

CPS: Synergy: Adaptive Management of Large Energy Storage Systems for Vehicle Electrification (CNS-1446117)

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> > **OVERVIEW**

Comprehensive management (i.e., discharging, charging, temperature and monitoring) of large-scale batteries via joint consideration of peak power, operation time, and battery lifetime for vehicle electrification











CSR



REAL-TIME ENERGY STORAGE MANAGEMENT SYSTEM

	w/o Regulator	w/ Regulator	
SHARE-Full	10,743.4	6,214.2	
SHARE-Partial	10,385.6	5,959.8	SHARE
SoH-Oblivious	9,758.7	5647.6	

Connect cells with similar strength only in series to improve deliverable capacity from batteries => 30% increase of system operation time.

- SHARE: SoH-Aware Reconfiguration to Enhance Deliverable Capacity of Large-Scale Battery Packs, ICCPS'15



Cooling or heating batteries based on their real-time conditions, making a tradeoff between operation time and lifetime => 58.4% improvement in operation time.

- Real-Time Battery Thermal Management for Electric Vehicles, ICCPS'14





Identify the optimal discharging current and temperature by modeling the battery voltage and its degradation => 85.4% improvement in operation time

Modeling and Real-time Scheduling of Large-Scale Batteries for Maximizing Performance, RTSS'15-CPS track



Accurate estimation of SoCs of device batteries based on



Weak cell dominates capacity delivery

Improve battery's capacity delivery by skipping weak cells

- from discharging, prolonging system operation by up to 94%.
- Resting Weak Cells to Improve Battery Pack's Capacity Delivery via Reconfiguration, e-Energy'16



Provide an offline power-supply guarantee such that every power-demand operation completes its execution in time without making total power demand exceed the power capability of the energy storage system at any time

Offline Guarantee and Online Management of Power Demand and Supply in Cyber-Physical Systems, RTSS'16-CPS track



Reconfiguring the connectivity among battery cells to provide an optimal voltage to the load, thus improving the energy efficiency of multi-cell battery packs



Exploiting ultra-capacitor to offset the peak power demand, prolonging the battery lifetime by 37.7%.

- Real-Time Discharge/Charge Rate Management for Hybrid Energy Storage in Electric Vehicles, RTSS'14-CPS track



1) Capturing the interactions among battery temperature, battery current, and ambient environment, facilitating

their voltage only

Battery State-of-Charge Estimation for Mobile Devices, ICCPS'17



Charging-assisted battery diagnosis, enabling real-time prognosis with operation conditions in consideration



- Adaptive Battery Diagnosis/Prognosis for Efficient Operation *Control, e-Energy'19*







