Battery Energy Storage Control System

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SUMMARY

UCLA researchers have developed a battery energy storage system capable of both shifting power consumption pattern and shaping power consumption profile with minimal delay.

BACKGROUND

Energy management systems (EMS) enable optimization of energy generation, transmission, and utilization. Utilization of battery energy storage systems (BESS) has recently been investigated in addition to conventional energy management systems for active controls.

INNOVATION

The invention is a battery energy storage control system (BESS) capable of both shifting power consumption pattern and shaping power consumption profile with minimal delay. The hardware of the system consists of local controller hardware and central controller hardware:

- Consists of microcontroller, communication interface, and protection equipment
- Central controller hardware includes a server and monitoring equipment
- Local controller collects and transmits data to the central controller which then sends out commands to the local controller to optimize power flow

The software system consists of a communication control section, an operation control section, and a safety control section:

- Communication and operation control sections belong to the local controller
- Two-layer software system can be written in multiple languages and operated in multiple environments, enabling parallel computations and executions
- Employs discrete signal processing theorems, optimization algorithms and prediction techniques to minimize the required battery size and reduce delay in system performance

APPLICATIONS

- Energy management systems
- Small-scale smart grids to support stable power output in a more energy-efficient way

ADVANTAGES

The integrated control system is capable of:

- Managing communication between battery management system (BMS), grid-tie inverter, measurement units and local controller
- Controlling active and reactive power flow of BESS in real time to support the grid power flow via four modes of operations (charging, discharging, reactive leading, reactive lagging)
- Supervising the safety of system operation

STATE OF DEVELOPMENT

The software has been developed and integrated into a lab-scale grid-connected battery energy storage system for data acquisition and analysis. Power demand shaping has been demonstrated by smoothing the power fluctuation of solar panels on a building, whereas power demand shifting has been demonstrated on the vehicle charging stations in a parking structure at UCLA.

CONTACT

UCLA Technology Development Group
ncd@tdg.ucla.edu
tel: 310.794.0558.

INVENTORS

- Gadh, Rajit

OTHER INFORMATION

KEYWORDS

Battery energy storage system, energy management, communication control, operation control, safety control, smart grid, real-time control, solar integration, power smoothing, battery size optimization, power consumption shifting, power consumption shaping, four-quadrant operation, discrete signal processing, minimum lag, minimum delay

CATEGORIZED AS

- **Energy**
  - Storage/Battery

RELATED CASES

2016-213-0

RELATED MATERIALS

- H. Nazaripouya, Y. Wang, P. Chu, H. R. Pota, and R. Gadh, Optimal sizing and placement of battery energy storage in distribution system based on solar size for voltage regulation, 2015 IEEE Power & Energy Society General Meeting, IEEE, 2015.

PATENT STATUS

Country	Type	Number	Dated	Case
United States Of America	Issued Patent	11,387,654	07/12/2022	2016-213

ADDITIONAL TECHNOLOGIES BY THESE INVENTORS

- WinSmartEV: Smart EV Charging and Grid Integration
- Architecture and Level 2 Variable Power Control Scheme

UCLA Technology Development Group
10889 Wilshire Blvd., Suite 920,Los Angeles,CA 90095
tdg.ucla.edu
Tel: 310.794.0558 | Fax: 310.794.0638 | ncd@tdg.ucla.edu