



The Hong Kong University of Science and Technology

Department of Mathematics

PhD THESIS EXAMINATION

**Learning-Based Methods for
High-Dimensional Statistical Inference and PDE Solution Operators**

By

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ABSTRACT

This thesis develops learning-based methods for high-dimensional streaming inference and time-dependent PDE solution operators. First, a sequential intersection-bound procedure updates debiased lasso estimates over a candidate set to infer the largest coefficient in a high-dimensional linear model. Under regularity and margin conditions, it recovers the maximizing set and attains asymptotically exact coverage. Second, the Split-Step Fourier Neural Operator combines learned spectral evolution with the nonlinear phase structure of the split-step Fourier method for Gross-Pitaevskii dynamics. Controlled comparisons show that its phase transformation improves accuracy against a parameter-matched Block FNO; rollout and conservation diagnostics characterize behavior beyond one-step prediction, and the design is tested on three-dimensional binary dipolar condensates. Third, the Stabilized Convex-Splitting Network constructs current-state, stabilized linear, and signed cubic channels before each recurrent Fourier block; learned Fourier and pointwise branches then process these solver-inspired contributions. This organization lowers relative L2 training and validation losses and held-out fixed-horizon errors on Allen-Cahn and separately trained Cahn-Hilliard tasks compared with controlled baselines.

Date : 23 September 2026, Wednesday

Time : 10:00 am

Venue : Room 4472 (near Lifts 25/26)

Thesis Examination Committee:

Chairman	:	Prof. Lizhong ZHENG, ECE/HKUST
Thesis Supervisor	:	Prof. Yang XIANG, MATH/HKUST
Member	:	Prof. Shing Yu LEUNG, MATH/HKUST
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Member	:	Prof. Chao TANG, ACCT/HKUST
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(Open to all faculty and students)

The student's thesis is now being displayed on the reception counter in the General Administration Office (Room 3461).