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Performance Evaluation of Data-Enhanced Hierarchical Control for Grid Operations

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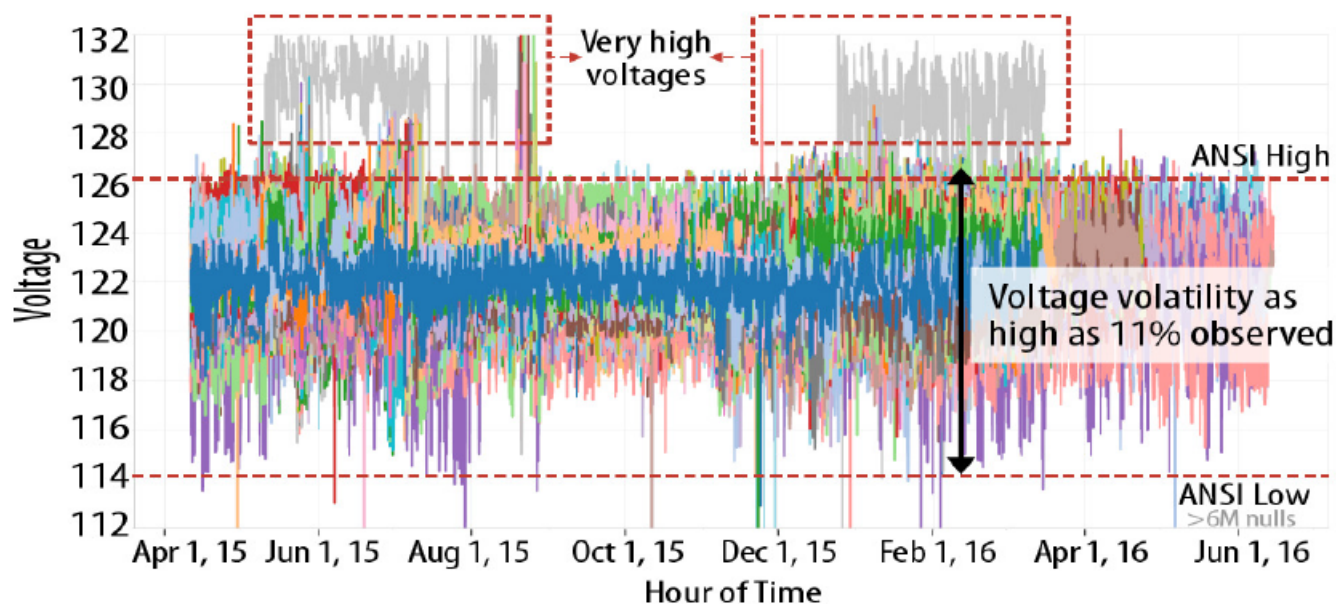
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Background

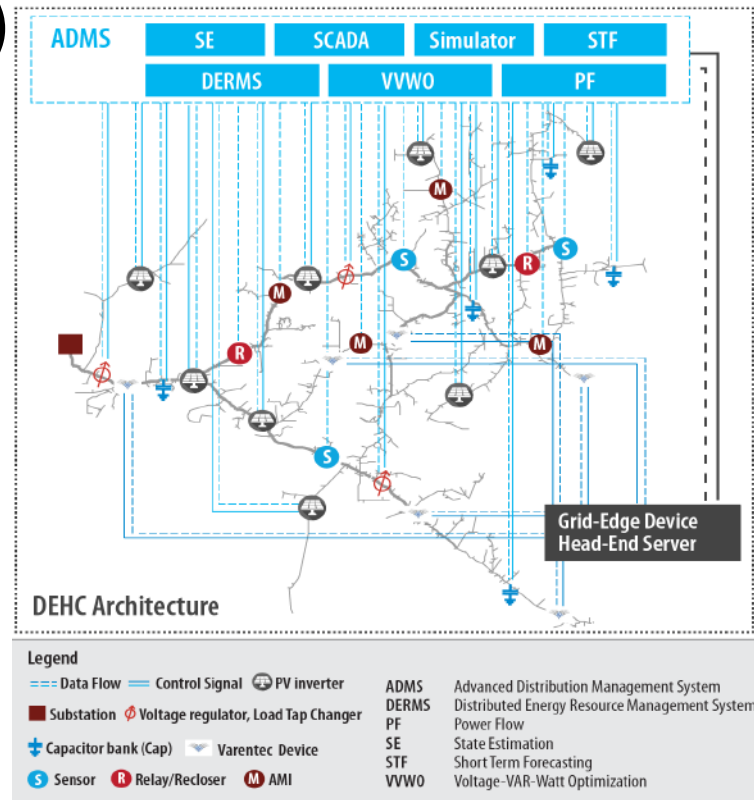
- Address the challenges associated with high penetrations of distributed PV, such as voltage stability



Voltage variability at the grid edge measured by 1,005 AMI meters collected over 14 months

Background

- State-of-the-art grid operation
- Develop a unique and innovative **Data-Enhanced Hierarchical Control (DEHC) architecture**
- Hybrid and coordinated approach
- Advanced application for real-time operation and control
 - ADMS
 - ADMS—grid-edge synergy
 - Real-time optimal power flow (DERMS).

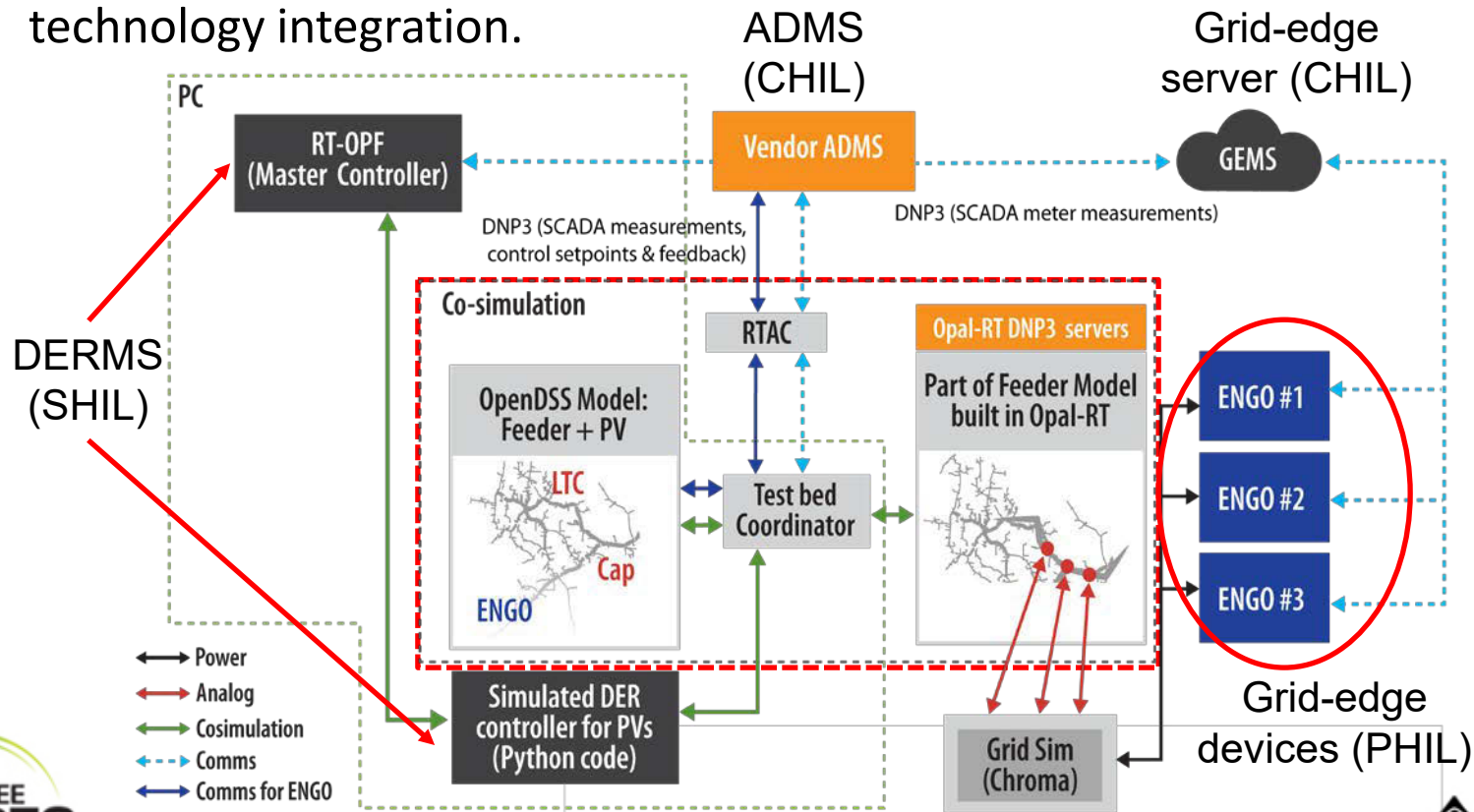


Need to test this integrated system prior to field commissioning

Proposed Hardware-in-the-Loop (HIL) platform

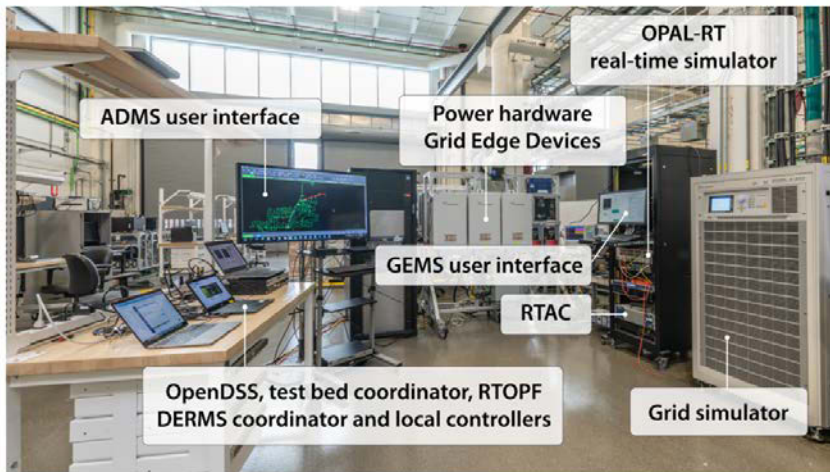
– Co-simulation of CHIL and PHIL with standard communications protocols

- Accurate real-time modeling of distribution system from a utility partner
- Real controller (ADMS and grid-edge server), software controller DERMS
- Hardware grid-edge devices
- Provide realistic laboratory testing and de-risk potential issues with new technology integration.

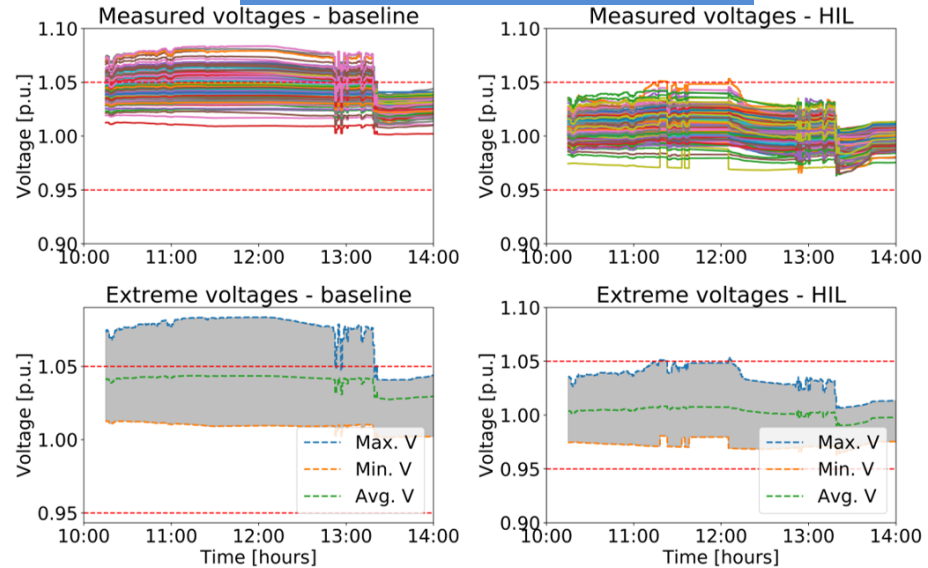


Experimental Results—Voltage Regulation

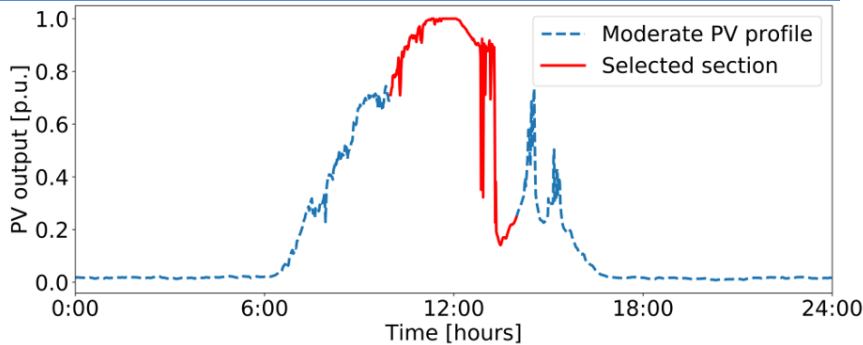
Photo of setup in the lab



Voltage measurements

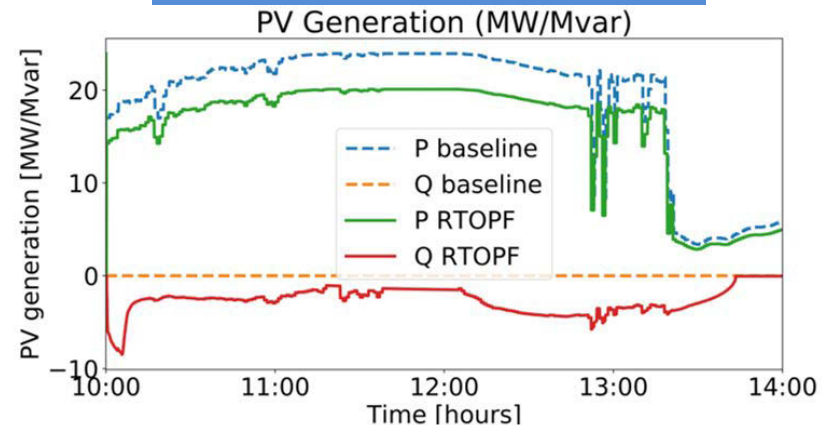


Selected PV profile—high-voltage scenario



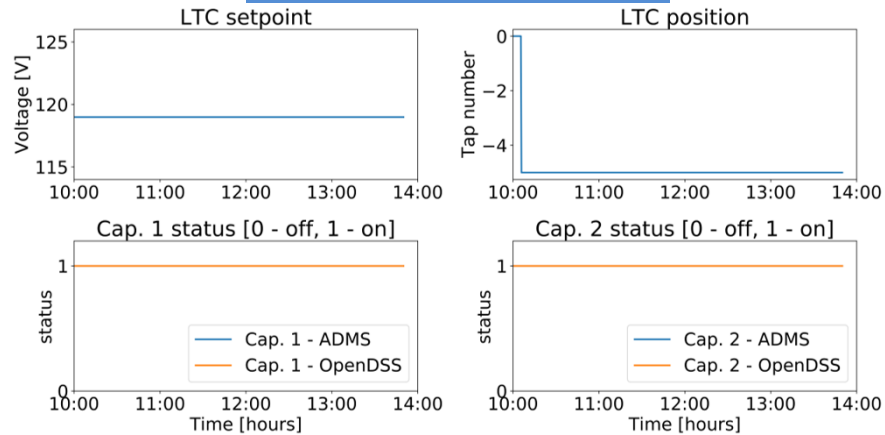
4-hour run (10:00 – 14:00)

Total PV measurements

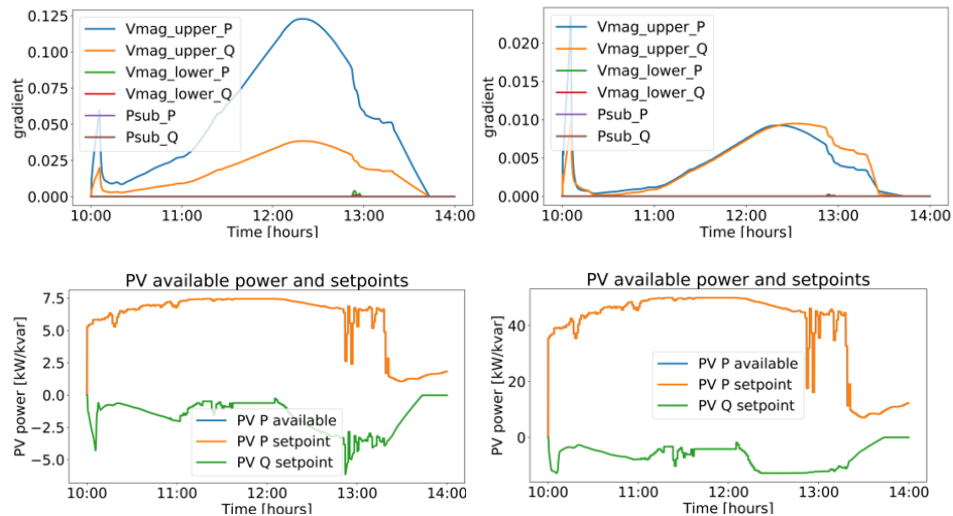


Experimental Results

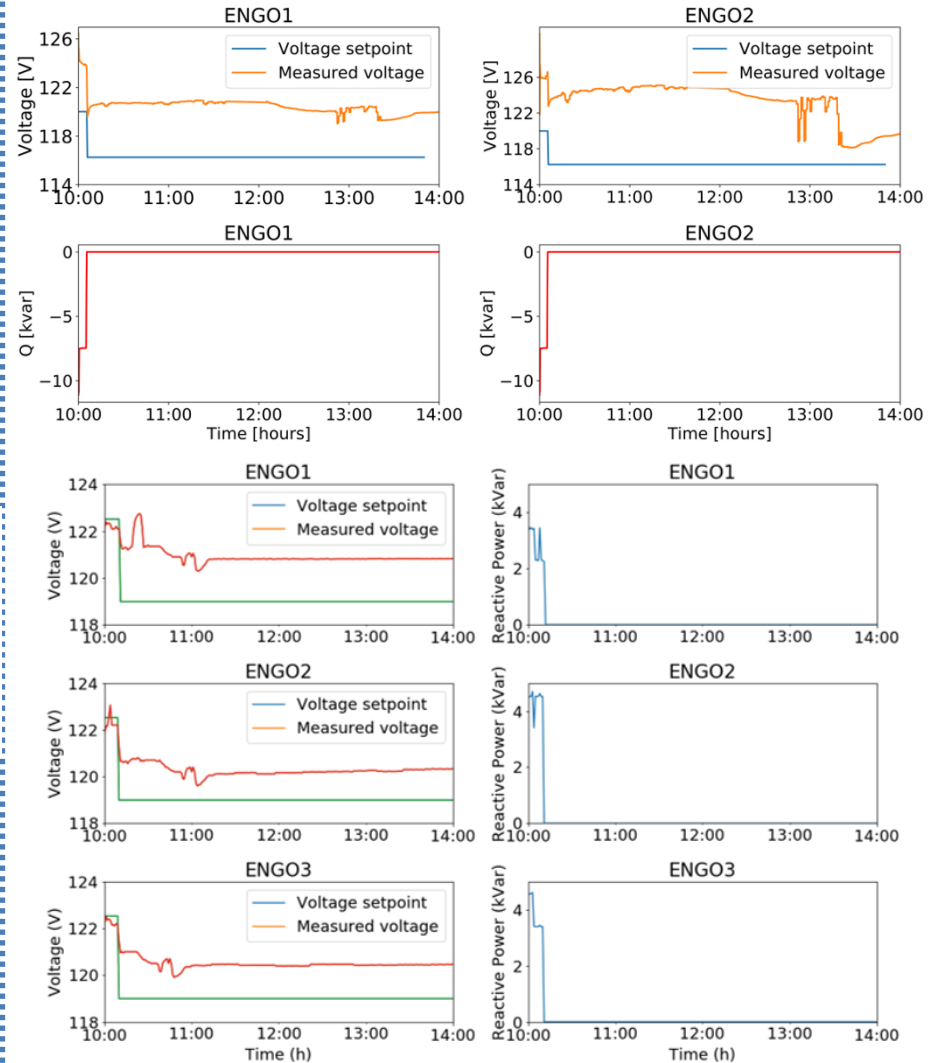
Legacy devices



DERMS and PV



Grid-edge devices



Conclusions

- The voltage regulation performance of the DEHC with ADMS-centered and coordinated operation is effectively evaluated with the laboratory HIL simulation.
- Results demonstrate that the DEHC can manage the entire distribution system and all the assets; enable seamless integration of conventional devices and DERs implementing advanced control schemes; and provide optimal operations with high solar penetrations.
- This is a **first-of-its-kind** deployment and provides evidence of the effectiveness of the proposed technology and grid operation guidelines to the broader utilities, industry, etc.

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