

# ZEXI FAN

Phone: (+86) 189-1096-4688  $\diamond$  Email: [fanzexi\\_francis@stu.pku.edu.cn](mailto:fanzexi_francis@stu.pku.edu.cn)

Personal Homepage

X  $\diamond$  Github  $\diamond$  LinkedIn

## EDUCATION

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**Peking University(PKU)**

Sep 2022 - Present

B.S. in Computational Mathematics

Major GPA: 3.6/4.0

Selected Courses: Abstract Algebra(93), Machine Learning(93), Advanced Algebra 2(90)

Advanced Mathematical Skills: Stochastic Analysis&Control, Scientific Machine Learning, PDE

GRE: (164+169+4)/(170+170+6)

Aug 2023

## TOPICS I HAVE WORKED ON

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- Multilevel Monte Carlo and its Applications
- Diffusion Models and Other Stochastic Interpolants(Optimal Transport, Schrodinger Bridge, Transition Path)
- Scientific Machine Learning
- High Dimensional PDE Solver

I am also open to work on other topics in Machine Learning and Applied Mathematics.

## PUBLICATIONS

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**Simulation-Calibrated Scientific Machine Learning (SCaSML) for Solving High-Dimensional Partial Differential Equations (Preprint)**

submitted

*Contribution: First Author*

## RESEARCH EXPERIENCE

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**Exploring Training Strategy of GAN via MCST in Go**

Sep 2019 - June 2020

*Supervisors: Dr. Hailong Qin*

HIT

- Proposed an algorithm that leverages MCST algorithm in AlphaGo to balance the training of discriminator and generator in GAN
- Implemented an experiment on MINST to illustrate the efficiency of the algorithm in early stages
- This is an award-winning paper of the National Innovation Competition of Youth(at Beijing), a research-oriented competition for high schoolers

**Unbiased Square Root Convergent Estimation for High-Dimensional Semilinear Parabolic Heat Equation**

Sep 2023 - Feb 2024

*Supervisors: Prof. Yiping Lu*

NYU

- Proposed an estimator for solving high-dimensional semilinear parabolic heat equations based on Multilevel Picard Iteration and randomized Multilevel Monte Carlo
- Proved the unbiasedness of the estimator
- Showcasing the estimator has bounded variance

**Flow Calibrated RL for Transition Path Sampling (Slides)**

Feb 2024 - June 2024

*Supervisors: Prof. Yiping Lu and Dr. Dinghuai Zhang*

NYU, Mila

- Proposed an algorithm for sampling distribution-to-distribution transition paths under SDE framework

- Formulated the problem into a rigid stochastic optimal control problems that can be solved in RL
- Developed continuous versions of Soft Actor-Critic and that of GFlowNet by stochastic analysis
- Combining the two solvers for better exploration-exploitation trade-off
- Considering appropriate reparameterization for continuous Soft Actor-Critic

**Simulation-Calibrated Scientific Machine Learning (SCaSML) for Solving High-Dimensional Partial Differential Equations (Codebase)**

June 2024 - Present  
Northwest, Gatech

*Supervisors: Prof. Yiping Lu and Dr. Yan Sun*

- Helped develop a family of simulation-based estimators to calibrate the error of PINN
- Proved the rate improvements in convergence for Multilevel Picard Iteration estimators
- Demonstrated the effectiveness of SCaSML by numerical experiments on multiple 100d+ PDEs

ACADEMIC ACTIVITIES

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Graduate course: Combinatorics, Score: 92, taught by Prof. Chunwei Song	<i>Spring 2023</i>
Graduate course: Machine learning, Score: 93, taught by Prof. Kedian Mou	<i>Winter 2023</i>
Graduate course: Mathematical image processing, Audit, taught by Prof. Bin Dong	<i>Winter 2023</i>
Seminar: Blowup in fluid equations, organized by Prof. Jiajun Tong&Prof. De Huang	<i>Winter 2023</i>
Seminar: Stochastic optimal control, organized by Dr. Xinhan Duan	<i>Spring 2024</i>
Summer school: Beauty of theoretical computer science, organized by NJU CS Dept.	<i>Summer 2024</i>

SOCIAL ACTIVITIES

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Academic&Innovation Department, SMS Student Union	<i>Spring 2023</i>
English Debate Club	<i>Summer 2024</i>

SKILLS/HOBBIES

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<b>Programming Languages</b>	Python, Matlab, Latex, Markdown
<b>Machine Learning Tools</b>	Pytorch, Tensorflow, Numpy, Jax, Wandb, DeepXDE
<b>Hobbies</b>	Animation and Program Designing
<b>Languages</b>	English and Chinese