



The Hong Kong University of Science and Technology

Department of Mathematics

PhD THESIS EXAMINATION

**Semantic Information Under Bandwidth and Compute Constraints in
Visual Compression and Generation**

By

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ABSTRACT

This thesis studies semantic information in visual systems that have little bandwidth or limited inference compute. The first part focuses on ultra-low bitrate image compression. TextBoost sends optical-character-recognition output as lightweight side information and uses it at the decoder to recover small scene text without reallocating image bits. Source-Anchored Visual Autoregression (SAVAR) then considers extreme image compression with visual autoregressive models: early scale tokens give the reconstruction a source-specific anchor, while compact captions supply missing high-level semantics. The second part shifts from compression to generation. Using the same coarse-to-fine autoregressive scale structure, process-level trajectory screening shows that mid-scale previews can approximate final composition quality on GenEval tasks, which makes it possible to filter weak candidates before expensive vision-language evaluation. Finally, Information Commitment studies when the future of a visual autoregressive trajectory becomes determined. It introduces Decision Scale as an operational statistic and analyzes emergence, stability, recoverability, intervention sensitivity, and scaling behavior. Across these projects, semantic content is not only a property of the final reconstructed or generated image. It is carried by intermediate representations, constrained by what has already been transmitted or generated, and sometimes committed before the image looks complete. This view leads to more efficient compression, cheaper test-time search, and more direct analysis of large visual generative models.

Date : 3 August 2026, Monday

Time : 3:00 pm

Venue : Room 5508 (Lifts 25-26), 5/F Academic Building

Thesis Examination Committee:

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|--------------------------|----------|--|
| Chairman | : | Prof. Jun ZHANG, ECE/HKUST |
| Thesis Supervisor | : | Prof. Yang XIANG, MATH/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).