DGI-App Economic Dispatch for GEH System under Forecast Errors

Zheyuan Cheng, Jie Duan, Yuan Zhang, and Mo-Yuen Chow

Background

- Day-ahead schedule determines the most economic dispatch for DESDs based on day-ahead forecast.
- Forecast errors exist in day-ahead renewable/demand information, as shown in Fig.1.

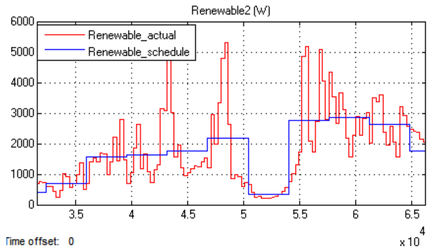


Fig.1 Forecast error in Day-ahead information

- A distributed load balancing mechanism is needed to adjust the day-ahead schedule in response of forecast errors

Problem Statement

- Develop and implement a real-time DESD dispatch strategy in DGI platform
- System level demonstration in GEH testbed
- The control diagram of the economic dispatch strategy is shown in Fig.2

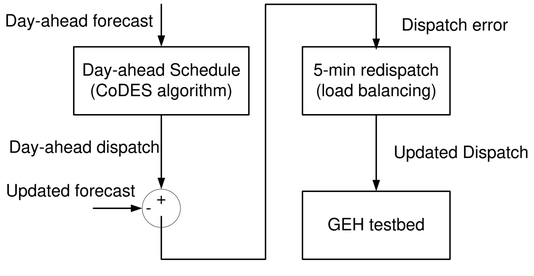


Fig.2 Control Strategy for GEH testbed

Method

Technical Approach

- System Level Demonstration Platform

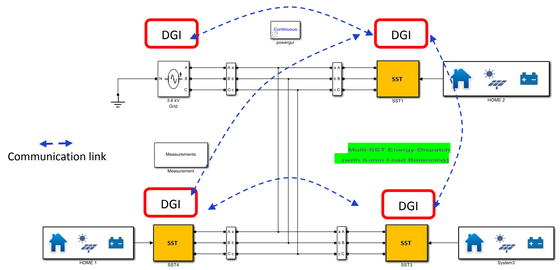


Fig.3 GEH testbed embedded with DGI controllers

- Economic Dispatch Strategy

Day-ahead schedule

Input (Day-ahead Data)
- Energy price
- Renewable forecast
- Load profile

Process (CoDES algorithm)
- Minimize the total electricity bill

Outputs
- DESD commands
- Energy transaction with grid

DGI Execution

1 round/day

5-min Redispatch

Input (5-min Data)
- Renewable forecast
- Load profile

Process (Load balancing)
- meet the supply-demand balance

Outputs
- DESD adjustments

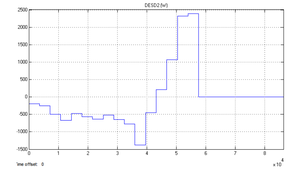
DGI Execution

288 rounds/day

Results

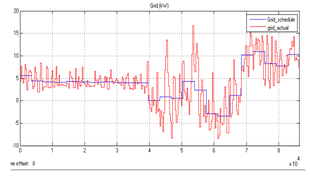
Case Study:

- GEH testbed as shown in Fig.3, forecast errors exist in every renewable/demand node
- Day-ahead Schedule Without Redispatch
  - DESD response



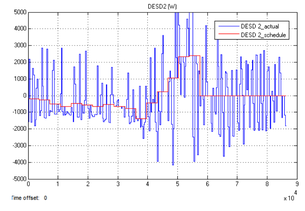
DESDs follows the day-ahead schedule

  - Grid response

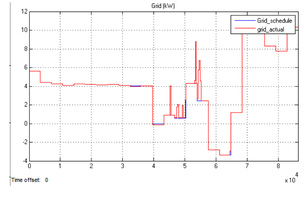


Additional power from grid

- Day-ahead Schedule With Redispatch

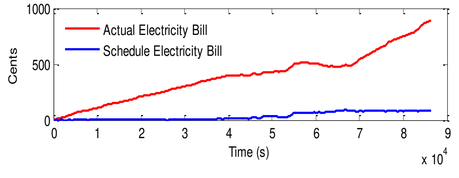


DESDs collaborate to respond



Almost no additional power from grid

- Electricity Bill without Redispatch



Future Work

- Still need to integrate measurements and control with GEH devices
- Further validate the economic dispatch strategy in larger systems, e.g. HIL

References

1. Navid Rahbari-Asr, Yuan Zhang, and Mo-Yuen Chow, “Consensus-based Distributed Scheduling for Cooperative Operation of Distributed Energy Resources and Storage Devices in Smart Grids”, in *IET Generation, Transmission & Distribution*, vol. 10, no. 5, pp. 1268-1277, 2016
2. R. Akella, F. Meng, D. Ditch, B. McMillin and M. Crow, "Distributed Power Balancing for the FREEDM System," 2010 First IEEE International Conference on Smart Grid Communications, Gaithersburg, MD, 2010, pp. 7-12.

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