Temple University
College of Engineering

PhD Prelim Exam Presentation
Department of Electrical and Computer Engineering

12:00 PM – 1:00 PM, Tuesday, November 11, 2025
ECE Conference Room (ENGR 709B)

Feature-Enriched AI and Quantum Methods in Digital Pathology

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Abstract:

In this presentation, we advocate for the importance of using relevant features in the development of robust computational solutions for digital pathology applications (DPATH). Feature extraction remains one of the most critical stages in AI development, as the quality and representativeness of extracted features directly determine performance. Quantum computing approaches are emerging as a promising paradigm to improve learning efficiency. These quantum-enhanced frameworks ultimately lead to more efficient and expressive models for digital pathology.

The first paper, titled “Quantitative chemical imaging of breast calcifications in association with neoplastic processes,” highlights the potential of crystallography and spectroscopic imaging as tools for model feedback and dataset enrichment. By applying hyperspectral stimulated Raman scattering and second harmonic generation microscopy, the study demonstrates that the chemical composition and spatial heterogeneity of breast calcifications are strongly associated with local pathological processes. These findings suggest that specific mineralogical features, particularly variations in carbonate content, correlate with the development and progression of neoplastic lesions.

The second paper, titled “QDeepColonNet: a quantum-based deep learning network for colorectal cancer classification using attention-driven DenseNet and shuffled dynamic local feature extraction network,” introduces a hybrid Deep Learning and Quantum Machine Learning framework designed to enhance classification performance and learning efficiency in histopathological image analysis. The proposed network employs a dual-track architecture that combines DenseNet with an Enhanced Feature Learnable Group Attention block to capture high- and mid-level features, while the Shuffled Dynamic Local Feature Extraction Network integrated with a Lightweight Multi-Kernel Convolution block focuses on modeling fine-grained, short-range dependencies. The outputs from both tracks are concatenated and refined through Efficient Channel Attention for inter-channel interactions without additional computational burden.

The final paper, titled “Hybrid quantum-classical graph neural networks for tumor classification in digital pathology,” presents a quantum–classical framework that integrates advanced graph neural networks with variational quantum classifiers to address key spatial challenges.

Collectively, these studies illustrate a conceptual progression from data-centric enrichment to advanced model architectures. They exemplify how theoretical insights, novel architectures, and application-driven design converge to advance next-generation digital pathology systems.

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Zoom: https://temple.zoom.us/j/95986267996?jst=2 (Meeting ID: 95986267996)