# **Tyler Chen**

tyler.chen@nyu.edu https://chen.pw

#### **Academic Positions**

Assistant Professor / Courant Instructor

- Mathematics at Courant, Computer Science and Engineering at Tandon
- Sponsor: Christopher Musco

#### Education

Ph.D. in Applied Mathematics

- Thesis: Lanczos-based methods for matrix functions
- Advisors: Anne Greenbaum, Thomas Trogdon

M.Sc. in Applied Mathematics

B.S. Summa Cum Laude in Mathematics and Physics; Minor in Studio Art

#### **Research Interests**

I'm interested in incorporating randomization techniques into classical algorithms from applied mathematics to develop methods which are fast and reliable in theory and in practice. Much of my research centers on Krylov subspace methods and other approaches for simple linear algebraic tasks like solving linear systems of equations and computing matrix functions.

#### In submission

- [4] Qichen Xu and Tyler Chen. A posteriori error bounds for the block-Lanczos method for matrix function approximation. 2022. arXiv: 2211.15643 [math.NA].
- [3] Raghu Bollapragada, Tyler Chen, and Rachel Ward. On the fast convergence of minibatch heavy ball momentum. 2022. arXiv: 2206.07553 [cs.LG].
- [2] Tyler Chen and Eric Hallman. Krylov-aware stochastic trace estimation. 2022. arXiv: 2205.01736 [math.NA].
- [1] Tyler Chen, Thomas Trogdon, and Shashanka Ubaru. Randomized matrix-free quadrature for spectrum and spectral sum approximation. 2022. arXiv: 2204.01941 [math.NA].

### **Publications**

- [7] Tyler Chen, Anne Greenbaum, Cameron Musco, and Christopher Musco. "Low-memory Krylov subspace methods for optimal rational matrix function approximation". In: SIAM Journal on Matrix Analysis and Applications (2023). to appear. arXiv: 2202.11251 [math.NA].
- [6] Tyler Chen and Yu-Chen Cheng. "Numerical computation of the equilibrium-reduced density matrix for strongly coupled open quantum systems". In: *The Journal of Chemical Physics* 157.6 (Aug. 2022), p. 064106. arXiv: 2204.08147 [quant-ph]. URL: https://doi.org/10.1063/5.0099761.
- [5] Tyler Chen, Anne Greenbaum, Cameron Musco, and Christopher Musco. "Error Bounds for Lanczos-Based Matrix Function Approximation". In: SIAM Journal on Matrix Analysis and Applications 43.2 (May 2022), pp. 787-811. arXiv: 2106.09806 [math.NA]. URL: https://doi.org/10.1137/21m1427784.
- [4] Tyler Chen, Thomas Trogdon, and Shashanka Ubaru. "Analysis of stochastic Lanczos quadrature for spectrum approximation". In: *Proceedings of the 38th International Conference on Machine Learning*. Vol. 139. Proceedings of Machine Learning Research. PMLR, 18–24 Jul 2021, pp. 1728–1739. arXiv: 2105.06595 [cs.DS]. URL: http://proceedings.mlr.press/v139/chen21s.html.
  - selected for long presentation (top 3%)
- [3] Anne Greenbaum, Hexuan Liu, and Tyler Chen. "On the Convergence Rate of Variants of the Conjugate Gradient Algorithm in Finite Precision Arithmetic". In: SIAM Journal on Scientific Computing (July 2021), S496-S515. arXiv: 1905.05874 [cs.NA]. URL: https://doi.org/10.1137/20m1346249.
- [2] Tyler Chen. "Non-asymptotic moment bounds for random variables rounded to non-uniformly spaced sets". In: Stat (June 2021), e395. arXiv: 2007.11041 [math.ST]. URL: https://onlinelibrary.wiley.com/doi/10.1002/sta4.395.
- [1] Tyler Chen and Erin C. Carson. "Predict-and-recompute conjugate gradient variants". In: SIAM Journal on Scientific Computing 42.5 (Jan. 2020), A3084-A3108. arXiv: 1905.01549 [cs.NA]. URL: https://doi.org/10.1137/19m1276856.
  - abridged version was Student Paper Competition winner at 16<sup>th</sup> Copper Mountain Conference on Iterative Methods

## **Teaching**

Instructor, Numerical Analysis (NYU MATH-UA 252)	spring 2023
Instructor, Mathematical Statistics (NYU MATH-UA 234)	fall 2022
Instructor, Applied Linear Algebra and Numerical Analysis (UW AMATH 352)	spring 2021
Instructor, Interdisciplinary Writing/Natural Science (UW ENGL 199)	winter 2021
Instructor, Interdisciplinary Writing/Natural Science (UW ENGL 199)	autumn 2020
TA, Probability and Statistics for Computational Finance (UW CFRM 410)	winter 2019
TA, Calculus with Analytic Geometry I (UW MATH 124)	autumn 2018
TA, Calculus with Analytic Geometry II (UW MATH 12)	winter 2018
TA, Calculus with Analytic Geometry II (UW MATH 125)	autumn 2017
TA, Electronics (Tufts PHY 41)	spring 2017
TA, Electronics (Tufts PHY 41)	spring 2016
Grader Discrete Mathematics (Tuffs MATH 61)	sprina 2016

	der, Calculus III (Tufts MATH 42)
	der, Differential Equations (Tufts MATH 51)
Gra	der, Calculus III (Tufts MATH 42)
Adv	vising
-	hen Xu
Aw	vards & Honors
Boe	ing Research Award (UW Department of Applied Mathematics)
Student Paper Competition Winner (Copper Mountain Conference on Iterative Methods)	
Gra	duate Research Fellowship (NSF)
Тор	Scholars Fellowship (UW)
The	Audrey Butvay Gruss Science Award (Tufts)
Phi	Beta Kappa (Tufts)
_	ma Pi Sigma Physics Honors Society (Tufts)
The	Howard Sample Prize Scholarship in Physics (Tufts)
Tall	ks and Posters
[10]	Randomized matrix-free quarature. Presentation at Courant Numerical Analysis and Scientific Computing Seminar. Sept. 2022. [pdf]
[9]	GMRES, pseudospectra, and Crouzeix's conjecture for shifted and scaled Ginbre matrices. Presentation at Conference on Random Matrix Theory and Numerical Linear Algebra. June 2022. [pdf]
[8]	Simple Algorithms for Spectral Sum and Spectrum Approximation. Poster at Workshop on Algorithms for Large Data (Online). Aug. 2021. [pdf]
[7]	Analysis of stochastic Lanczos quadrature for spectrum approximation. Oral at International Conference on Machine Learning. July 2021. [video]
[6]	Concentration in the Lanczos Algorithm. Presentation at SIAM Linear Algebra 21. May 2021. [pdf]
[5]	Analysis of stochastic Lanczos quadrature for spectrum approximation. Presentation at at Baidu Research. Mar. 2021. [pdf]
[4]	Analyzing the Effects of Local Roundoff Error on Predict-and-Recompute Conjugate Gradient Variants. Poster at Householder Symposium (Cancelled). June 2020.
[3]	Predict-and-recompute conjugate gradient variants. Presentation at Copper Mountain Student Paper Award Session (Cancelled). Mar. 2020.

[2] Predict-and-recompute conjugate gradient variants. Presentation at SIAM Parallel Processing. Feb. 2020.

[1] Symmetric Preconditioner Refinement Using Low Rank Approximations. Presentation at Baidu Research.

[pdf]

Feb. 2019.

# **Service and Outreach**

Minisymposium Organizer
<b>Graduate Student Representative</b>
Minisymposium Organizer
<b>Diversity Committee Departmental Climate Orientation</b>
Numerical Analysis Research Club
Washington Directed Reading Program
SIAM UW Mental Health Conversation and Resources

## Software

PETSc (https://www.mcs.anl.gov/petsc/)

Contribute PIPEPRCG. This method can be used by with the flag  $-\mathtt{ksp\_type}$  pipeprcg.

 $\textbf{Research code} \ (\texttt{https://github.com/tchen-research})$ 

Code to generate figures and experiments from my papers