

# Yukuan Hu

PH.D. IN COMPUTATIONAL MATHEMATICS

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## Education

Academy of Mathematics and Systems Science (AMSS), Chinese Academy of Sciences (CAS)

Beijing, China

Ph.D. in Computational Mathematics

09/2019 - 06/2024

Supervisor: Prof. Xin Liu

School of Mathematical Sciences, Tongji University

Shanghai, China

B.Sc. in Mathematics and Applied Mathematics

09/2015 - 06/2019

Thesis advisor: Prof. Junfeng Yin

## Academic Experience

CERMICS, École nationale des ponts et chaussées, Institut Polytechnique de Paris

Champs-sur-Marne, France

Postdoctoral Fellow

09/2024 - Present

Advisor: Prof. Eric Cancès

Department of Applied Mathematics, The Hong Kong Polytechnic University

Hong Kong, China

Research Associate

07/2024 - 08/2024

Host: Prof. Zaikun Zhang

## Research Interests

- Numerical optimization
- Computational quantum chemistry
- Computational materials science

My interests focus on developing numerical optimization methods for scientific and engineering applications. Recently, I have been working on the topics in computational quantum chemistry and computational materials science, including electronic excited states calculations, electronic energy landscape analysis, strongly correlated electrons calculations, and structure relaxation with physical constraints.

## Publications & Preprints

1. **Critical point search and linear response theory for computing electronic excitation energies of molecular systems. Part I: General framework, application to Hartree-Fock and DFT**  
arXiv preprint arXiv:2025.16420, 2025 (preprint)  
Laura Grazioli, **Yukuan Hu**, Eric Cancès
2. **Sampling-based approaches for multi-block optimization problems over transport polytopes**  
*Mathematics of Computation*, 2025, 94(353): 1281–1322 (doi, preprint)  
**Yukuan Hu**, Mengyu Li, Xin Liu, Cheng Meng
3. **Complexity of tensor product functions in representing antisymmetry**  
arXiv preprint arXiv:2501.05958, 2025 (preprint)  
Yuyang Wang, **Yukuan Hu**, Xin Liu
4. **The exactness of the  $\ell_1$  penalty function for a class of mathematical programs with generalized complementarity constraints**  
*Fundamental Research*, 2024, 4(6): 1459–1464 (doi, preprint)  
**Yukuan Hu**, Xin Liu
5. **Projected gradient descent algorithm for *ab initio* crystal structure relaxation under a fixed unit cell volume**  
*Physical Review B*, 2024, 109(22): 224109 (14 pages) (doi, preprint)  
**Yukuan Hu**, Junlei Yin, Xingyu Gao, Xin Liu, Haifeng Song

6. **The convergence properties of infeasible inexact proximal alternating linearized minimization**  
*Science China Mathematics*, 2023, 66(10): 2385–2410 (doi, preprint)  
Yukuan Hu, Xin Liu
7. **A global optimization approach for multimarginal optimal transport problems with Coulomb cost**  
*SIAM Journal on Scientific Computing*, 2023, 45(3): A1214–A1238 (doi, preprint)  
Yukuan Hu, Huajie Chen, Xin Liu
8. **Force-based gradient descent method for *ab initio* atomic structure relaxation**  
*Physical Review B*, 2022, 106(10): 104101 (10 pages) (doi, preprint)  
Yukuan Hu, Xingyu Gao, Yafan Zhao, Xin Liu, Haifeng Song

## Patents & Copyrights

1. 晶体结构弛豫软件包 ProME-SuRe  
Description: **A suite for crystal structure relaxation**; static-link library files are available upon request  
*CN Software Copyright*, 2023, 2023SR1558824  
Xingyu Gao, Xin Liu, **Yukuan Hu**, Haifeng Song, Xin Chen, Yuechao Wang, Lifang Wang
2. 固定晶格体积晶体结构弛豫的计算方法及装置  
Description: **Computational methods and apparatus for crystal structure relaxation with a fixed unit cell volume**  
*CN Patent*, 2023, ZL 202211210741.3  
Xingyu Gao, Xin Liu, Haifeng Song, **Yukuan Hu**, Xin Chen, Yuechao Wang, Jun Fang, Lifang Wang, Le Zhang
3. 原子结构弛豫的非单调线搜索方法及装置  
Description: **Computational methods and apparatus for atomic structure relaxation**  
*CN Patent*, 2022, ZL 202111534901.5  
Xingyu Gao, Xin Liu, Haifeng Song, **Yukuan Hu**, Jun Fang, Zhen Yang, Yafan Zhao, Lifang Wang, Haifeng Liu

## Selected Projects

### As a member

09/2024 – 08/2026      Extremely-scale Mathematically-based Computational Chemistry (EMC2)      *EU Horizon 2020, ERC*

## Selected Presentations

08/2025	The 15th International Conference on Numerical Optimization and Numerical Linear Algebra	<i>Harbin, China</i>
07/2025	The 8th International Conference on Continuous Optimization (ICCOPT 2025)	<i>Los Angeles, USA</i>
06/2025	The 22nd Conference on Advances in Continuous Optimization (EUROPT 2025)	<i>Southampton, UK</i>
07/2024	The First Forum for Ph.D. Students in Computational Mathematics	<i>Beijing, China</i>
10/2023	The 21st Annual Meeting of China Society for Industrial and Applied Mathematics (CSIAM 2023)	<i>Kunming, China</i>
08/2023	The 10th International Congress on Industrial and Applied Mathematics (ICIAM 2023)	<i>Tokyo, Japan</i>
08/2023	The 14th International Conference on Numerical Optimization and Numerical Linear Algebra	<i>Taiyuan, China</i>
06/2023	Applied Math Ph.D. Seminar at Fudan University	<i>Shanghai, China</i>

## Selected Honors & Awards

09/2025	CAS Excellent Ph.D. Dissertation (TOP 78 in CAS, TOP 2 in AMSS)	CAS
11/2024	CAS President's Special Award (10,000 CNY, TOP 59 in CAS, TOP 2 in AMSS)	CAS
11/2023	Beijing Mathematical Society (BMS) Excellent Youth Paper (the only Ph.D. candidate selected)	BMS
11/2023	Zhu Li Yuehua Outstanding Doctoral Student Award (5,000 CNY)	University of CAS
09/2023	AMSS President's Special Award (32,000 CNY, TOP 4 in AMSS)	AMSS
04/2023	Financial Support Program	ICIAM 2023
09/2022	Loo-Keng Hua Scholarship (100,000 CNY)	AMSS
09/2021	Loo-Keng Hua Scholarship (100,000 CNY)	AMSS

## Professional Activities

### Conference organizations

06/2025      Session Chair for “Advances in Manifold Optimization”, EUROPT 2025      *Southampton, UK*

### Referee for journals

- IEEE Transactions on Signal Processing
- The Innovation
- Numerical Functional Analysis and Optimization
- npj Unconventional Computing

## Skills

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<b>Languages</b>	Chinese (mother tongue), English (professional fluency), French (beginner)
<b>Programming</b>	Python, Fortran, C, MATLAB, $\text{\LaTeX}$ , Shell
<b>Parallel Computing</b>	MPI, OpenMP