

A Digital Battery Energy Storage System Based on Dynamic Reconfigurable Network: A Real Case Study

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Traditional battery energy storage systems (BESSs) suffer from several major system-level deficiencies, such as high inconsistency and poor safety, due to the fixed connections between battery modules. To address the challenges of traditional BESSs, this paper proposes a novel digital battery energy storage system (DBESS) based on the dynamic reconfigurable battery network (DRBN). In particular, the proposed DRBN topology relies on power electronic switches to digitize continuous energy flow, which enjoys the benefits of efficient module balancing, circulating current suppression, and fault isolation. Relying on the DRBN topology, a modular control framework with a multiobjective optimization (MOO) problem formulation is proposed to realize states estimation, real-time optimal control and safety protection. The real case study of a large-scale DBESS validates that the proposed architecture and control framework can separately or simultaneously achieve voltage balancing, state-of-charge (SOC) balancing, and thermal management. Furthermore, the fault recordings verify that the DBESS has the capability to isolate faulty modules and improve safety.