

### LIVE DEMONSTRATION OF HIL EXPERIMENTS

#### Smart Grids Research Unit: Smart RUE National Technical University of Athens

<u>www.smartrue.gr</u>

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# PHIL environment for DER at the NTUA Eric

Connecting European Smart Grid Infrastructures



#### Main part of NTUA's laboratory







### Live Demonstration



#### 1. PHIL testing of island power system

## 2. CHIL/PHIL testing of centralized coordinated voltage controller



### 1) PHIL testing of island power system



- Hardware inverter operating with P(f) droop control
- Simulated storage system providing virtual inertia



© The <u>ERIGrid Consortium</u> EU H2020 Programme GA No. 654113 P. Kotsampopoulos, V. Kleftakis, N. Hatziargyriou, "Laboratory Education of Modern Power Systems using PHIL Simulation", IEEE Transactions on Power Systems, Vol. 32, Issue: 5, Sept.2017



## Let's HIL



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#### More Results

Erigrid Connecting European Smart Grid Infrastructures



- System level testing (not only the inverter is tested but also its impact on the system).
- The full hardware implementation would be challenging



## 2) CHIL/PHIL testing of centralized coordinated voltage controller

 Optimal solution to voltage rise (due to high DG penetration) and voltage drop (during peak load periods) problems



Benchmark LV network by CIGRE was used



## CHIL/PHIL testing of centralized coordinated voltage controller (CVC)



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M. Maniatopoulos, D. Lagos, P. Kotsampopoulos, N. Hatziargyriou, "Combined Control and Power Hardware-in-the-Loop simulation for testing Smart grid control algorithms", IET Generation, Transmission & Distribution, August 2017.



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#### More results PHIL & CHIL





#### Voltage of all nodes without voltage control

Voltage of all nodes with CVC



#### More results PHIL & CHIL



- The SoC of the BESS was restored to the reference level of 40% during the night to early morning hours (12 a.m. to 9 a.m.), so that it is available for maximum charging during the midday hours of high irradiance.
- The active power exchange of the BESS was restricted to periods of either high irradiance (charge) or high load demand (discharge), where the voltage rise/drop problems are greatest.





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### Thank you for your attention!



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