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Performance Evaluation of Distributed Energy Resource Management Algorithm in Large Distribution Networks

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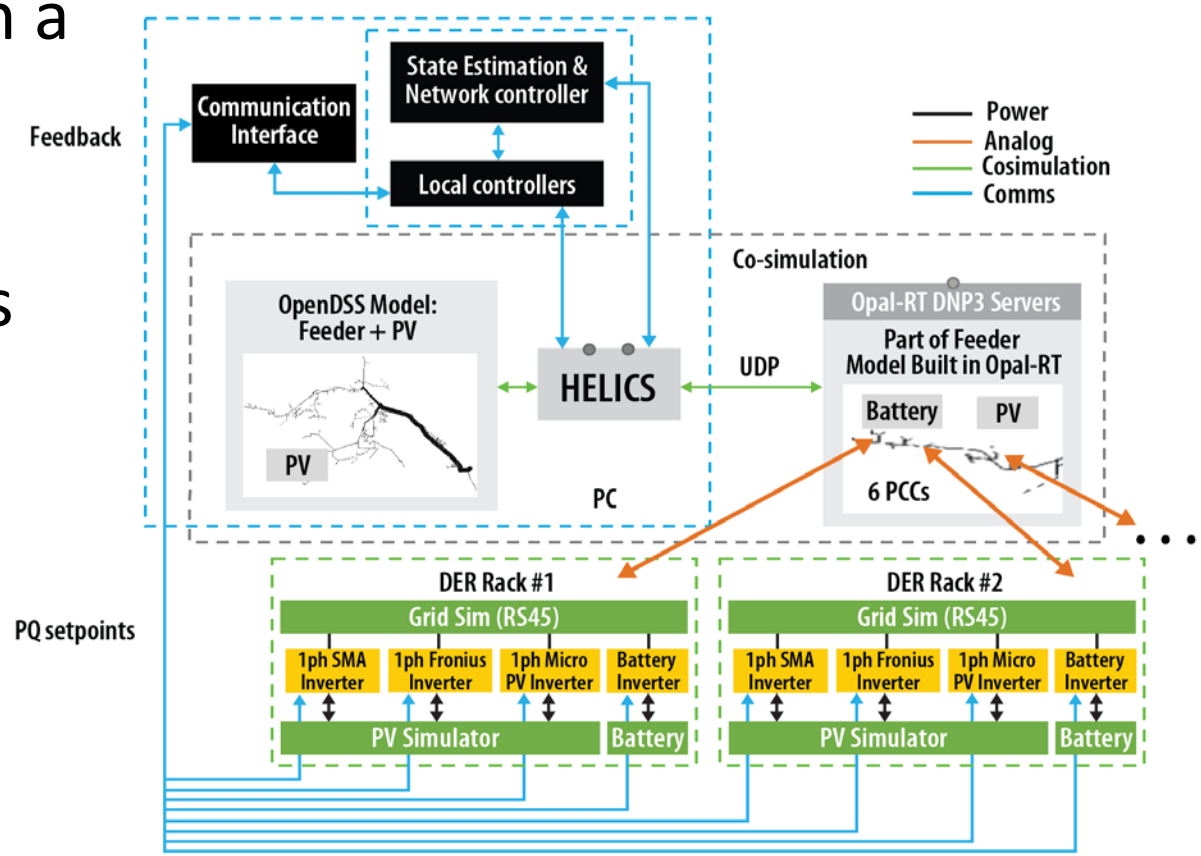
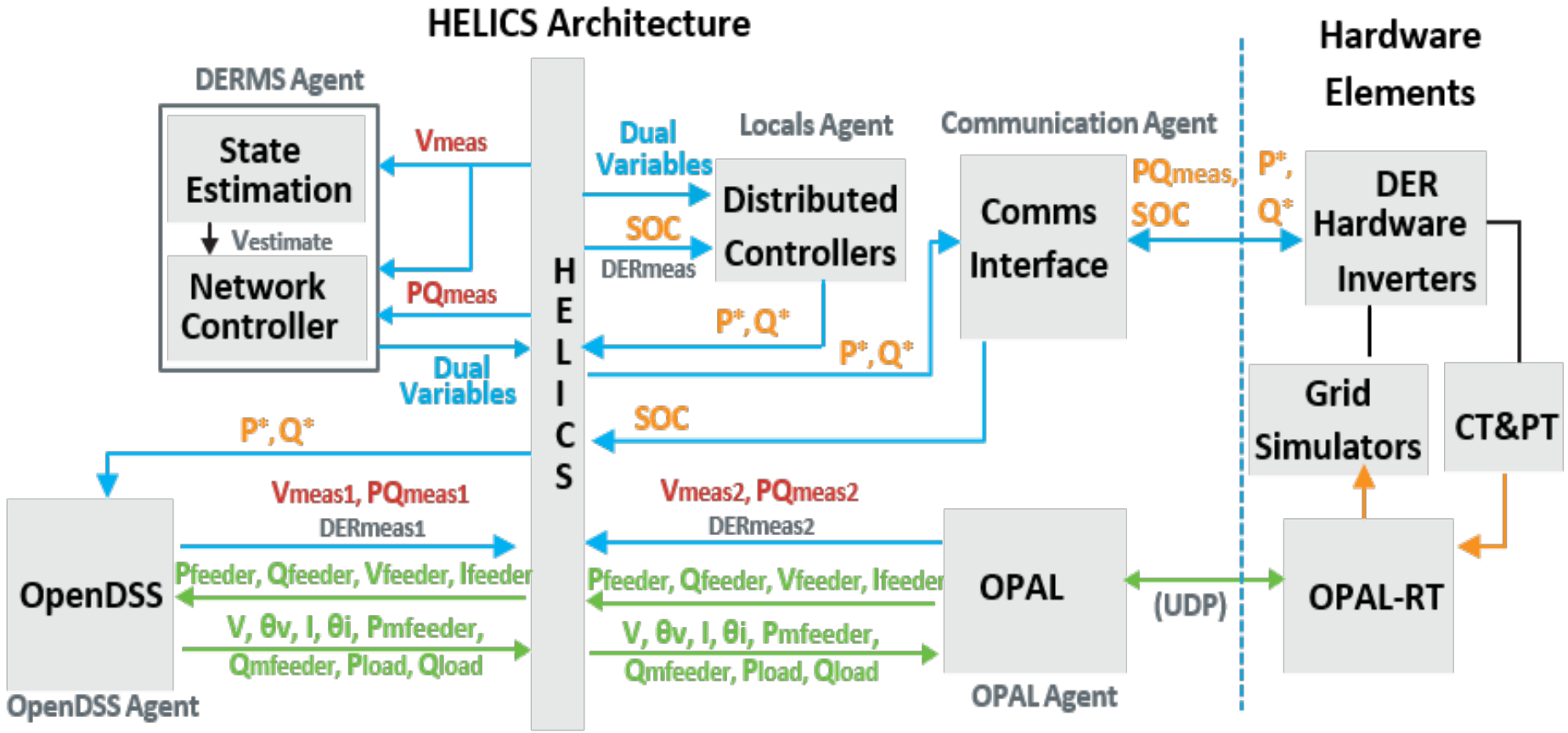
Background & Proposed HIL Architecture

- Need to evaluate DERMS Technology in a more realistic environment
- **Requirements**: real-time simulation of large network, software controller runs in fixed time-step, interact with hardware inverters with standard communication protocols.
- Integrated hardware-in-the-loop platform by using HELICS



Implementation

- HELICS Architecture and Hardware Setup

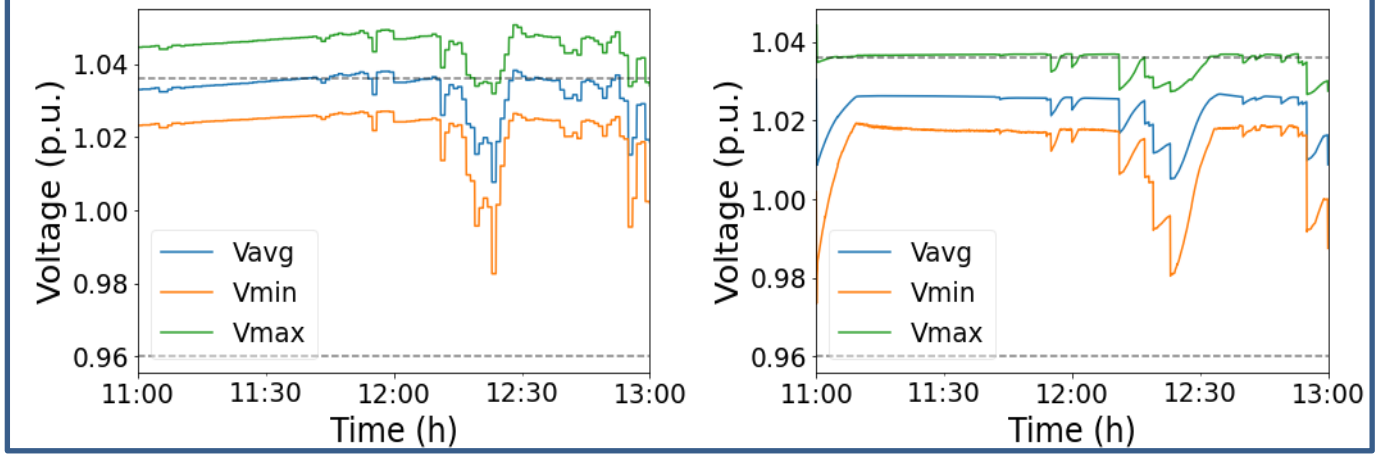


Experimental Results

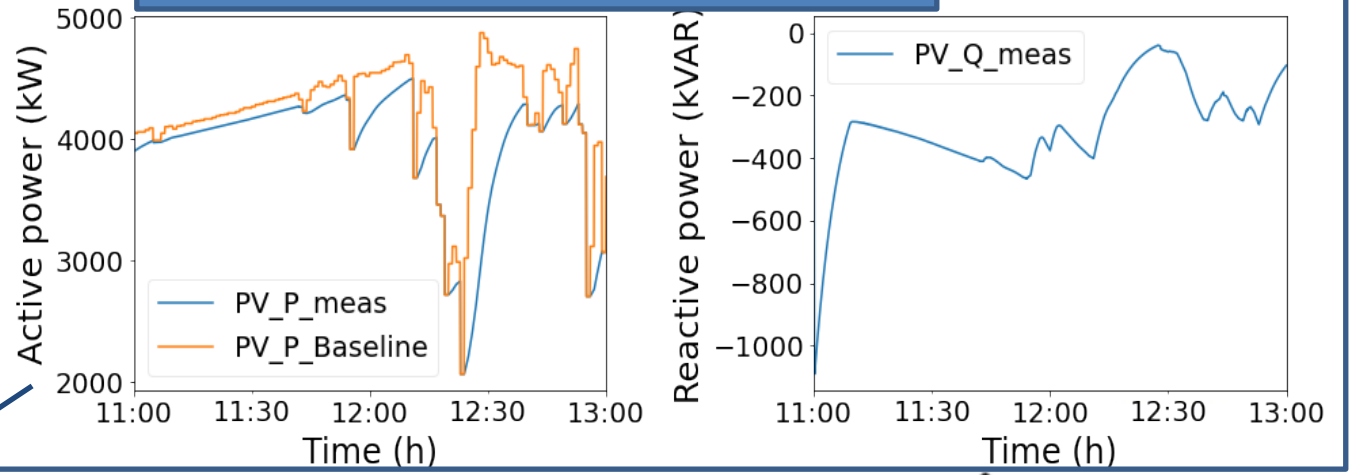
CHIL and PHIL testing

- Setup configuration
  - 11,000 node distribution feeder (IEEE 8,500 node test feeder and a modified EPRI Ctk7 test feeder)
  - 532 simulated PV in OpenDSS
  - 6 PCCs in OPAL-RT with PHIL testing of 6 DER Racks (90 DER hardware inverters)
  - 2-h from 11:00-13:00
  - Voltage regulation performance

Baseline and Controlled voltages



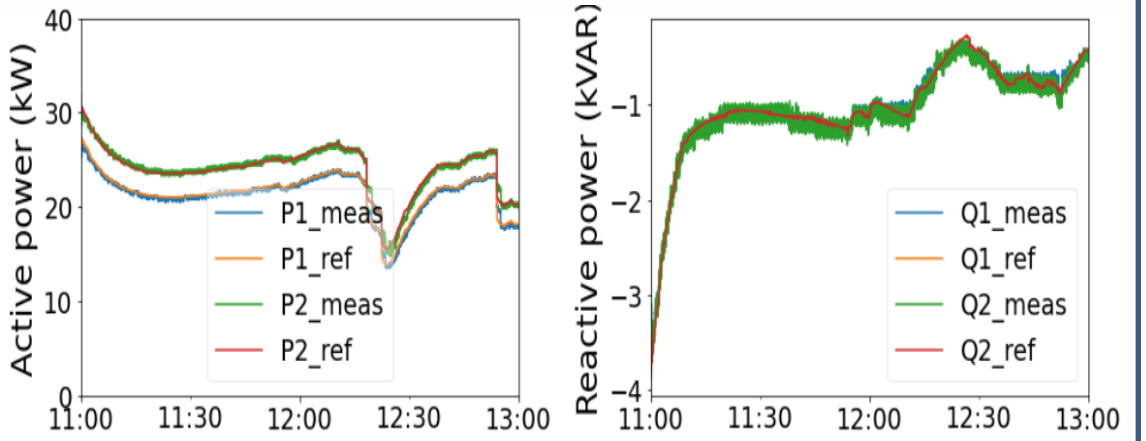
Total PV Active and Reactive Power



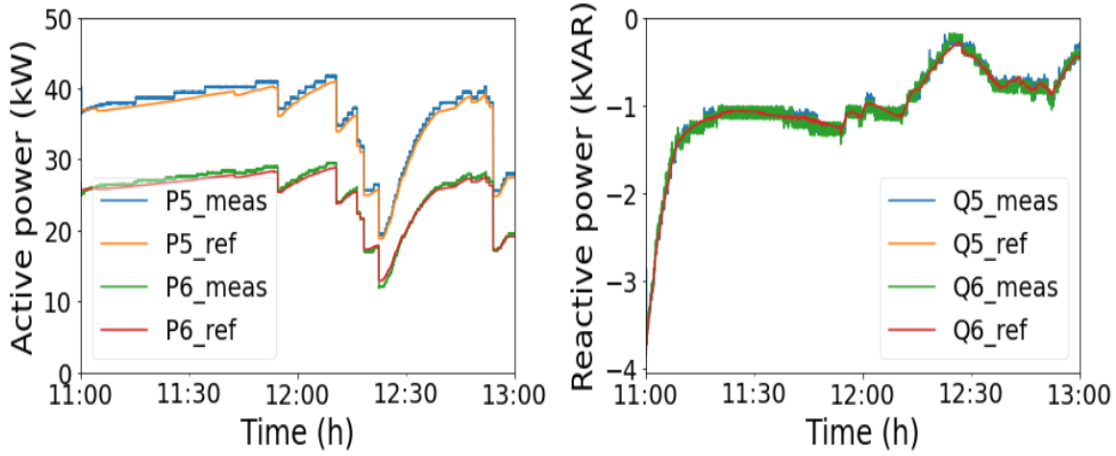
6.55% curtailment

Experimental Results

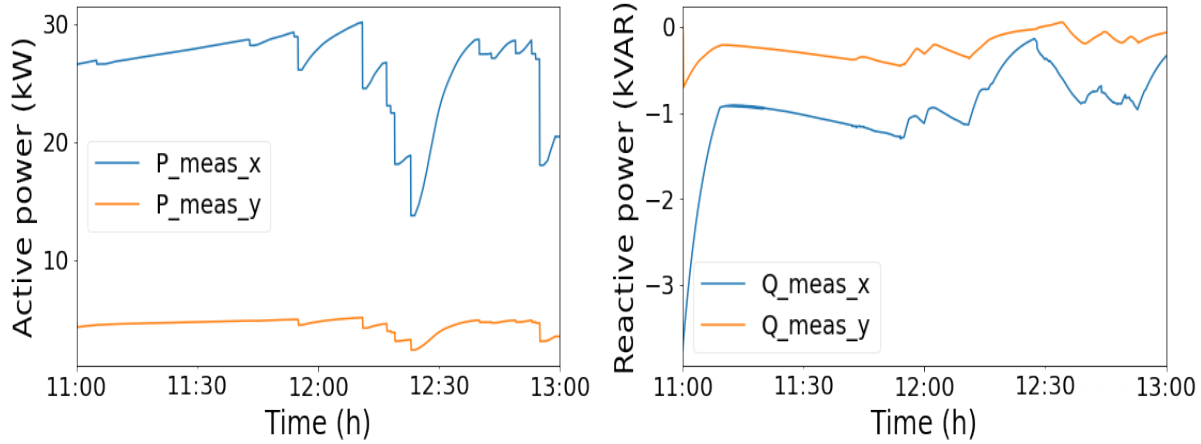
PHIL results: DER Rack #1-4



PHIL results: DER Rack #5-6



Results of two selected simulated PV



Conclusions

- This paper presented the performance evaluation of a DERMS control algorithm for fast DER dispatch using an advanced HIL platform.
- HELICS is the key tool to integrate all the software pieces and hardware devices together.
- The experimental tests demonstrate that the DERMS controller functions well in both smooth solar and intermittent solar to maintain system voltages within the target limits.

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