Tram hybrid energy storage

Therefore, it has higher requirements for tram energy storage devices and SOC control. It is particularly important to effectively and rationally control the SOC of the energy storage device in the fuel cell hybrid power system, provide sufficient capacity for the recovery of braking energy and ensure the stable operation of the system under ...

Compared with the traditional filtering algorithms and DRL algorithms, the results show that the proposed method converges faster and is more energy saving and stable while ...

This paper investigates an ESS based on supercapacitors for trams as a reliable technical solution with considerable energy saving potential and proposes a position-based Takagi-Sugeno fuzzy (T-S fuzzy) PM for human-driven trams with an E SS. Energy storage systems (ESSs) play a significant role in performance improvement of future electric traction ...

An all active-active topology for the on-board hybrid energy storage system of the tram is established, as shown TABLE 1. Main technical parameters of tram. in Figure 1. In order to facilitate the ...

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Traction power fluctuations have economic and environmental effects on high-speed railway system (HSRS). The combination of energy storage system (ESS) and HSRS shows a promising potential for utilization of regenerative braking energy and peak shaving and valley filling. This paper studies a hybrid energy storage system (HESS) for traction substation ...

A tram"s hybrid power system mainly consists of an energy storage system and a motor system. The motor system is connected to the DC bus through the inverter, whose power is all from the hybrid ...

PV: photovoltaic; RoR: run-of-river; HESS: hybrid energy storage system; CSP + TES: concentrating solar power with thermal energy storage; the Mechanical storage icon encompasses compressed air energy storage and flywheels, both of which ultimately convert the stored energy to electricity.

Resource Characterization, Forecasting, and Maps. To identify the best locations for hybrid plant development, NREL has created high-resolution wind and solar maps using a national database called the WIND Toolkit for wind integration and forecasting, as well as National Solar Radiation Database data. NREL researchers are also advancing the science of wind measurements and ...

A tram with on-board hybrid energy storage systems based on batteries and supercapacitors is a new option for

the urban traffic system. ... When this method is successfully applied to the world"s first commercial fuel cell/supercapacitor LF-LRV hybrid tram, its energy consumption and fuel cell system (FCS) output fluctuation rate are ...

Fig. 1 Operation condition of the catenary-SCs hybrid tram. ... energy storage system, vehicle system, and signal system is. established. The power flow from power sources to wheels can be.

Trams with energy storage are popular for their energy efficiency and reduced operational risk. An effective energy management strategy is optimized to enable a reasonable distribution of demand power among the storage elements, efficient use of energy as well as enhance the service life of the hybrid energy storage system (HESS). Thus, an energy management strategy optimization ...

A hybrid energy storage system (HESS) of tram composed of different energy storage elements (ESEs) is gradually being adopted, leveraging the advantages of each ESE. The optimal sizing of HESS with a reasonable combination of different ESEs has become an important issue in improving energy management efficiency.

Abstract: A tram with on-board hybrid energy storage systems based on batteries and supercapacitors is a new option for the urban traffic system. This configuration enables the tram to operate in both catenary zones and catenary-free zones, and the storage of regenerative braking energy for later usage.

The simulation results show that the energy management strategy based on PMP can ensure the normal operation of tram. Keep the bus voltage of hybrid energy storage tram within a reasonable range. Compared with the energy management method based on rule control, the power consumption is reduced by 9%.

This article proposes a rolling optimization strategy (ROS) based on wavelet neural network prediction and dynamic programming (DP) for tram equipped with on-board battery-supercapacitor hybrid energy storage system, and proves the rationality of using RB strategy to replace ROS strategy entirely or partially in some scenarios. This article focuses on ...

Hybrid energy storage system for rail vehicles: Techical data double-layer capacitors * Usable energy content [kWh] project specific, e.g. 4,3 Maximum power ... -emissions per year and tram y Stabilizing the line voltage: Increasing the availability of rail vehicles by increasing

The hybrid energy storage tram in this paper uses lithium batteries and supercapacitors as power sources. The battery and the supercapacitor are connected to the DC bus through a bidirectional DC/DC converter, respectively. When the tram is on the state of starting, accelerating, and cruising phase, the lithium battery and the supercapacitor ...

This paper has test a hybrid tram composed by a PEM FC as primary energy source, a LB and an UC as energy storage systems. Each power source has a DC/DC converter, which allows the connection between the

sources and the traction DC bus. This configuration will allow the tram to work without connecting to the electrical grid.

The greater the distance between stations, the greater the demand energy. The first interval has the largest distance and maximum energy consumption. If the recovered braking energy is not included, the energy consumption is 7.012 kwh. Fig. 3. DC bus demand energy curve. The tram adopts the power supply mode of catenary free and on-board SESS.

Currently, hybrid-electric trains are generally based on dual-mode diesel/electric powertrains. However, the last decade saw an increasing interest in rail vehicles with onboard energy storage systems (OESSs) for improved energy efficiency and potential catenary-free operation.

A tram with on-board hybrid energy storage systems based on batteries and supercapacitors is a new option for the urban traffic system. This configuration enables the tram to operate in both ...

In order to design a well-performing hybrid storage system for trams, optimization of energy management strategy (EMS) and sizing is crucial. This paper proposes an improved EMS with energy ...

Since the on-board energy storage tram [1, 2] does not need to lay traction power supply lines and networks, it can effectively reduce the difficulty and cost of construction, and the energy storage tram is widely used. In engineering projects, it is necessary to consider both the construction cost and the reliability of the power supply system ...

A hybrid energy storage system (HESS) of tram composed of different energy storage elements (ESEs) is gradually being adopted, leveraging the advantages of each ESE. ...

The modern tram system is an essential part of urban public transportation, and it has been developed considerably worldwide in recent years. With the advantages of safety, low cost, and friendliness to the urban landscape, energy storage trams have gradually become an important method to relieve the pressure of public transportation.

Trams with energy storage are popular for their energy efficiency and reduced operational risk. An effective energy management strategy is optimized to enable a reasonable distribution of demand power among the storage elements, efficient use of energy as well as enhance the service life of the hybrid energy storage system (HESS).

One key trend in the evolving U.S. energy sector is the emergence of hybrid energy systems (HES). We define HES in this report as systems involving multiple energy generation, storage, and/or conversion technologies that are integrated--through an overarching control framework or physically--to achieve cost savings and

This article focuses on the optimization of energy management strategy (EMS) for the tram equipped with

on-board battery-supercapacitor hybrid energy storage system. The purposes of ...

An optimal control model has been developed to minimize energy consumption from traction substations with supercapacitors voltage limitations and the effect of trip time on energy consumption is assessed. Hybrid electric trams equip with additional on-board energy storage devices to improve the performance of power sources. Both of optimal energy ...

Energy management strategy optimization for hybrid energy storage system of tram based on competitive particle swarm algorithms. Zhenyu ... based methodology for power demand prediction and a power distribution strategy for battery/supercapacitor hybrid energy storage systems of pure electric vehicles and shows that obviously enhanced ...