ECE Graduate Research Seminars-Summer 2024

In Person Sessions: June 3-4, 2024

Remote Sessions: June 17-18, 2024

June 18, 2024-Afternoon Session

N**ame: Milad Ahmadi**
Area of Research: Power Systems Engineering
Name of Supervisor: Rajiv Varma

Novel Controls of Battery Energy Storage Systems as STATCOM (BESS-STATCOM)
A new control for operating a Battery Energy Storage System (BESS) as a STATCOM, termed BESS-STATCOM, is proposed to stabilize a critical induction motor against large disturbances on a 24/7 basis to prevent significant financial losses to the motor facility. Simulation studies are performed using PSCAD on the realistic distribution feeder with a BESS to demonstrate the effectiveness of the proposed control method. When a large disturbance is created, even if the BESS is in a high state of charge or discharging, the control system curtails the active power to release the entire inverter capacity for operating as a STATCOM. This active power curtailment lasts for less than a minute. During this time, the induction motor is stabilized. The proposed BESS-STATCOM technology is expected to be ten times more economical than installing a new STATCOM of equivalent size for stabilizing the same critical motor. The proposed BESS-STATCOM control will soon be field demonstrated in the utility network of Elexicon Energy, Ajax, Ontario.

Name: Mohammad Ghanbari
Area of Research: Power Systems Engineering
Name of Supervisors: Jing Jiang

Power System Resilience: Assessment and Metrics
With the recent increase in extreme events impacting power systems, traditional operational and control methods may no longer suffice to ensure reliability. Consequently, the concept of power system resilience has emerged. However, diverse definitions and metrics associated with this concept have led to misconceptions and confusion, particularly with reliability and robustness. This study aims to provide clarity by proposing a new approach to resilience assessment and metrics, addressing previous gaps in research.

Name: Thanuri Fonseka
Area of Research: Software Engineering
Name of Supervisor: Katarina Grolinger

Deep Learning for the Detection of Deviant Store-Product Sales Patterns

The vast repositories of transactional sales data collected daily in the retail industry represent an opportunity to increase sales revenue and optimize business operations. Major retailers with a network of stores, selling vast quantities of product, may take advantage of an automated mechanism detecting contextual sales anomalies - sales patterns of a particular store outperforming its most similar stores on the level of a Stock Keeping Unit (SKU). When such anomalies are detected, the outperforming store's activity could be further examined to determine performance drivers for a given SKU, establish best practices, and boost sales performance across the network. This way, an individual store's performance can influence its peer stores and benefit the business at large. However, anomaly detection in this context is challenging, given the number and diversity of products and stores in a given retail network. Therefore, this research proposes a framework that leverages deep learning techniques to automatically identify contextual sales anomalies that exist within large volumes of sales data, collected from retail stores network of a major corporation in Canada. This anomaly detection entails a data processing pipeline followed by a deep learning based Autoencoder model that learns normal sales behaviour. The anomalous data instances that are reconstructed by the Autoencoder with large errors, are then compared across peer stores based on a custom deviation metric, to identify anomalous Store-SKU combinations demonstrating anomalous sales patterns.

Name: Tiancheng Feng
Area of Research: Microsystems and Digital Signal Processing
Name of Supervisor: Vijay Parsa

Noise Suppression in Industrial Application

In industrial plants, fluid flow through equipment can be monitored from acoustic emissions with non-invasive methods. However, ambient noise interferes with the acoustic measurements. Effective use of acoustic emissions requires mitigation of ambient noise. This presentation explores several denoising methodologies specifically for addressing ambient noise in chemical industry plant environments. The discussed denoising techniques include filter-based denoising and wavelet-based denoising approaches, aimed at enhancing the reliability of acoustic measurements.

Name: Aisha Edrah
Area of Research: Software Engineering
Name of Supervisor: Abdelkader Ouda

Enhanced Security Access Control using Statistical-based Legitimate or Counterfeit Identification System

With an increasing reliance on technology, the demand for an efficient and seamless access control system has become critical. Smartphone-centric biometric methods offer a diverse range of potential solutions capable of verifying users and providing an additional layer of security to prevent unauthorized access. To ensure the security and accuracy of the smartphone-centric biometric identification system, it is essential that the phone identify its rightful owner seamlessly. Once the legitimate holder has been successfully determined, the phone can provide real-time identity verification to various applications effortlessly. To achieve this goal, we introduce a novel detection and control system integrated into smartphones, utilizing gait cycle analysis, called Identification: Legitimate or Counterfeit (ILC). The ILC system employs the smartphone's accelerometer sensor, along with advanced statistical methods, to detect the user's gait pattern, thus enabling a real-time response that identifies the smartphone owner. This approach relies on a statistical method that utilizes measurements obtained from the accelerometer sensor, specifically peaks extracted from the X-axis accelerometer data. Subsequently, a probability distribution function (PDF) of the derived feature is computed and compared to the PDF of the known user. The calculated probability is used to verify the similarity between the two distributions, and a decision is made on the basis of a predetermined verification threshold. The ILC system achieves an accuracy of 92.18 % in recognizing unauthorized access, illustrating the effectiveness of the proposed approach for user identification. Additionally, the ILC solution improves user experience by offering seamless, password-free smartphone access control. The reliability of the proposed identification scheme is further enhanced by calculating and comparing three different gait cycle features.