

Xiaopei Jiao, Ph.D.

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PERSONAL INFORMATION

BIRTH DATE: March, 2nd, 1995
NATIONALITY: China
ADDRESS: Yanmingyuan 1-3-1004, Huairou district, Beijing, China.

EDUCATION

2024.07 - 2024.11	University of Twente, Netherlands Postdoctoral researcher
2022.07 - 2024.06	Beijing Institute of Applied Mathematics and Application (BIMSA), China Postdoctoral researcher Mentor: Stephen S.-T. Yau , Jie Wu
2017.07 - 2022.06	Tsinghua University, China Ph.D. in Applied Mathematics , Department of mathematical sciences. Supervisor: Stephen S.-T. Yau
2013.07 - 2017.06	Shanghai Jiao Tong University, China B.S. in Physics , Zhiyuan College Supervisor: David Cai Dual B.S. in Computer Science .

RESEARCH INTERESTS

Nonlinear filter; Control theory; Physics-informed machine learning; Computational biology.

PROJECT AND RESEARCH

2017-2019	Mathematical stochastic modelling of gene expression A three-stage model is proposed to calculate mRNA distribution in cell population. By considering methylation allocation, random simulation is used to reveal novel distribution which is highly consistent with single-cell data.
2019-2021	Particle filter algorithm based on optimal transportation By applying optimal transport technique, feedback control algorithm is exploited to make data denoising based on the Monge-Ampere equation. 100 dimensional simulations can be calculated efficiently compared to common algorithms such as the Kalman filter, ensemble filter etc.
2018-2022	Theoretical classification of nonlinear filter By applying various pure mathematical tools such as partial differential equation, Lie algebra etc, classification problems of finite dimensional filter system proposed by U.S. academician R. W. Brockett in International Congress of Mathematician has been partially solved successfully.
2018-2022	Analysis and prediction of COVID-19 genome sequence data We develop a mathematical method to predict new genome sequences from real data. Using natural vector and convex hull principles, our approach optimizes the detection of nucleotide composition in sequences. Validation with SARS-CoV-2 datasets confirms its effectiveness in predicting these compositions.
2022-2024	Algorithms of data denoising of stochastic optimal control <ul style="list-style-type: none">• Numerical calculation of backward stochastic differential equation.• Analysis on equivalent Hamilton-Jacobi-Bellman equation and stochastic maximal principle related to several types of data smoothing frameworks.
2022-2024	Application of Physics-Informed machine Learning in the stochastic filter <ul style="list-style-type: none">• Numerical calculation of parabolic partial differential equation, and use Matlab and Python code for thousands of lines related to the machine learning library.• By taking fusion of physics information to Kolmogorov equation, a new high-fidelity and fast inference surrogate model is designed to deal with data denoising algorithm.

BASIC SKILLS

- Applied Math: Numerical partial differential equation; **Scientific machine learning** (Physics-informed Neural Network, Neural Operator); **data denoising/smoothing** (Kalman filter etc, optimal and feedback control); **Biological simulation** (cancer microenvironment modeling, Omics data analysis).
- Computer Science: Proficiency in **Python, Matlab, C++, R**; Familiar with deep learning library **Pytorch, Jax**.
- English: Literature reading and writing, free communication with native English speakers.

ACADEMIC SERVICES

Peer Reviewer of *IEEE Conference on Decision and Control*
Peer Reviewer of *IEEE Transactions and Automatic Control*
Peer Reviewer of *American Control Conference (ACC)*.

HONORS AND AWARDS

- 2021: **First class scholarship**, Tsinghua University.
- 2015: **Meritorious Award** in the Mathematical Contest in Modeling (MCM), U.S.

TEACHING

- 2017- 2020: Teaching Asistant in Mathematical department, Tsinghua University

ACADEMIC VISITS

- 2024: Visiting Scholar. **University of Twente, Netherlands**
- 2021: Invited speaker. **SIAM Annual Meeting**, Philadelphia, U.S.
- 2015: Visiting Scholar. **Oxford University, U.K.**

PUBLICATIONS

Equal contribution; * Corresponding author;

Publications with peer review process

1. Shi, J.[#], **Jiao, X.**[#], & Yau, S. S.-T.* (2024). DGLG: A deep Generalized Legendre-Galerkin approach to optimal filtering problem. *IEEE Trans Autom Control*. (Q1, IF=7.5)
2. Shi, J.[#], **Jiao, X.**[#], & Yau, S. S.-T.* (2024). A Novel Logarithmic Transformed Deep Galerkin Approach To Optimal Filtering Problem. *IEEE Conference on Decision and Control*.
3. **Jiao, X.**,& Yau, S. S. T.* (2023). Structure of finite dimensional exact estimation algebra on state dimension 3 and linear rank 2. *International Journal of Control*, 96(2), 362-373. (Q2, IF=2.1)
4. **Jiao, X.**, & Yau, S. S. T.* (2023). Finite-dimensional estimation algebra on arbitrary state dimension with nonmaximal rank: linear structure of Wong matrix. *International Journal of Control*, 1-8. (Q2, IF=2.1)
5. **Jiao, X.**, Pei, S., Sun, Z., Kang, J., & Yau, S. S. T.* (2021). Determination of the nucleotide or amino acid composition of genome or protein sequences by using natural vector method and convex hull principle. *Fundamental Research*, 1(5), 559-564. (Q1, IF=6.2)
6. **Jiao, X.**, & Yau, S. S. T.* (2020). New classes of finite dimensional filters with nonmaximal rank estimation algebra on state dimension n and linear rank n-2. *SIAM J CONTROL OPTIM*, 58(6), 3413-3427. (Q1, IF=2.6)
7. **Jiao, X.**, & Lei, J.* (2018). Dynamics of gene expression based on epigenetic modifications. *Communications in Information and Systems*, 18(3), 125-148. (IF=0.9)
8. **Jiao, X.**, & Yau, S. S. T.*. Weak form Mitter conjecture on nonmaximal rank estimation algebra: state dimension 4 and rank 3. *Journal of Systems Science & Complexity* (To appear)(Q2, IF=2.6)

9. Yu, H., **Jiao, X.**, & Yau, S. S. T.* (2023). Complete Classification of Finite Dimensional Estimation Algebras with State Dimension N , Linear Rank $n-1$ and Constant Wong Matrix. IEEE Trans Autom Control. (Q1, IF=7.5)
10. Kang, J., **Jiao, X.**, & Yau, S. S. T.* (2023). Finite Dimensional Estimation Algebra for Time-Varying Filtering System and Optimal Transport Particle filter: A Tangent Flow Point of View. IEEE T AERO ELEC SYS (Q1, IF=4.6)
11. Zhang, C.#, Shao, C.#, **Jiao, X.#**, Bai, Y., Li, M., Shi, H., Lei, J., Zhong, X.* (2021). Individual cell-based modeling of tumor cell plasticity-induced immune escape after CAR-T therapy. Computational and Systems Oncology, 1(3), e21029.
12. Lai, X.#, **Jiao, X.#**, Zhang, H., & Lei, J.*. Computational modeling reveals key factors driving treatment-free remission in chronic myeloid leukemia patients. Npj systems biology and applications. (Q1, IF=4.3)

Submitted publications with peer review process:

1. **Jiao, X.**, Shi, J., & Yau, S. S.-T.*. Time varying Schrodinger equation with polynomial potential and its application in nonlinear filtering. (Submit to International Journal of Control)
2. **Jiao, X.**, & Xiong, F.*. GsPINN: A novel fast Green kernel solver based on symmetric Physics-Informed neural networks. (Submit to Neurocomputing)
3. Kang, J., **Jiao, X.**, & Yau, S. S. T.*. Estimation of the Linear System via Optimal Transportation and Its Application for Missing Data Observations. (submit to IEEE TAC)