УДК 658.26(075.8)

APPLICATION OF DIGITAL TWIN IN PHOTOVOLTAIC POWER STATION

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Digital twin technology has received extensive attention in various fields, and a large number of research have been carried out in the power field at home and abroad. This paper analyzes the connotation, key technology and application prospect of digital twin photovoltaic power station, which provides ideas for the realization of digital twin photovoltaic power station.

Keywords: *Digital twin, photovoltaic power station, application.*

With the integration and application of cloud computing, Internet of things, big data and other new information technologies with manufacturing, countries around the world have introduced their own advanced manufacturing development strategies. The most representative strategy are the industrial Internet strategy of the United States and the industrial 4.0 strategy of Germany. One of the purposes is to take advantage of the new information technology to realize the interconnection and intelligent operation of the physical world and information world of manufacturing, and then realize intelligent manufacturing [1]. As one of the important technologies connecting the physical world and the virtual world, digital twin has attracted extensive attention. Gartner, the world's most authoritative IT research and consulting firm, listed digital twin as one of the top ten strategic technology development trends for four consecutive years [2].

The idea of digital twin was first put forward by Professor Michael grieves in the product life cycle management course of the University of Michigan in 2003, and formed three components of digital twin in 2011: physical product of physical space, virtual product of virtual space, as well as data and information interaction interface between physical space and virtual space [3]. Digital twin was applied in the aerospace field and was first applied to the F-35 production and manufacturing of Lockheed Martin company. Then, the U.S. Department of defense applied digital twin to the monitoring, maintenance and support of aerospace vehicles. With the popularization of the concept of digital twin, it has received extensive attention in various fields, and various application concepts emerge, including automobile manufacturing, architectural design, urban management, environmental protection, power field, oil and gas industry, health care, smart agriculture, aerospace, ship shipping, safety first aid, etc.

As a rapidly developing power system in the last decade, photovoltaic power station also has the characteristics of large scale and high complexity of ordinary power system. A lot of capital and technology need to be invested in the construction process. During operation, the operation and maintenance cost is high due to the wide distribution range of the system, many types and quantities of equipment and other problems. Therefore, it also faces the needs of digital transformation.

1. Connotation of digital twin photovoltaic power station. Digital twin photovoltaic power station is composed of physical power station, virtual power station as well as data and information interaction interface between them. The virtual power station uses the digital twin technology to establish the multi-dimensional and multi domain model of the physical power station and the technollogy of model fusion, so as to accurately reflect the state of the physical power station in the real world and promote the digitization and virtualization of all elements, real-time and visualization of all states. At the same time, the virtual real interaction technology is used to transmit the operation history data and real-time data of the physical power station to the virtual power station, and transmit the measurement and operation optimization data of the virtual power station to the physical power station, so as to realize the collaborative interaction, virtual real iteration and continuous optimization between the physical power station and the virtual power station, and finally realize the independent management of the power station operation[4].

2. Key technologies for the construction of digital twin photovoltaic power station. Digital twin photovoltaic power station is a complex technology and application system for new digital intelligent photovoltaic power station. The integration of multiple technologies, the integration of multi-source data and the connection of various platform functions are the key elements of the construction of digital twin photovoltaic power station.

1) Intelligent sensing technology. Intelligent sensing system is the entrance and channel of sensing interconnection for digital twin photovoltaic power stations. The deployment of sensing devices in the whole area requires a lot of capital and human investment for the purchase, installation, management and maintenance. Therefore, select representative equipment to deploy miniaturized, IOT and high-precision sensing devices, integrate low-power communication technology to realize the integration of sensing and transmission, and then build the integration model of the same type of equipment based on modeling technology. After simulation verification and continuous iteration of the model, the effect of deploying sensing devices in the whole area can be achieved.

For the new equipment, the necessary sensing and communication devices can be integrated according to the corresponding standards and specifications in the production and manufacturing stage to realize the intelligent sensing of the equipment.

2) Equipment IOT management technology. The equipment IOT management platform is a platform that provides equipment connection and related services. There are some problems in the access of various intelligent sensing devices, such as language barrier, different operating systems, different communication protocols and so on. Therefore, the equipment IOT management technology of the digital twin photovoltaic power station needs to adapt to the access and data communication needs of different terminal devices with multi language, multi operating system, and ensure the communication security, real-time and stability. It also needs to have a variety of development tools to accept the data sent by any device equipped with protocol driver.

3) Data resource collection technology. The construction and iterative optimization of digital twin models of equipment, subsystems and photovoltaic power station rely on the collection of data collected by global intelligent sensing devices. Based on the data center under construction, the collection, management and sharing of data resources from various sources and structures can be realized. Through metadata specification, unified conversion format and unified data service interface, the barrier that heterogeneous data and cross professional data can not be used together can be broken, and the data sharing, analysis and circulate requirements between professions and levels can be realized.

4) Digital twin model construction technology. The core of digital twin photovoltaic power station is a high-precision and multi coupling digital twin photovoltaic power station model. The model building technology of digital twin photovoltaic power station adopts the combination of model driven modeling and data-driven modeling. Initialization modeling uses actual perception measurement, equipment three-dimensional modeling, digital modeling and other means to obtain the original data, and generates the digital twin model through data fusion processing, superposition system modeling and dynamic modeling. The modeling strategy is based on equipment modeling, and then integrates to the digital twin model of the subsystem and the digital twin model of the whole photovoltaic power station.

3. Application of digital twin photovoltaic power station

1) Immersive virtual-reality interaction of photovoltaic power station. The digital twin photovoltaic power station uses the refined digital twin model that operates synchronously with the physical power station to simulate the operation state of the power station in real time, superimpose VR technology and three-dimensional visualization technology, so that users can immersively monitor the operation state of the photovoltaic power station, and feed back the operation of the virtual power station to the physical power station in real time, so as to realize the operation of the physical power station.

2) Photovoltaic power station fault warning. Through the virtual-reality interactive interface, the physical power station operation history data and real-time data are deeply integrated with the digital power station. Using big data, machine learning and other technologies, a fault prediction model is formed in the virtual power station. In the process of virtual power station operation, through the analysis of real-time operation data, the power station operation fault early warning information is fed back to the physical power station, so as to promote the improvement of physical equipment operation and maintenance strategy.

Summary. This paper introduces the development of digital twin technology, the meaning and key technologies of digital twin photovoltaic power station, and studies the application of digital twin photovoltaic power station, which provides ideas for the realization of digital twin photovoltaic power station.

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