3190645.3190680

2. 2018. T. C. H. Lux, L. T. Watson, **T. H. Chang**, J. Bernard, B. Li, X. Yu, L. Xu, G. Back, A. R. Butt, K. W. Cameron, D. Yao, and Y. Hong. Novel meshes for multivariate interpolation and approximation. *In Proc. 2018 ACM Southeast Conference (ACMSE '18)*, Article 13, 7 pages. Richmond, KY, USA. **doi:** 10.1145/3190645.3190687

1. 2017. C. Raghunath, **T. H. Chang**, L. T. Watson, M. Jrad, R. K. Kapania, and R. M. Kolonay. Global deterministic and stochastic optimization in a service oriented architecture. *In Proc. 2017 Spring Simulation Conference (SpringSim '17)*, Article 7, 12 pages. Virginia Beach, VA, USA. **doi:** 10.22360/springsim.2017.hpc.023

Technical Reports and Dissertations

5. 2023. **T. H. Chang**, S. M. Wild, and H. Dickinson[1]. *ParMOO: Python library for parallel multiobjective simulation optimization*. Technical Report Version 0.3.1. Argonne National Laboratory, Lemont, Illinois, USA. **url:** https://parmoo.readthedocs.io/_/downloads/en/latest/pdf/

4. 2020. A. K. Gillette and **T. H. Chang**. *ALGORITHMS: assessing latent space dimension by Delaunay loss*. Technical Report LLNL-CONF-814930. Lawrence Livermore National Laboratory, Livermore, California, USA. **url:** https://www.osti.gov/servlets/purl/1756748

3. 2020. **T. H. Chang**. *Mathematical software for multiobjective optimization problems*. Ph.D. Dissertation. Department of Computer Science, Virginia Polytechnic Institute and State University (Virginia Tech), Blacksburg, VA, USA. **Dept. of Computer Science Nominee for Outstanding Dissertation Award**. **url:** http://hdl.handle.net/10919/98915

2. 2016. **T. H. Chang**. *GPU saturation for multiple matrix-vector multiplications*. Bachelor's Thesis. Department of Computer Science, Virginia Wesleyan University, Virginia Beach, VA, USA.

1. 2015. **T. H. Chang**. *Implementing the optimal control-based obstacle avoidance (OCOA) algorithm in compiled code*. In ARL Summer Student Research Symposium Compendium of Abstracts vol. 2, ARL-TM-2015A. US Army Research Laboratory, Adelphi, MD, USA. `url:` https://apps.dtic.mil/sti/pdfs/AD1000355.pdf

Talks and Presentations

Invited Conference Talks

6. Aug 2023. Data sampling for surrogate modeling and optimization. *The 10th International Congress on Industrial and Applied Mathematics (ICIAM 2023)*, Tokyo, Japan.
5. 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.
3. Sep 2022. Geometric considerations when surrogate modeling. *SIAM Conference on Mathematics of Data Science (MDS 2022)*, San Diego, CA, USA.
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.

Seminars and Colloquia

5. Sep 2023. The curse of dimensionality. *CAA&CM Argonne Student Visit*, Lemont, IL, USA.
4. July 2023. Toward interpretable machine learning via Delaunay interpolation – challenges and next steps. *Argonne National Laboratory, LANS Seminar Series*, Lemont, IL, USA.
3. Feb 2020. Algorithms and software for Delaunay interpolation and multiobjective optimization. *Sandia National Laboratory, Wind Energy Technology Division Seminar*, virtual event.
2. Feb 2020. Algorithms and software for Delaunay interpolation and multiobjective optimization. *Argonne National Laboratory, Mathematics and Computer Science Division Seminar*, Lemont, IL, USA.
1. Jan 2020. Algorithms and software for Delaunay interpolation and multiobjective optimization. *Sandia National Laboratory, Center for Computing Research Seminar*, Albuquerque, NM, USA.

Tutorials and Guest Lectures

2. 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.
1. May 2022. An introduction to multiobjective simulation optimization with ParMOO. *Univeristy of Chicago, Pritzker School of Molecular Engineering, guest lecture*, virtual event.

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).

Advising

Jun 2022 - Aug 2022. Manisha Garg (UIUC), NSF MSGI (PhD student intern) at Argonne
- Project: Model agnostic sampling techniques for generating design-of-experiments

Jun 2022 - Aug 2022. Hyrum Dickinson (UIUC), DOE SULI (undergraduate intern) at Argonne
- Project: Visualization tools for the ParMOO library

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)