The Chinese University of Hong Kong
Department of Biomedical Engineering

Graduate Seminar – PhD Oral Defence

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Date	***:***	31 July 2024
Time	***:***	9:30 am
Venue	***:***	Room 1122, William M W Mong Engineering Building, CUHK

Title: Enhancing Kirigami Piezoresistive and Porous Soft Sensor Performance for Handling Drift and Improving Posture Sensing Accuracy

Recent research has shown increasing interest in applying machine learning to sense and control soft robots. Soft sensors offer adaptability and miniaturization potential, but their viscoelastic properties present challenges such as nonlinearity, hysteresis, and signal drift. Calibration methodologies are necessary to address these challenges. Data-driven approaches, such as LSTM neural networks, are effective but have suboptimal outcomes. However, a comprehensive calibration approach leveraging sensor characteristics for optimal long-term performance is yet to be explored, particularly in the context of long-term sensor usage drift. Additionally, there is a lack of optimization in processing sensing information and perception performance in distributed posture sensing methods.

This research proposes methodologies to enhance neural networks' performance in compensating for viscoelasticity and improving distributed sensing methods. Drift patterns and frequency domain features are extracted to improve learning capabilities regarding viscoelasticity. Data preprocessing techniques, such as Autoencoder, compress multiple sensing signals and extract spatial features from sensor combinations in distributed sensing methods. The first part introduces a drift-aware feature learning approach using an autoencoder and LSTM regression neural network, demonstrating superiority over conventional methods in reducing root mean square error (RMSE). Additionally, frequency domain feature learning is presented, incorporating dynamic characteristics through frequency domain coefficients to mitigate nonlinearity, hysteresis, and signal drift. The second part focuses on utilizing Autoencoders to condense sensor information, reducing computational redundancy and complexity caused by an increasing number of sensors. Besides, a scaffold-based conceptualization of sensor distribution is proposed for distributed sensing methods, leveraging autoencoders to extract informative features from various combinations of sensor arrays, encompassing vertical columns and horizontal planes. Comparative investigations substantiate the advantages of these arrangements, with improved estimation accuracy.

***** ALL ARE WELCOME *****

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