

Can onboard energy storage devices reduce the catenary energy consumption?

Abstract: For improving the energy efficiency of railway systems, onboard energy storage devices (OESDs) have been applied to assist the traction and recover the regenerative energy. This article aims to address the optimal sizing problem of OESDs to minimize the catenary energy consumption for practical train operations.

Does an on-board energy storage device reutilize braking energy?

The effectiveness of an on-board energy storage device (ESD) is verified for the reutilization of the braking energy in case of the electrified railway transportation. A mathematical model of the ESD based train is developed with the aid of the Modeltrack simulation tool.

What are the power supply parameters of on-board ESS?

Power supply parameters of on-board ESS. The supercapacitor monomer forms an energy storage module through 2 parallel connections and 8 series connections, 43 sets of energy storage modules form an energy storage power supply in series, and 3 sets of energy storage power supply form a SESS in parallel, including 2064 supercapacitor monomers.

Can supercapacitors be used in energy storage systems?

In recent years, it has been widely used in energy storage systems. The application of supercapacitors in energy storage systems not only can reduce system cost and increase system efficiency but also can improve overall system performance.

What is the optimal sizing method of battery-supercapacitor energy storage systems?

The optimal sizing of HESS with a reasonable combination of different ESEs has become an important issue in improving energy management efficiency. Therefore, the optimal sizing method of battery-supercapacitor energy storage systems for trams is developed to investigate the optimal configuration of ESEs based on a constant power threshold.

What are the parameters of a supercapacitor monomer?

Parameters of supercapacitor monomer. The HESS uses the power battery and supercapacitor as energy storage components. The power battery has high energy density and a long charging time, which is not suitable for intermediate station charging.

system, the collaborative energy storage charging system has a boost DC/DC converter and supercapacitor energy storage devices. In Figure 1a, the transformer parameters are AC 10 kV/900 V 800 kVA; in Figure 1b the transformer parameters are AC 10 kV/400 V 125 kVA. As shown in Figure 2, the main improvements of the collaborative energy storage

Based on the supercapacitor SOC and the independent photovoltaic output DC bus voltage stabilization target, an energy storage system management strategy integrating supercapacitor energy management and power conversion is proposed. The proposed control strategy is simulated by building a simulation model in Matlab/Simulink.

The on-board supercapacitor energy storage system for subway vehicles is used to absorb vehicles braking energy. Because operating voltage, maximum braking current and discharge depth of ...

This paper discusses the control strategy for energy management in railway transit network with wayside (substation) supercapacitor (SC) energy storage system (ESS). Firstly, the structure of the wayside energy storage system is introduced. Secondly, the model of energy storage system is built and the control strategy is described. Thirdly, in order to estimate the required energy ...

The paper considers the problem of choosing the optimum size for on-board energy storage system (ESS) based on supercapacitors (SCs) taking into account both the braking energy and the braking ...

At present, new energy trams mostly use an on-board energy storage power supply method, and by using a single energy storage component such as batteries, or supercapacitors. The hybrid energy storage system (HESS) composed of different energy ...

In order to absorb the regenerative braking energy of trains, supercapacitor energy storage systems (ESS) are widely used in subways. Although wayside ESS are widely used, because of the influence of no-load voltage, and so on, a wayside ESS cannot absorb all the regenerative braking energy in some special cases, and the brake resistor is still activated, ...

the total number of the supercapacitors required for energy storage system can be obtained, satisfying Inequalities (18)-(19). $N \geq 2E_{br} U^2 C_{max} CS^{-1} d^2$ (18) $N \geq P_{br,max} UC_{max} IC_{max} d$ (19) On the premise of satisfying power and energy, the total number of the supercapacitors required for the storage system is minimized.

The effectiveness of an on-board energy storage device (ESD) is verified for the reutilization of the braking energy in case of the electrified railway transportation [144]. A ...

Energy Storage Systems (ESS) are an attractive solution in environments with a high amount of renewable energy sources, as they can improve the power quality in such places and if required, can extend the integration of more renewable sources of energy. If a large amount of power is needed, then supercapacitors are viable energy storage devices due to their ...

This paper presents the development of a supercapacitor energy storage system (ESS) aimed to minimize weight, which is very important for aerospace applications, whilst integrating smart functionalities like voltage

monitoring, equalization, and overvoltage protection for the cells. The methodology for selecting the supercapacitor cells type/size is detailed to ...

A hybrid energy-storage system (HESS), which fully utilizes the durability of energy-oriented storage devices and the rapidity of power-oriented storage devices, is an efficient solution to managing energy and power legitimately and symmetrically. Hence, research into these systems is drawing more attention with substantial findings. A battery-supercapacitor ...

T1 - Analysis and configuration of supercapacitor based energy storage system on-board light rail vehicles. AU - Barrero Fernandez, Ricardo. AU - Tackoen, Xavier. AU - Van Mierlo, Joeri. PY - 2008/9/3. Y1 - 2008/9/3. N2 - This article will propose different energy storage systems, ranging from 0.91 kWh to 1.56 kWh, suitable for a 30 m long tram.

By coordinated control with a wayside supercapacitor, the residual regenerative braking energy can be absorbed even in special cases, and this strategy can effectively reduce the system loss by adjusting the DC voltage on the inverter-side. In order to absorb the regenerative braking energy of trains, supercapacitor energy storage systems (ESS) are ...

Electrochemical energy storage devices are classified into supercapacitors, batteries including primary and secondary batteries, and hybrid systems. Each has positive and negative electrodes, a separator, and current collector. The schematic representation of an electrochemical energy storage device is given in Fig. 4. Electrodes are loaded ...

Energy storage systems (ESS) are highly attractive in enhancing the energy efficiency besides the integration of several renewable energy sources into electricity systems. While choosing an energy storage device, the most significant parameters under consideration are specific energy, power, lifetime, dependability and protection [1]. On the ...

Supercapacitor has the advantages of fast charging and discharging, high current and long life comparing with lithium-ion battery. It has received wide attention in various systems for converting and storing electrical energy from renewable sources [3], intelligent systems for combined power supply of lighting equipment devices [4], energy storage devices ...

For improving the energy efficiency of railway systems, onboard energy storage devices (OESDs) ... Results show that without the constraints of capital cost and volume, the supercapacitor, Li-ion battery, and flywheel with optimized capacity can save the catenary energy consumption by 23.6%, 22.9%, and 23.7% compared with the cases without ...

1. Introduction. For decades, science has been intensively researching electrochemical systems that exhibit extremely high capacitance values (in the order of hundreds of Fg⁻¹), which were previously unattainable. The

early researches have shown the unsuspected possibilities of supercapacitors and traced a new direction for the development of electrical ...

A problem of peak power in DC-electrified railway systems is mainly caused by train power demand during acceleration. If this power is reduced, substation peak power will be significantly decreased. This paper presents a study on optimal energy saving in DC-electrified railway with on-board energy storage system (OBESS) by using peak demand cutting strategy ...

A design toolbox has been developed for hybrid energy storage systems (HESSs) that employ both batteries and supercapacitors, primarily focusing on optimizing the system sizing/cost and mitigating battery aging. The toolbox incorporates the BaSiS model, a non-empirical physical-electrochemical degradation model for lithium-ion batteries that enables ...

Caption: MIT engineers have created a "supercapacitor" made of ancient, abundant materials, that can store large amounts of energy. Made of just cement, water, and carbon black (which resembles powdered charcoal), the device could form the basis for inexpensive systems that store intermittently renewable energy, such as solar or wind energy.

The performance improvement for supercapacitor is shown in Fig. 1 a graph termed as Ragone plot, where power density is measured along the vertical axis versus energy density on the horizontal axis. This power vs energy density graph is an illustration of the comparison of various power devices storage, where it is shown that supercapacitors occupy ...

An energy storage system (ESS) that stores regenerative braking energy in an electrical storage medium, such as a supercapacitor [7], a battery [8], and a flywheel [9], and releases to the ...

In order to absorb the regenerative braking energy of trains, supercapacitor energy storage systems (ESS) are widely used in subways. Although wayside ESS are widely used, because of the influence of no-load voltage, and so on, a wayside ESS cannot absorb all the regenerative braking energy in some special cases, and the brake resistor is still activated, which leading to ...

As evident from Table 1, electrochemical batteries can be considered high energy density devices with a typical gravimetric energy densities of commercially available battery systems in the region of 70-100 (Wh/kg). Electrochemical batteries have abilities to store large amount of energy which can be released over a longer period whereas SCs are on the other ...

Moreover, a reduced order model was implemented to simulate transient cases, potentially resulting in low voltage ride-through with or without a supercapacitor energy storage system. The findings revealed that the supercapacitor energy storage system swiftly controlled transient cases, effectively eliminating oscillations [185].

The hybrid energy storage system (HESS), which pairs two or more complementary energy storage components, is a solution to compensate for the shortage of single energy storage acting alone. By pairing energy-intensive batteries with power-intensive supercapacitors (SCs), the battery-SC HESS is one widely studied practice of HESS [5] .

In order to completely replace the on-board brake resistor, this paper configures a certain on-board super-capacitor, and based on a DC-side series super-capacitor topology, ...

Peer-review responsibility of the scientific committee of the 8th International Conference on Applied Energy. 4562 Nima Ghaviha et al. / Energy Procedia 105 (2017) 4561 âEUR" 4568 Nomenclature EMU Electric Multiple Unit DMU Diesel Multiple Unit ESS Energy Storage System SESS Stationary Energy Storage System OESS On-board Energy ...

To solve the challenge of low efficiency and high operation cost caused by intermittent high-power charging in an energy storage tram, this work presents a collaborative power supply system with ...

Based on matching their characteristics, a power distribution control strategy for on-board supercapacitor energy storage system is proposed. A simulation model and a 3kW experimental platform are set up, in order to simulate single vehicle and single substation. Both of the simulation results and experimental results have verified the ...

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