

Can artificial intelligence be used in the smart grid?

However, the traditional modeling, optimization, and control technologies have many limitations in processing the data; thus, the applications of artificial intelligence (AI) techniques in the smart grid are becoming more apparent.

What types of AI systems are possible in the smart grid?

Two types of AI systems are possible in the smart grid: virtual AI and physical AI. Virtual AI systems include informatics that can help grid operators perform their jobs. Physical AI systems include self-aware AI systems that can optimize and control specific grid operations with or without human intervention.

What are the challenges of artificial intelligence in smart grids?

Challenges of Artificial Intelligence in Smart Grids Traditional power systems are very complex, and their analysis and control primarily depend on physical modeling and numerical calculations.

What are the applications of Big Data Analytics in smart grids?

This book covers the applications of various big data analytics, artificial intelligence, and machine learning technologies in smart grids for demand prediction, decision-making processes, policy, and energy management.

How can AI help a smart grid?

AI plays a crucial role in the development of smart grids, where intelligent algorithms manage and optimize the flow of electricity (Omitaomu and Niu, 2021). This includes dynamically rerouting energy to avoid congestion, integrating renewable sources seamlessly, and responding to fluctuations in demand in real-time. ...

...

Who are the authors of intelligent energy balancing of microgrids?

Hisham Alghamdi, Taimoor Ahmad Khan, Lyu-Guang Hua, Ghulam Hafeez, Imran Khan, Safeer Ullah, and Farrukh Aslam Khan. A novel intelligent optimal control methodology for energy balancing of microgrids with renewable energy and storage batteries. Journal of Energy Storage, 90:111657, 2024. Yang Xin-She, Deb Suash. Cuckoo search via Levy flights.

The statistics shown in Fig. 1., clearly demonstrate a noticeable increase in the adoption of these technologies across various smart grid applications over the past five to six years. AI and Big Data algorithms enable the grid to analyze vast amounts of data in real time, enabling predictive maintenance, fault detection, and load forecasting []. ...

For instance, in June 2024, the first NVIDIA-powered AI Smart Grid Solution was deployed in the U.S. which will provide real-time insights and controls to the modern power grid using renewable energy sources. Renewable Energy Integration. Integrating renewable energy sources, such as solar and wind, into existing

energy systems poses ...

In conclusion, the adoption of transformer DTs represents a significant advancement for smart grid operators. As highlighted by Sruti Chakraborty, leveraging AI-driven solutions can maximize ROI, though decision-makers must weigh the costs and expertise required for customization against the potential benefits.

The smart grid is enabling the collection of massive amounts of high-dimensional and multi-type data about the electric power grid operations, by integrating advanced metering infrastructure ...

The collaboration of blockchain and AI with smart grid & power distribution is becoming a significant key solution for facilitating comprehensive privacy and security functionalities [98], [99], [100]. However, the adaptation of blockchain technology is envisioned almost all over the world, various organizations are moving towards the ...

A smart grid is an advanced technology-enabled electrical grid system with the incorporation of information and communication technology. The smart grid also enables two-way power flow, and enhanced metering infrastructure capable of self-healing, resilient to attacks, and can forecast future uncertainties. ... Sultan K., Dhelim S., Ai Y ...

At this juncture of the world's energy system, sustainability and resilience are gaining prominence as key considerations in the pursuit of a more reliable and environmentally friendly energy future [1]. Two critical components lie at the core of this paradigm shift: the incorporation of smart grid technology and the application of hydrogen energy [2].

Video used courtesy of U.S. Government Connect . Cybersecurity Algorithms. While many AI algorithms are being developed for energy cybersecurity applications, machine learning, deep learning, and federated learning (a subset of machine learning) are the frontrunners. AI can also be used to predict attacks in the physical and cyber layers of the ...

A smart grid in cities [8], [9], [10] is a modernized infrastructure of information and communication that facilitates the optimization of the power system in four stages i.e. production of energy, transmission of energy, distribution among consumers, and low-cost storage solution. Other major benefits of the smart grid [4] have been depicted. The main domains ...

Neara, an AI-powered predictive modeling software platform for critical infrastructure, announced a \$31 million Series C funding round. Neara said the funding will accelerate its global operations across the United States, the United Kingdom, Europe, and Asia Pacific as the company continues to focus on the challenges of energy resilience and ...

This book covers the applications of various big data analytics, artificial intelligence, and machine learning technologies in smart grids for demand prediction, decision-making processes, policy, ...

The company's smart grid solutions deliver real, quantifiable benefits and have proved pivotal to validating the case for smart grid investment. Itron's grid management solution provides utilities with a unified platform for managing the ever increasing complexity of the smart grid. 9. Hitachi Market cap: US\$74.37bn

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There are many operational and technical obstacles in the way of the shift to a decentralized, sustainable smart grid. In the face of growing renewable energy integration, distributed ...

2024 Smart Grid System Report. Joe Paladino. Office of Electricity. Briefing to the EAC February 14, 2024. 2 DER Deployment DERs and the demand flexibility they provide are expected to grow 262 GW from 2023 to 2027, nearly matching 271 GW in ...

In this paper, we present a literature review about utilizing AI in the key elements of smart grids including grid-connected vehicles, data-driven components, and the power system network. ...

This survey presents a structured review of the existing research into some common AI techniques applied to load forecasting, power grid stability assessment, faults detection, and security ...

Edge AI helps dynamically manage these resources, predict demand, and allocate supply to enhance grid resiliency. Advances in smart meters--powered by a software-defined smart grid chip based on the NVIDIA® Jetson(TM) edge ...

A microgrid (MG) is an independent energy system catering to a specific area, such as a college campus, hospital complex, business center, or neighbourhood (Alsharif, 2017a, Venkatesan et al., 2021a) relies on various distributed energy sources like solar panels, wind turbines, combined heat and power, and generators (AlQaisy et al., 2022, Alsharif, 2017b, Venkatesan et al., ...

AI and ML can make smart grid capable of making intelligent decisions, ability to respond to intermittent nature of RES, sudden changes in energy demands of customers & power outages. Supervised Learning helps in forecasting future energy demand of customers through their energy consumption patterns obtained from smart meter data. Reinforcement ...

In particular, AI architecture and trends are used in power systems, machine learning algorithms in smart grids, blockchain integrated AI-based solutions in electrical power system applications, batteries-based ...

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