

# Mokai Pan

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## Education

### ShanghaiTech University

Undergraduates, Major: Computer Science

Shanghai

Sep. 2021 - Present

- GPA: 3.64 / 4.0
- CET4: 610; CET6: 508
- Relevant Course:
  - Mathematical Analysis I & II : A
  - Probability and Statistics I: A+
  - Numerical Optimization: A
  - Convex Optimization: A
  - Computational Science and Engineering: A
  - Fundamentals of Information Theory: A+

## Skills

- Programming** C, C++, Java, Python
- Drawing & Typesetting** Office,  $\LaTeX$
- Languages** Chinese (Native), English (fluent)

## Selected Research & Projects

### UniDB++: Fast Sampling of Unified Diffusion Bridge

Shanghai

ArXiv: 2505.21528 (First author)

Mar. 2025 - May. 2025

- We propose UniDB++, a fast sampling algorithm for the UniDB models. UniDB++ derives exact closed-form solutions for UniDB's reverse-time SDEs, complemented by replacing conventional noise prediction with the more stable data prediction model, along with an SDE-Corrector mechanism that maintains perceptual quality for low-step regimes.
- We demonstrate that UniDB++ can recover DBIMs as special cases by evaluating their update rules under some theoretical conditions, revealing the effectiveness of DBIMs from the perspective of the exact reverse SDE solutions of UniDB++.
- UniDB++ achieves  $5\times$  and up to  $20\times$  faster sampling compared to UniDB and achieves state-of-the-art performance in various image restoration tasks, including super-resolution, raindrop restoration, deraining, and inpainting tasks, which underscores the model's exceptional image quality and its versatility across a wide range of scenarios.
- Contributed to deriving all theoretical models, conducting all experiments and manuscript writing (Methods & Experiments sections).

### UniDB: A Unified Diffusion Bridge Framework via Stochastic Optimal Control

Shanghai

ICML 2025 Spotlight (Co-first author, second position)

Nov. 2024 - Feb. 2025

- We introduce UniDB, a novel unified diffusion bridge framework based on stochastic optimal control. This framework generalizes existing diffusion bridge models like DDBMs and GOUB, offering a comprehensive understanding and extension of Doob's  $h$ -transform by incorporating general forward SDE forms.
- We derive closed-form solutions for the SOC problem, demonstrating that Doob's  $h$ -transform is merely a special case within UniDB when the terminal penalty coefficient in the SOC cost function approaches infinity. This insight reveals inherent limitations in the existing diffusion bridge approaches, which UniDB overcomes. Notably, the improvement of UniDB requires minimal code modification, ensuring easy implementation.
- UniDB achieves state-of-the-art results in various image restoration tasks, including super-resolution (DIV2K), inpainting (CelebA-HQ), and deraining (Rain100H), which highlights the framework's superior image quality and adaptability across diverse scenarios.
- Contributed to deriving theoretical models (e.g., Theorem 4.2 and Proposition 4.3 in Section 4.2) and manuscript writing (Methods & Experiments sections).

## Extracurricular Activities

### Shanghai International Marathon

Volunteer

Shanghai

Nov. 27 2022

## Awards and Honors

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| Nov. 2021 | <b>Contest:</b> Second Prize in "Chinese Mathematics Competitions" | Shanghai |
| Nov. 2022 | <b>Contest:</b> Second Prize in "Chinese Mathematics Competitions" | Shanghai |
| Nov. 2023 | <b>Contest:</b> Second Prize in "Chinese Mathematics Competitions" | Shanghai |