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Intelligent control of wind power generation system



Overview

What is a wind power generation system (WPGS)?

This scholarly paper offers a wind power generation system (WPGS) that utilizes a configuration of parallel five-phase permanent magnet synchronous generators (PMSGs). The control mechanism for this system is based on a fifteen-switch rectifier (FSR) topology, which is specifically designed for grid-connected applications.

What is next-generation wind turbine control?

With turbines growing taller, blades extending longer, and installations expanding into offshore areas, supporting control systems must evolve to meet the complex demands of future power grids. This evolution calls for next-generation wind turbine control systems—a fusion of intelligent automation, digitalization, and adaptive control technologies.

What is the future of wind turbine control?

The future of wind turbine control will go beyond speed and power to deliver intelligence and resilience. These systems will learn from operational data, adapt to environmental and grid changes, and contribute to a more flexible, sustainable energy landscape.

How does the Integrated wind power system work?

The integrated WPS operates in both motor and generator modes, depending on the excess or shortfall of generated wind energy relative to load demand. In generator mode, the WPS supplements power when wind speeds are insufficient, while in motor mode, it stores excess energy by pumping water to an upper reservoir.

Can a hybrid controller improve the performance of a PMSG-based wind turbine?

In this paper, the proposed WTPGS system is designed in MATLAB/Simulink

software where a hybrid controller (ANFIS-PI) is implemented in the machine-side converter (MSC) and grid-side converter (GSC) of a variable speed PMSG-based wind turbine to enhance its performance subjected to wind variations.

What are the key enablers of wind turbine control?

Key enablers include: Cybersecurity has become a core design priority, essential as turbines become part of critical national infrastructure. The future of wind turbine control will go beyond speed and power to deliver intelligence and resilience.

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