Advanced Electrical Power Systems UTC

Disturbance Identification and Mitigation in Power System: Challenges with Observability

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Disturbances identification in Power System

The modern power system is well-proliferated with Renewable Energy (RE) sources and so its dynamics are changing following up the new interconnections and intermittent nature of power sources. This putforth significant challenges regarding observability, detecting disturbances in the network and mitigating its cause. Therefore, this work aims to investigate the IBRs-related disturbances in the power system network, characterize its requirements for detection and identify the optimal solution for system observability to enhance the resiliency and response to events.

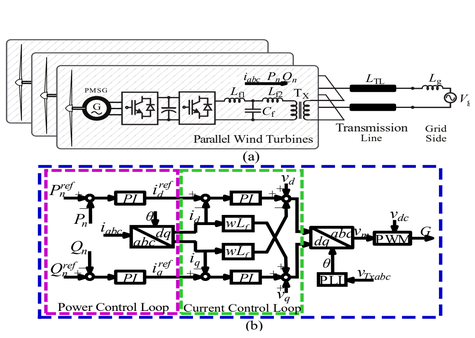
1. Project objectives

This project aims to explore creative solutions that can be generated with WAMS and control systems with the embedded intelligence of data analysis to,

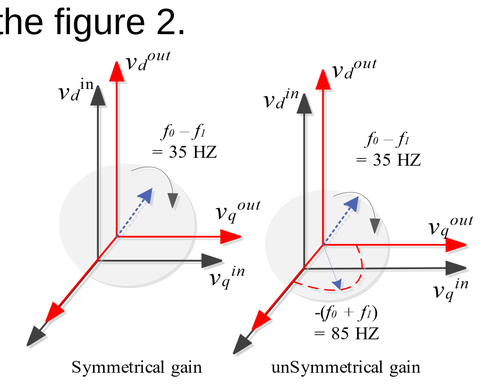
- Develop new decentralized and distributed approaches that utilize phasor measurement and waveform data to a) accurately assess transients in the networks, b) identify the area in the network where such events occur (localization) and c) provide measures for mitigation of the same.
- Analyse and quantify the fidelity/quantization of measurements required to reliably identify disturbances in real-time with the least number of intelligent nodes.
- Experimental testing of developed approaches within a systems testing environment proving their feasibility and applicability for real-world deployment.
- Analyse and improve data compression to minimize the burden on the communications network. This will be of crucial importance to enable distributed implementation that is necessary for more complex dependencies identification not possible by decentralized operation.

2. Case Study–Oscillation Detection

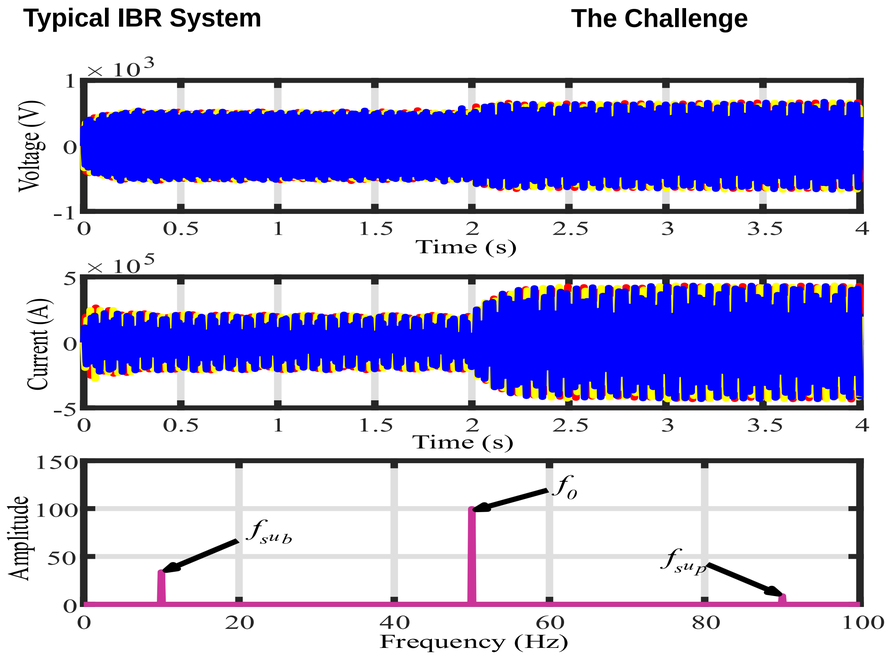
The concept of observability and disturbance identification is realized by investigating multimode synchronous resonance in IBRs based RE sources as shown in the figure 2.



Typical IBR System



The Challenge

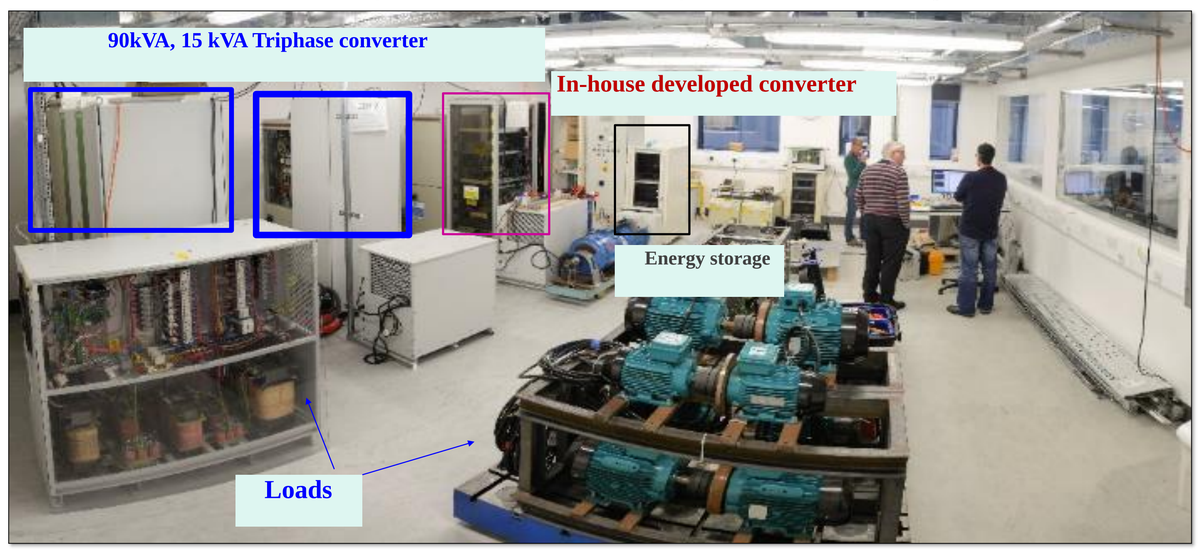


The Solution -Observability

Fig. 2: Framework for disturbance detection

3. Experimental Setup for Replicating Wide Area System

The Dynamic power system laboratory (DPSL) at the University of Strathclyde has state-of-the-art equipment and facilities to demonstrate the observability, control and detection mechanism of large power networks. Real-time power system disturbances are to be replicated with the ensembled 90 kVA triphase, energy storage system and in-house developed converters. The RTDS and micro-PMU prototype further facilitate real-time data production and acquisition for analysis.



Micro-PMU prototype

Wide area monitoring demonstrator (64 PMUs)

Opal-RT and RTDS

Fig. 3: Experimental setup [TOP], Hybrid Microgrid Setup with 90 kVA Triphase converter, Energy storage and power converters [Bottom Left-Right], i) Micro PMU prototype ii) WAMS demonstrator replicating large systems, iii) Real-time Digital Simulator

4. Conclusions and future work

- Development of a testbed to prototype different types of disturbances in the network specifically driven by IBRs.
- Analyze and develop alternate and efficient algorithms that can detect the exact modes of disturbance in the network for characterization.
- Localize the source based on the available data and mitigate the disturbance by dispatching optimal solutions (Control parameters and System Information)

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