

# Fengyu Yang

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## ABOUT ME

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I am currently a Ph.D. candidate at the University of North Carolina at Chapel Hill, advised by Prof. Shahar Kovalsky. My research focuses on *Differentiable Optimization*, *Machine Learning*, and *Statistical Modeling*. In Summer 2025, I have been a Research Scientist intern at ByteDance Seed-AI for Science team, working on AI-driven protein structure reconstruction. I will graduate in May 2026 and am seeking full-time AI/ML researcher positions starting Summer 2026.

## EDUCATION

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### University of North Carolina, Chapel Hill

Ph.D. in Applied Mathematics, Minor in Statistics & Operations Research

Aug. 2021 – May 2026

### University of Chicago

M.S. in Computational and Applied Mathematics, GPA: 3.8/4.0

Sept. 2019 – Mar. 2021

### Shandong University

B.S. in Statistics of Mathematics School, GPA: 90/100

Sept. 2015 – June 2019

## RESEARCH EXPERIENCE

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### Differentiation Through Black-box Convex Optimization Solvers

Advisor: Shahar Kovalsky

- Developed a modular convex optimization layer enabling end-to-end differentiation through **arbitrary forward solvers**, incorporating domain knowledge into neural network training, and supporting bilevel optimization.
- Addressed limitations of existing methods that rely on specific solvers, achieving up to **3 orders of magnitude** performance improvements on large-scale problems.
- Extended methodology to broader convex optimization problems including Semidefinite Programming.

### Coupling Structural and Functional Brain Connectome

Advisor: Shahar Kovalsky

- Developed model for jointly analyzing brain structure connectome (DT-MRI) and the temporal dynamics of individual brain regions (fMRI) using **graph spectral analysis** and **signal processing**, uncovering cognitive and motor mechanisms while providing insights into degenerative processes associated with aging and diseases.

### Methods of Moments for 3D Particle Ab Initio Modeling

Advisor: Yuehaw Khoo

- Developed method of moments approach for ab initio 3D molecular reconstruction from 2D projected cryogenic electron microscopy (cryo-EM) images.
- Formulated mathematical framework using representation theory, harmonic analysis and numerical analysis, generalizing viewing angle distribution representation to **arbitrary basis functions**, enabling enhanced representation power for diverse real data distributions.
- Implemented algorithms in MATLAB and validated reconstruction accuracy on synthetic data.

## PROFESSIONAL EXPERIENCE

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### ByteDance

May 2025 – Dec 2025

Seed-AI for Science, Research Scientist Intern

San Jose, CA

- Leading development of the **first** systematic PyTorch-based open-source cryo-EM reconstruction software **from scratch**, addressing limitations of traditional tools with poor extensibility and limited GPU acceleration, delivering superior performance and enhanced extensibility for AI-based method development.
- Executed complete software development lifecycle independently, from design to deployment.
- Developing **AI foundation generative model** using flow matching and discrete posterior sampling, integrating the software for downstream biology tasks, enabling enhanced protein structure prediction.
- Delivered core reconstruction module that achieves high-resolution 3D protein density reconstruction. Implemented **Distributed Data Parallel (DDP)** scaling across multiple GPUs and nodes, achieving 10x computational speedup.

## Argonne National Laboratory

May 2023 - Aug. 2023

Givens Associate, Advisor: Prof. Mihai Anitescu

Chicago, IL

- Developed statistical parametric model for analyzing positional and substitutional disorder in crystallography.
- Proved theoretical convergence of algorithms with Julia implementation presented at DOE conference.

## Deloitte Consulting (Shanghai)

Aug. 2018 - Feb. 2019

Data Visualization & Analyst Intern

Beijing, China

- Developed business intelligence dashboards for world-renowned companies; facilitated 4 bidding projects with 2 completed orders and 1 consulting project successfully delivered.

## PUBLICATIONS

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“Differentiation Through Black-Box Quadratic Programming Solvers.” C. W. Magoon\*, **F. Yang\***, N. Aigerman, and S. Z. Kovalsky. *NeurIPS*, 2025.

(\* Equal contribution)

## PREPRINTS

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“A Generative Foundation Model for Cryo-EM Densities.” Y. Li, J. Yuan, Y. Zhou, Z. Wang, S. Chen, **F. Yang**, H. Ling, S. Z. Kovalsky, X. Zheng, and Q. Gu. *bioRxiv*, 2025.

doi: 10.64898/2025.12.29.696802

## ACADEMIC ACTIVITIES

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**The Thirty-Ninth Annual Conference on Neural Information Processing Systems (NeurIPS)** Dec. 2025

**Poster:** Differentiation Through Black-Box Quadratic Programming Solvers

**The Triangle Computational and Applied Mathematics Symposium (TriCAMS)** Nov. 2023

**Lightning Talk + Poster:** Coupling Structural and Functional Brain Connectome

**NSF Focused Research Group (FRG) Collaborative Research Meeting** Nov. 2023

**Presentation:** Spatio-Temporal Analysis of Brain Imaging

**2023 Summer Argonne Student Symposium (SASSy)** Jul. 2023

**Presentation:** Statistical Model of Crystallographic Disorder

## TEACHING EXPERIENCE

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- TA for *Scientific Computation* (graduate level), *Optimization with Applications in Machine Learning*, *Numerical PDE*, *Linear Algebra*, *Discrete Mathematics*.
- Recitation Leader for *Calculus I, II, III*.

## COMPUTER SKILLS

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Python, PyTorch, MATLAB, Julia, R, JavaScript, Tableau