Energy storage power control for electric buses

Can energy storage systems improve bus charging and transit center energy management?
The widespread use of energy storage systems in electric bus transit centers presents new opportunities and challenges for bus charging and transit center energy management. A unified optimization model is proposed to jointly optimize the bus charging plan and energy storage system power profile.

Can a bus charging method optimize energy storage systems in seconds?
The numerical simulations demonstrate that the proposed method can optimize the bus charging time, charging power, and power profile of energy storage systems in seconds. Monte Carlo simulations reveal that the proposed method significantly reduces the cost and has sufficient robustness to uncertain fluctuations in photovoltaics and office loads.

Do electric buses need a range extender?
In comparison,the absence of a range extender contributes to a 7 % reduction in energy consumption. However,considering the range anxiety of the driver,the designed electric bus for rapid transit is recommended to utilize both the range extender and parallel regenerative braking strategy.

Can a commercial solver optimize bus charging time and power profile?
This means that we can obtain the exact solution of the model quickly with a commercial solver that is fully adapted to the time scale of day-ahead scheduling. The numerical simulations demonstrate that the proposed method can optimize the bus charging time, charging power, and power profile of energy storage systems in seconds.

Should electric buses be used for rapid transit?
However,considering the range anxiety of the driver,the designed electric bus for rapid transit is recommended to utilize both the range extender and parallel regenerative braking strategy. The developed model in this work can be implemented to redesign or further optimize specific components and operating procedures of the bus.

Does electric bus charging scheduling affect battery degradation?
Electric bus charging scheduling for a single public transport route considering nonlinear charging profile and battery degradation effect. Transportation Research Part B: Methodological, 159: 49-75 Zhou Y, Wang H, Wang Y, Li R (2022b). Robust optimization for integrated planning of electric-bus charger deployment and charging scheduling.

A novel hybrid energy storage system for electric buses is proposed by introducing a flywheel in addition to the existing battery. A simulation model of the hybrid energy storage system is ...

A new power control algorithm, which integrates a power grading strategy with the filtration control method, is introduced in this paper, achieving further improvement of battery lifetime....

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Studies on the BEB charging scheduling problem usually assume a given BEB fleet size, battery size, and charging infrastructure layout. For example, Jahic et al. (2019) solved the depot charging scheduling problem for large-scale electric bus systems. The authors proposed a greedy algorithm and a heuristic algorithm to optimize the charging schedules of BEBs such ...

In this review, we have comprehensively surveyed three primary parts: important components; existing research topics; and open issues of EBs. Specifically, we first introduce ...

Public transport vehicles based on electric vehicles are suitable for regular extreme fast charging (R-XFC) with supercapacitors as energy storage. Quick recharges cause power ...

This paper proposes a novel use of superconducting magnetic energy storage (SMES) hybridized with the battery into the electric bus (EB) with the benefit of extending battery lifetime. A new power control algorithm, which integrates a power grading strategy with the filtration control method, is introduced in this paper, achieving further improvement of battery lifetime. To ...

As an important member of the field of new energy vehicles, electric buses are gradually becoming the object of vigorous development of green transportation in China. Due to the constraints of battery technology at this stage, electric vehicles with a single energy storage device still have certain limitations in terms of range and cycle life. As a newly developed ...

To address the power distribution problem that occurs in hybrid energy storage systems (HESSs) in electric vehicles, a fuzzy control distribution method is proposed in this paper, taking the vehicle demand power; ...

A new power control algorithm, which integrates a power grading strategy with the filtration control method, is introduced in this paper, achieving further improvement of battery lifetime. To demonstrate the performance of the SMES/battery hybrid energy storage system (HESS), a dynamic EB system is described with the advantage of considering ...

Since overcharging is a risk factor, Volvo electric buses communicate with the charging equipment. In addition, all relevant vehicle parameters are followed up during the charging process. For the driver, there is an emergency cut-off switch. Volvo Buses electric safety Thermal control The energy storage system, which includes the

Reference [19] introduced a new concept of high-power density energy storage for electric vehicles (EVs), namely the Dual Inertial Flywheel Energy Storage System (DIFESS). DIFESS is an improvement based on a single FESS, which achieves better adaptability by dividing the single FESS into multiple inertial parts and can more effectively respond ...

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To control the power ratio between different ESS, the droop coefficients for the battery and the SMES are set based on their different energy storage characteristics and operating constraints. ... SMES/battery hybrid energy storage system for electric buses. IEEE Trans Appl Supercond, 26 (4) (2016), pp. 1-5. Google Scholar [26] C. Gavriluta, J ...

Electric buses are usually designed with various energy management features to overcome the limited cruising range problem. This paper reveals the impact of different energy ...

where and are average currents of the DC bus and battery, respectively. The values of, and are relatively constant at a certain shoot-through duty cycle .On the other hand, the DC-bus average current or power is controlled by the motor drive system and M, independently.Thus, according to and (), the battery power, which is equal to the difference between SMES and DC ...

In particular, given the nonlinear consumption of power on electric buses (Fiori et al., ... Nearly 56% of the energy consumption of the optimal control strategy is distributed in the low price period of 0.3 RMB/kWoh, and the remaining 44% is distributed in the region of 0.6 RMB/kW·h. ... Value of the energy storage system in an electric bus ...

The large-scale deployment of electric buses contributes to the development of low-carbon transportation systems and carbon neutrality strategies. Effectively predicting the available ...

It is noteworthy that the unstable and intermittent solar energy could cause mismatch between the PV power generation and the bus charging demand [5], [14], which increases demand for energy storage and impacts the local grid [15]. Therefore, charging events of electric buses should be coordinated to improve solar energy on-site consumption.

The hybrid energy storage system (HESS), which combines batteries and supercapacitors, has high potentials in vehicular applications because it entails the advantages of both supercapacitors and batteries, including high power density and high energy density [3].Among different types of vehicles, city buses are ideal for applying the HESS to reduce ...

Control Method for Hybrid Energy Storage System The main challenge in implementing hybrid energy storage units for vehicle electrification is to efficiently distribute energy demand among different power sources in real-time.

Supercapacitor is considered one of the most promising and unique energy storage technologies because of its excellent discharge and charge capabilities, ability to transfer more power than conventional batteries, and long cycle life. Furthermore, these energy storage technologies have extreme energy density for hybrid electric vehicles.

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Journal of Energy Storage. Volume 77, 30 January 2024, ... Stochastic model predictive control for energy management of power-split plug-in hybrid electric vehicles based on reinforcement learning. ... Driving-behavior-aware stochastic model predictive control for plug-in hybrid electric buses. Appl. Energy, 162 (2016), pp. 868-879.

Develops two model predictive control (MPC) schemes for power management. Evaluates AC-MPC and GPRC-MPC for fuel cell hybrid electric buses (FCHEBs). ...

A unified optimization model is proposed to jointly optimize the bus charging plan and energy storage system power profile. The model optimizes overall costs by considering ...

For EVs, one reason for the reduced mileage in cold weather conditions is the performance attenuation of lithium-ion batteries at low temperatures [6, 7].Another major reason for the reduced mileage is that the energy consumed by the cabin heating is very large, even exceeding the energy consumed by the electric motor [8].For ICEVs, only a small part of the ...

To address the power distribution problem that occurs in hybrid energy storage systems (HESSs) in electric vehicles, a fuzzy control distribution method is proposed in this ...

The energy dilemma of fossil fuels and environmental pollution are becoming more and more serious, which pose a threat to the sustainable development of the automotive industry [[1], [2], [3]].Plug-in hybrid electric vehicles (PHEVs) with larger energy storage systems demonstrate the advantages of strong power, low emissions, and long-distance driving ...

16 optimal control rules based on selected power profiles are extracted from offline DP results. ... The influence of driving cycle characteristics on the integrated optimization of hybrid energy storage system for electric city buses. Energy, 135 (Sep. 2017), pp. 91-100, 10.1016/j.energy.2017.06.096.

The dynamic programming (DP) algorithm is used in Ref. [9] to derive an energy management strategy of a hybrid electric vehicle, and power distribution between ICE and battery is modeled as an optimal control problem. Experimental results indicated that the fuel economy could be significantly improved.

Pareto front analysis of the objective function in model predictive control based power management system of a plug-in hybrid electric vehicle. IEEE transportation electrification ... The influence of driving cycle characteristics on the integrated optimization of hybrid energy storage system for electric city buses. Energy, 135 (2017), pp ...

What is more, the AC system as an important auxiliary part of the electric bus significantly affects the energy consumption and the driving range of the vehicle is usually the largest energy consumption component except the power system, and requires a considerable percentage of the battery energy [3], [4], [5].

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EMS utilizes the representations transfer-based reinforced machine learning to extend the vehicle range in electric buses [8]. In the case of energy storage systems, employing the hierarchical control strategy [9] and scholastic model predictive control are efficacious in load forecasting of storage systems [10].

Second, a surrogate model for electric buses estimates their energy consumption based on inputs from weather forecast fleet telemetry data pipelines. Third, an optimization model outputs feasible, cost- and emissions-minimizing operations of the bus fleet and battery storage for the upcoming horizon and is solved within a day in advance.

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