

Hu Hanyang

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EDUCATION

National University of Singapore, B.Sc. (Hons) with Major in Mathematics

Aug 2021 – May 2025

- **GPA:** 4.66/5.0
- Participant of the **Special Programme in Mathematics (SPM)** for selected students with strong aptitude.
- **Specialization:** Operations Research & Data Analytics
- **Relevant Courses:** Artificial Intelligence, Bayesian Statistics, Computer Organization, Convex Optimization, Data Structures and Algorithms (in C++), Data Modelling and Computation, Differentiable Manifolds, Differential Geometry on Curves and Surfaces, Discrete Mathematics, Game Theory, Information Theory, Numerical Computation, Stochastic Operations Research, Stochastic Processes, Theory of Computation

EXPERIENCE

Software Team Lead, NUS Calibur Robotics – Singapore

Aug 2022 – July 2024

- Led data collection and curation of over 6000 images to train lightweight models for armor plate detection.
- Applied the SORT algorithm and Kalman filters for motion tracking and prediction.
- Applied Perspective-n-Point (PnP) pose computation for robot localization.
- Achieved 2nd place as a team in the RoboMaster University League (RMUL) 2023, Seattle.
- Conducted multiple workshop sessions in the DarkNUS program to teach participants about our aimbot systems.
- Implemented particle filters and various path planning algorithms in simulations, including A* and DWA; and investigated reinforcement learning-based navigation through implicit Q learning (IQL) and reward shaping.

SELECTED PROJECTS

Gaussian Processes for Model-Based Reinforcement Learning

Aug 2024 - now

Mathematics Capstone Project (MA4198+MA4288x) | Supervisor: Prof. Jonathan Scarlett.

- **Ongoing Plan:** (1) Investigate and develop scalable, online, and non-stationary GP regression models;
(2) Incorporate GP dynamics/reward models with MBRL methods such as TD-MPC.
- Implemented efficient update of the mean cache and LOVE cache, achieved approximately 100x speedup in runtime on the Elevator dataset ($\approx 10k$ data points) for frequent fantasization compared to the implementation of exact GP with LOVE in GPyTorch.
- Implemented subsampling methods such as Farthest Point Sampling (FPS) using KeOps, achieved at least 60x speedup on the 3D Road dataset ($\approx 400k$ data points) compared to PyTorch-based implementations.
- Implemented (input-dependent) output warping strategies to enhance GP modeling power.
- Combined exact GP and WISKI with TD-MPC (no latent), tested on the pendulum task in the Gymnasium.

Nonlinear Dimensionality Reduction with UMAP

Aug 2024 - Dec 2024

Course Project for Data Modelling and Computation (MA4270) | Instructor: Prof. Soh Yong Sheng

- Studied and summarized the curse of dimensionality and the (parametric) UMAP algorithm in a written report.
- Implemented parametric UMAP from scratch using PyTorch. Tested on synthetic and real-world datasets.
- Applied concepts in smooth manifolds to estimate intrinsic dimension (via probabilistic PCA on tangent spaces).

Unstructured High-Dimensional Bayesian Optimization

May 2024 - Aug 2024

Advanced UROPS in Mathematics (MA3288) | Supervisor: Prof. Jonathan Scarlett.

- Investigated the unknown hyperparameter issue of Bayesian optimization in high-dimensional settings, without imposing assumptions on low-dimensional structures or restricting to local regions.
- Proposed a soft approximation of Winsorization to address outliers and complex objective functions, achieving more robust results in finding controller parameters for the lunar lander task in the Gymnasium.
- Delivered a written report and presented findings through an oral presentation.