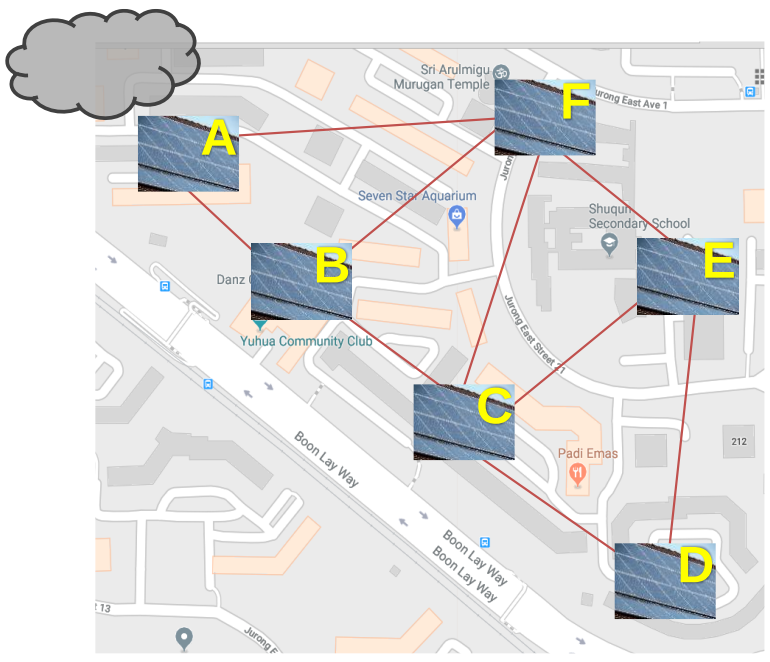
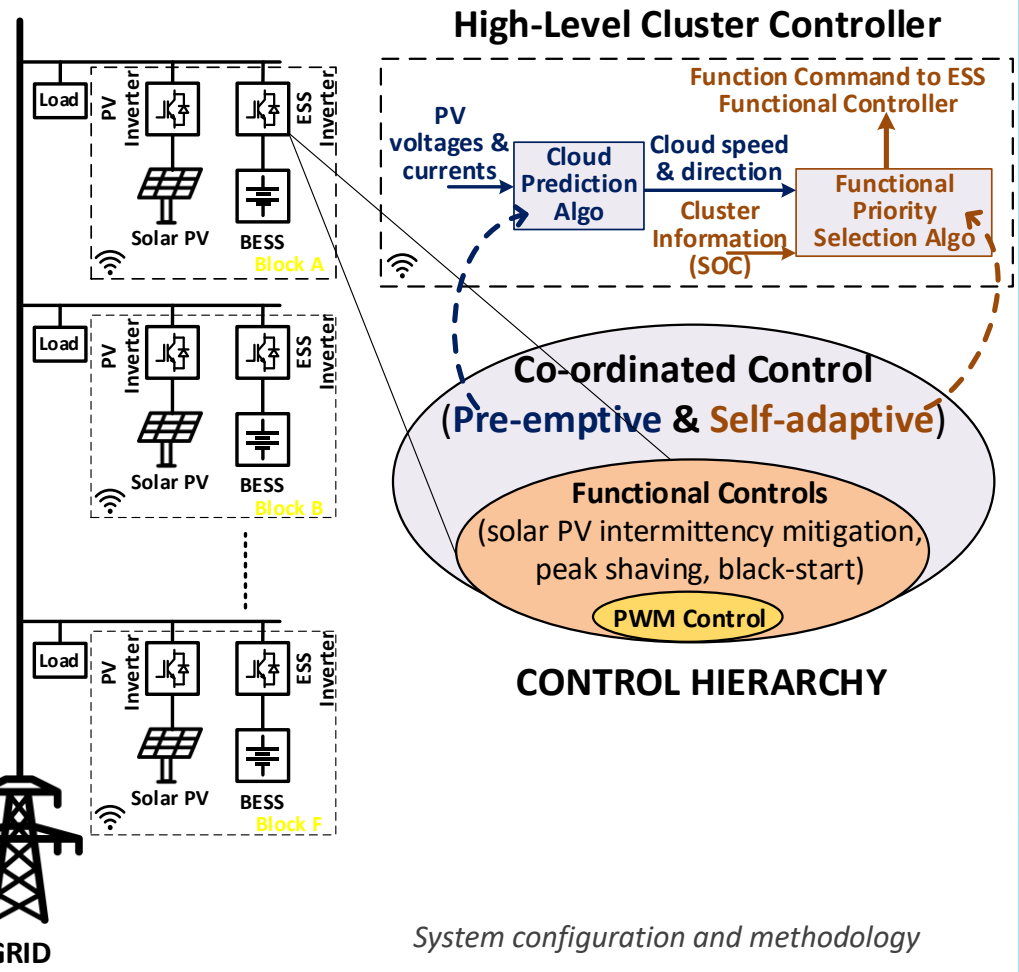
PRE-EMPTIVE AND SELF-ADAPTIVE CONTROL FOR PV CLUSTER INTERMITTENCY MITIGATION



Typical Solar PV panels installations on HDBs in Singapore

- As Solar PV deployment increases in Singapore, it is critical to manage solar intermittency.
- Battery Energy Storage Systems (BESS) is one of the most viable ways to maintain grid stability and facilitate greater deployment of solar.
- Currently, PV intermittency control methodologies are mostly reactive, where the BESS inverter only responses when there are changes in PV power.
- This project aims to optimise the control of a cluster of Solar PV and BESS installations via a pre-emptive and self-adaptive control system.

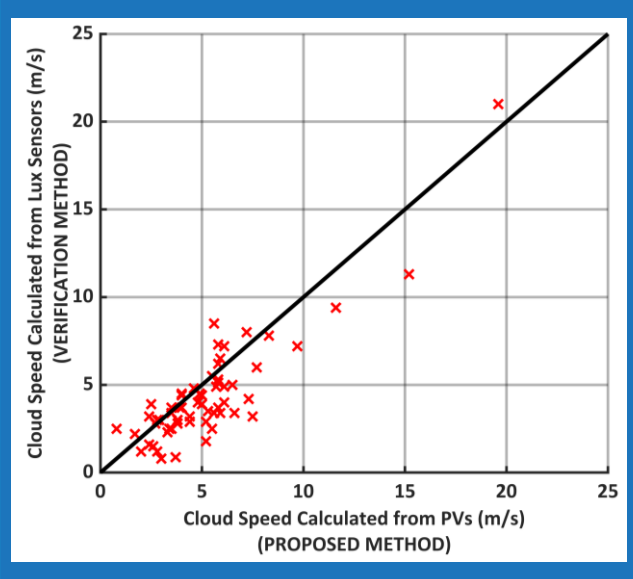
PROJECT SUMMARY



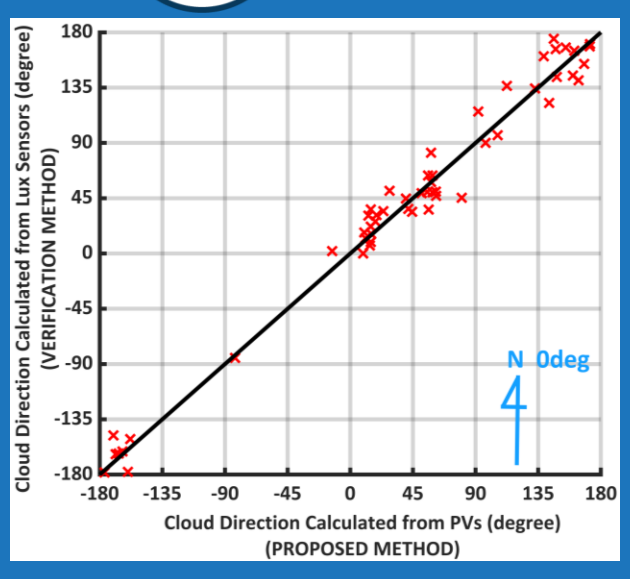
System configuration and methodology

- The main objective is to tackle the PV intermittency without using any environmental sensors. This is achieved through the use of pre-emptive PV intermittency mitigation control.
- The second objective is to develop coordinated multifunctional inverter controls (like ramp-rate control, peak shaving, black start, etc.) for effective utilization of installed BESS in a PV cluster. This includes seamless switching between multiple functions.

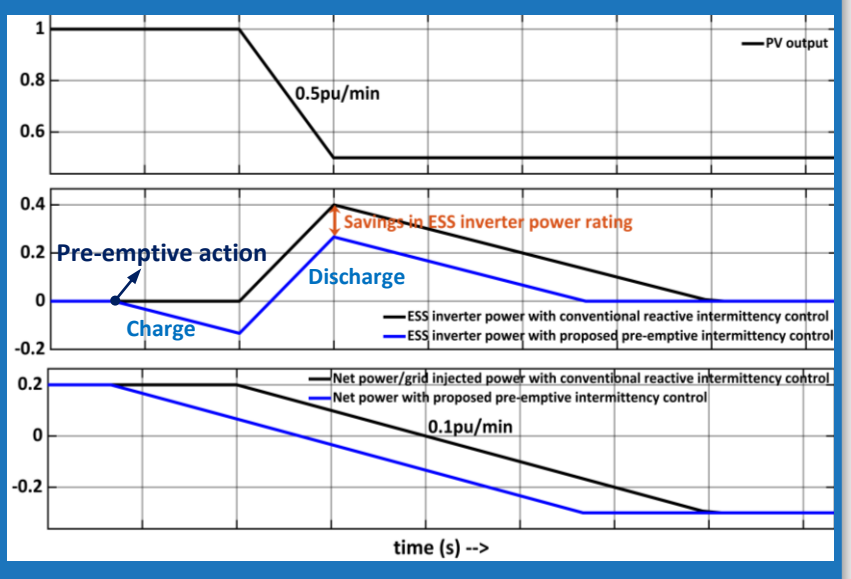
PROJECT OUTCOMES



Measurement of cloud speed using PV voltage and current sensors (PROPOSED METHOD) Vs Lux sensor (VERIFICATION METHOD)



Measurement of cloud direction using PV voltage and current sensors (PROPOSED METHOD) Vs Lux sensor (VERIFICATION METHOD)



Overview of conventional reactive control and proposed pre-emptive intermittency control

Note: The points closer to the 1:1 solid line means the error between the proposed method and verification method is less

For a total of **60** cloud motion events, Root Mean Square Deviation (**RMSD**) of the estimated cloud speed and direction are **1.7m/s** and **15°** with Mean Bias (MB) of **0.8m/s** and **-1°** respectively.

PROJECT PROGRESS

- A cloud estimation method without environmental sensors was developed and verified.
- A test-bed of three sites was identified at Ground-up Initiatives (91 Lor Chencharu, Singapore). PV installation was completed on two of the sites.
- Real-time data collection of the PV is in progress.
- The pre-emptive intermittency control algorithm was developed and validated through simulation.

PROJECT PLAN

- Test the proposed cloud estimation algorithm for a cluster with three PV sites data.
- Develop and validate the BESS inverters with pre-emptive intermittency and multifunctional controls for a PV cluster.

Cloud prediction **without** additional **environmental sensors**

Multi-functional controls for **effective utilisation** of ESS

New technology to mitigate the Solar PV intermittency issue

↓

40-50% reduction in ESS capacity & inverter with co-ordinated multi-functionalities control

Improve cluster level **reliability/resilience**

↓

Aligned to the Singapore target of deploying at least **2GWp of Solar PV by 2030** and at least **200MW ESS beyond 2025**

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