Tyler H. Chang

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Primary Interests

Numerical optimization, interpolation and regression, algorithms, and parallel computing for applications in scientific computing, data science, and engineering design.

Education

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

B.S., 2016, Computer Science & Mathematics, Virginia Wesleyan University, *Summa Cum Laude*

Research Experience

(June, 2020 – Present) **Postdoctoral Appointee: Argonne National Lab**, Mathematics and Computer Science (MCS) Division.

- R&D in multiobjective optimization, parallel computing, and scientific software.
- Member of FASTMATH: A SciDAC institute spanning 5 national labs and 5 universities.

(Aug, 2016 – May, 2020) **Cunningham Fellow: Virginia Tech**, Dept. of Computer Science.

- R&D in numerical analysis, math software, algorithms, parallel computing, and data science.
- Math & Algorithms team in VarSys: A NSF funded study of HPC performance variability.

(June, 2019 – Dec, 2019) **SCGSR Awardee: Argonne National Lab**, MCS Division.

- R&D in multiobjective optimization, funded via ORAU/ORISE (see awards for details).

(Feb – Aug, 2016) **Research Assistant: Old Dominion University**, Dept. of Computer Science.

- R&D in GPU computing and parallelization of NASA's FUN3D CFD kernel on NVIDIA GPUs.

(Summer 2014, Winter 2014, Summer 2015, & Winter 2015) **Intern: US Army Research Labs**, Computational Science Division (CSD) and Guidance Technology Branch (GTB).

- CSD — R&D in autonomous driving (Summer 2015) & virtual reality (Winter 2015).
- GTB — R&D in computer vision (Summer 2014) & embedded systems (Winter 2014).

Awards

Cunningham Doctoral Fellow (2016–2020). The Cunningham doctoral fellowship is a Virginia Tech graduate school wide award, guaranteeing 4 years of research funding.

Davenport Leadership Fellow (2016–17 & 2019–20). The Davenport leadership fellowship is a supplemental award given by Virginia Tech, College of Engineering on a per-year basis.

DOE SCGSR Awardee (2019). One of 70 proposals funded by the United States Dept. of Energy, Office of Science Graduate Student Research program, during the 2018, 2nd call for proposals.

Pratt Fellow (2017–18 & 2018–19). The Pratt fellowship is a supplemental award given by Virginia Tech, College of Engineering on a per-year basis.

Publicly Available Software

DELAUNAYSPARSE is a software package for computing the Delaunay interpolant in medium to high dimensions. Both serial and parallel drivers are available with interfaces in `Fortran`, `C/C++`, `Python 3.6+`, and command line. Download: `https://vtopt.github.io/DelaunaySparse`.

QAML is a `Python` package for embedding polynomial sum of squares minimization problems on the D-Wave quantum annealer. Download: `https://github.com/tchlux/qaml`.

Pending Software

VTMOP is a solver and framework for computationally expensive blackbox multiobjective optimization problems with continuous variables and 2+ objectives. Written in `Fortran`; a `Python` interface is also available through `libEnsemble` (`https://github.com/libensemble/libensemble`).

Peer-Reviewed Publications

Tyler H. Chang, Layne T. Watson, Thomas C. H. Lux, Ali R. Butt, Kirk W. Cameron, and Yili Hong. 2020. Algorithm 1012: DELAUNAYSPARSE: Interpolation via a sparse subset of the Delaunay triangulation in medium to high dimensions. ACM Transactions on Mathematical Software (TOMS), Vol. 46, No. 4, Article No. 38, pp. 1–20. DOI: 10.1145/3422818

Tyler H. Chang, Jeffrey Larson, Layne T. Watson, and Thomas C. H. Lux. 2020. Managing computationally expensive blackbox multiobjective optimization problems with libEnsemble. In Proceedings of the 2020 Spring Simulation Conference (SpringSim '20), Article No. 31, pp. 1–12. DOI: 10.22360/springsim.2020.hpc.001

Thomas C. H. Lux, Layne T. Watson, **Tyler H. Chang**, Li Xu, Yueyao Wang, and Yili Hong. 2020. An algorithm for constructing monotone quintic interpolating splines. In Proceedings of the 2020 Spring Simulation Conference (SpringSim '20), Article No. 33, pp. 1–12. DOI: 10.22360/springsim.2020.hpc.003

Li Xu, Yueyao Wang, Thomas C. H. Lux, **Tyler H. Chang**, Jon Bernard, Bo Li, Yili Hong, Kirk W. Cameron, and Layne T. Watson. 2020. Modeling I/O performance variability in high-

performance computing systems using mixture distributions. Journal of Parallel and Distributed Computing, Vol. 139, pp. 87–98. DOI: 10.1016/j.jpdc.2020.01.005

Tyler H. Chang, Thomas C. H. Lux, and Sai Sindhura Tipirneni. 2019. Least-squares solutions to polynomial systems of equations with quantum annealing. Quantum Information Processing, Vol. 18, No. 12, Article No. 374. DOI: 10.1007/s11128-019-2489-x

Tyler H. Chang, Layne T. Watson, Thomas C. H. Lux, Sharath Raghvendra, Bo Li, Li Xu, Ali R. Butt, Kirk W. Cameron, and Yili Hong. 2018. Computing the umbrella neighbourhood of a vertex in the Delaunay triangulation and a single Voronoi cell in arbitrary dimension. In Proceedings of IEEE SoutheastCon 2018, pp. 1–8. DOI: 10.1109/SECON.2018.8479003

Thomas C. H. Lux, Layne T. Watson, **Tyler H. Chang**, Jon Bernard, Bo Li, Xiaodong Yu, Li Xu, Godmar Back, Ali R. Butt, Kirk W. Cameron, Yili Hong, and Danfeng Yao. 2018. Nonparametric distribution models for predicting and managing computational performance variability. In Proceedings of IEEE SoutheastCon 2018, pp. 1–7. DOI: 10.1109/SECON.2018.8478814

Tyler H. Chang, Layne T. Watson, Thomas C. H. Lux, Jon Bernard, Bo Li, Li Xu, Godmar Back, Ali R. Butt, Kirk W. Cameron, and Yili Hong. 2018. Predicting system performance by interpolation using a high-dimensional Delaunay triangulation. In Proceedings of SpringSim 2018, the 26th High Performance Computing Symposium (HPC '18), Article No. 2, pp. 1–12. DOI: 10.22360/springsim.2018.hpc.003

Thomas C. H. Lux, Layne T. Watson, **Tyler H. Chang**, Jon Bernard, Bo Li, Li Xu, Godmar Back, Ali R. Butt, Kirk W. Cameron, and Yili Hong. 2018. Predictive modeling of I/O characteristics in high performance computing systems. In Proceedings of SpringSim 2018, the 26th High Performance Computing Symposium (HPC '18), Article No. 8, pp. 1–10. DOI: 10.22360/springsim.2018.hpc.009

Tyler H. Chang, Layne T. Watson, Thomas C. H. Lux, Bo Li, Li Xu, Ali R. Butt, Kirk W. Cameron, and Yili Hong. 2018. A polynomial time algorithm for multivariate interpolation in arbitrary dimension via the Delaunay triangulation. In Proceedings of the 2018 ACM Southeast Conference (ACMSE '18), Article No. 12, pp. 1–8. DOI: 10.1145/3190645.3190680

Thomas C. H. Lux, Layne T. Watson, **Tyler H. Chang**, Jon Bernard, Bo Li, Xiadong Yu, Li Xu, Godmar Back, Ali R. Butt, Kirk W. Cameron, Danfeng Yao, and Yili Hong. 2018. Novel meshes for multivariate interpolation and approximation. In Proceedings of the 2018 ACM Southeast Conference (ACMSE '18), Article No. 13, pp. 1–7. DOI: 10.1145/3190645.3190687

Chaitra Raghunath, **Tyler H. Chang**, Layne T. Watson, Mohamed Jrad, Rakesh K. Kapania, and Raymond M. Kolonay. 2017. Global deterministic and stochastic optimization in a service oriented architecture. In Proceedings of SpringSim 2017, the 25th High Performance Computing Symposium (HPC '17), Article No. 7, pp. 1–12. DOI: 10.22360/springsim.2017.hpc.023

In Press

Li Xu, Thomas C. H. Lux, **Tyler H. Chang**, Bo Li, Yili Hong, Layne T. Watson, Ali R. Butt, and Kirk W. Cameron. Prediction of high-performance computing input/output variability and its application to optimization for system configurations. Quality Engineering. To appear.

Thomas C. H. Lux, Layne T. Watson, **Tyler H. Chang**, Jon Bernard, Bo Li, Li Xu, Godmar Back, Ali R. Butt, Kirk W. Cameron, and Yili Hong. Interpolation of sparse high-dimensional data. Numerical Algorithms. DOI: 10.1007/s11075-020-01040-2

Tyler H. Chang, Jeffrey Larson, and Layne T. Watson. Multiobjective optimization of the variability of the high-performance LINPACK solver. In Proceedings of the 2020 Winter Simulation Conference (WSC 2020). To appear.

Thomas C. H. Lux and **Tyler H. Chang**. Analytic test functions for generalizable evaluation of convex optimization techniques. In Proceedings of IEEE SoutheastCon 2020. To appear.

Thomas C. H. Lux, Layne T. Watson, **Tyler H. Chang**, Li Xu, Yueyao Wang, Jon Bernard, Yili Hong, and Kirk W. Cameron. Effective nonparametric distribution modeling for distribution approximation applications. In Proceedings of IEEE SoutheastCon 2020. To appear.

Under Review

Thomas C. H. Lux, Layne T. Watson, **Tyler H. Chang**, and William I. Thacker. Algorithm XXXX: MQSI—Monotone quintic spline interpolation. Submitted to ACM Transactions on Mathematical Software, August, 2020.

Tyler H. Chang, Layne T. Watson, Jeffrey Larson, William I. Thacker, Shubhangi Deshpande, and Thomas C. H. Lux. Algorithm XXXX: VTMOP: Solver for blackbox multiobective optimization problems. Submitted to ACM Transactions on Mathematical Software, June, 2020.

Yueyao Wang, Li Xu, Yili Hong, Rong Pan, **Tyler H. Chang**, Thomas C. H. Lux, Jon Bernard, Layne T. Watson, and Kirk W. Cameron. Design strategies and approximation methods for high-performance computing variability management. Submitted to Journal of Quality Technology May, 2020.

Contributed Talks

Multiobjective optimization of simulations with PARMOO. Postdoctoral Research and Career Symposium. November 2020, virtual event.

A surrogate for local optimization using Delaunay triangulations. Sixth International Conference on Continuous Optimization (ICCOPT). August 2019, Berlin, Germany.

Professional Activities

Referee: For Journal of Machine Learning Research (2019); IEEE SoutheastCon (2018 – 2020).

Session Chair: SIAM Conference on Computational Science and Engineering (2021); SIAM Conference on Optimization (2021); IEEE SoutheastCon (2018).

Membership: ACM (2015 – Present); SIAM (2016 – Present); SCS (2020 – Present).

Counselor / Founding Member: Virginia Tech CS Graduate Counsel (Fall, 2017 – Fall, 2019). Organizing professional and social events for current and prospective graduate students.

Teaching Experience

(Spring, 2020) **Instructor: Virginia Tech**, Dept. of Computer Science.

- Instructor for *CS 3114: Data Structures and Algorithms*.

(Spring, 2013 – Fall, 2015) **Subject Tutor: Virginia Wesleyan University**, Learning Center.

- Subject tutor for undergraduate courses in calculus, computer science, and statistics.