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Utilization of Nanotechnology Optical Fibre for Electricity Transmission

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ABSTRACT

A power network's communication system is a necessary component to keep it running. This research investigates the use of optical fibre nanotechnology in power communication transmission. The optical transmission network technology, which is the primary transmission technology, is applied to the power communication network, and a functional model of the optical transmission network device node is constructed. In the optical transmission network, the form of the terminal multiplexing device function module, the electrical cross device function module, and the photoelectric hybrid cross device function module are examined. Utilizing optical transmission network technology, the optical multiplex portion and the optical transmission section are both subjected to the optical fibre nanotechnology. Strong third-order optical nonlinearity is used to transfer data in the power communication network. The experimental results demonstrate that the rate of the digital communication interface is higher than 7,000 bit/s in various service quantities, and the loss of the communication cable is within the standard range when optical fibre nanotechnology is applied to power communication transmission. This demonstrates the viability of optical fibre nanotechnology for the transmission of power.

INTRODUCTION

Power communication and the power system, safety and stability control system, and dispatch automation system are the three primary forces of power system security and stable operation. Power communication is primarily to ensure the safe and stable operation of the power system. Electric power communication is the foundation for the diversification of operations in non-electrical industries and is used for power grid automation control, modern management, and commercial operation services. Power system communication techniques are diversifying as a result of the ongoing advancements in communication technologies. The optical fibre communication technology provides the benefits of anti-electromagnetic interference, high voltage, and huge current due to the long relay distance, large transmission capacity, and superior transmission quality. Additionally, its usage in power communication is expanding and As civilization advances and develops, a growing number of jobs necessitate electricity in all spheres of life. The power communication system is required for the signal transmission of office automation to be successful. The power structure is highly professional and obviously relevant [1]. The communication network must be scalable so that it can accommodate the demands of various work phases. To maintain its regular functioning, the power system must rely on the power communication system, thus it is crucial to guarantee the system's dependable performance. In today's world, electric energy permeates every part of people's daily lives. Power outages will cause significant economic losses once they happen. With the meaningful raising of the level of Power system operation is in dissociable from power communication systems in automated power systems. Power system signals must be extremely reliable to be used since they play an indispensable function in power communication systems. Since optical fibre communication has been developed, its dependability has been more apparent. Power supply companies must keep enhancing their own specifications in response to the power industry's rapid development in order to advance and expand the power grid. The development and expansion of the electricity grid require a strong expansion, which is a prerequisite.

MATERIALS AND METHODS

Low latency ensures that communication is completed at a high pace, and delay in power communication is closely controlled. The person in control can be alerted as soon as feasible in case of danger or disaster to reduce damage. Rapidity defines the optical fibre communication rate. Silicon dioxide is the primary component needed for optical fibre transmission. China has large deposits of silica compared to other energy sources. The extensive usage of optical fibre communication contributes to the decline in power communication losses from various power sources. Additionally, it protects the environment and lowers air pollution, which has a significant impact on China's economy's ability to grow sustainably. With the current technology industry developing so quickly, the transmission capacity (transmission rate) of optical

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fibre communication is subject to higher requirements. Due to loss, dispersion, and the slow electronic response times of the optical electronic relay devices along the route, linear optical fibre communication systems currently have poor transmission rates and limited relay distances. The cost of the relay device rises steadily as the transmission rate approaches or exceeds 10 GB/s, which is a significant barrier to the optical fiberization of the communication system. Optical soliton communication is one such all-optical line solution that successfully addresses the aforementioned issues. The refractive index nonlinear self-phase modulation (SPM) effect (also known as the optical Kerr effect) is brought on by the intensity in the optical fibre when the refractive index of the optical fibre material SiO2 is nonlinearly related to the field strength of the optical pulse. The group velocity dispersion (GVD) effect can be cancelled out by the optical pulse compression generated by the anomalous dispersion area, keeping the optical pulse's shape constant throughout transmission. The main challenge of optical soliton communication and the foundation for achieving ultra-high speed, ultra-long distance, all-optical communication is optical soliton transmission in soliton communication systems. The transmission of optical solitons is influenced by a variety of circumstances. The optical fibre has a very high transmission capacity and a bandwidth of 25 THz. Because loss and dispersion are two major variables that limit the transmission of optical data, optical fibre communication systems currently have transmission rates that are substantially lower than 25 THz. The response times of optical bistable devices (such as switches and other switches) must be on the order of picoseconds in order to enable high speed optical communication technology. Because semiconductor optical switches have response times that are only on the order of nanoseconds, they fall short of the standards for high-speed optical communication, leading to the so-called "bottleneck effect" issue. All-optical logic devices will need to be quick to react in the all-optical communication sector of the future, but they also need to perform very well in the following two areas.

Equipment Form of Optical Transmission

To make the integration of the optical device easier, the material utilised in the device must first have a high nonlinear coefficient. Second, the material has a low loss and low threshold power to cut costs. The materials now in use fall short of fulfilling these criteria [2]. In order to create a nano optical fibre, it is suggested that semiconductor nanoparticles smaller than the exciton Bohr radius be incorporated into an incompatible optical fibre material (SiO2 medium). The semiconductor particles in this material system are subjected to the three-dimensional strong confinement of the third-order optical nonlinear sensitivity is much improved, displaying quasi-zero-dimensional quantum dot properties at the dielectric barrier. Additionally, this improved nonlinear response features low saturation absorption intensity, a tiny threshold power, and a fast reaction on the order of picoseconds, minimal loss, and other desirable properties. With the development of quantum dot semiconductor materials, it is now possible to create zero dimensional quantum confinement and confine electrons to point formations. New optical communication techniques and equipment will be available. There are numerous studies being done on power communication transmission at the moment. Based on an analysis of the internal environment of the three-way smart grid in China, the United States, and Europe, Downie et al. identified disparities in the development of smart grids in these three regions. The analysis focuses on the operability, controllability, observability, and flexibility of the smart grid and establishes the groundwork for future research paths, technology selection, technology development lines, and demonstration priorities. It assesses how far China, the US, and Europe have gotten in their research, development, and demonstration of smart grids and looks ahead to how they will develop in the future. Last but not least, it suggests corresponding countermeasures for the rise of smart grid technology in China [3]. According to Konczykowska et an analysis.'s of the internal workings of the evolution of the smart grid, under different time and space

Communication Rate Comparison

The power communication transmission network's optical fibre communication technology can be further broken down into quasi-synchronous digital systems, optical transmission networks, packet transmission networks, and similar systems [4]. Here, the transmission network for electricity communications is equipped with optical transmission network technology. Technology for optical transmission networks, which is based on wavelength division multiplexing, has advanced quickly in recent years. Public communication networks have made extensive use of it.

Optical Transmission

Optical transmission network technology is a Layer 1 communication model functioning in the Open Systems Interconnection (OSI), which is divided into two layers, according to the ITU-T G.984.3 standard [5]. The optical layer is also known as the Dense Wavelength Division Multiplexing (DWDM) layer, and the electrical layer is also known as digital packaging. While the optical layer is in charge of creating, multiplexing, exchanging, and managing the optical channels, the electrical layer is in charge of initiating, managing, and exchanging the entities of the client signals (optical data units). The signal between the clients, which may be fixed or variable in size, is transmitted using these optical data units k [6]. The benefit of the dynamic optical transmission network is that it may change the demand to adapt to failing networks or shifting traffic patterns. While maximizing the possibilities of network resources, this feature has the potential to lower operating expenses. Improved vibrancy in an optical transmission network can be achieved using two technologies: virtual concatenation technology and link capacity adjustment methods (LCAS). The functional model of an optical transmission network device node is depicted. A highly compatible optical communication transmission system that can accommodate the demands of many services is the optical transmission network. The optical transmission network device offers a variety of service type interfaces, including Synchronous Transport Module level (STM-N) optical unit interface, Ethernet interface, Plesiochronous digital hierarchy (PDH) interface, OTUK interface, FC service interface, Common Public Radio Interface (CPRI) service interface, and other service interfaces. These interfaces can be used to simultaneously meet the needs of the optical path and circuit. Through these interfaces, the communication service is sent to the optical data unit k interface, which is then transferred to the optical data k-crossing unit for cross-connection before being multiplexed into the optical fibre.

RESULTS

A regional power communication network is utilised to study the topological communication situation in order to confirm the efficacy of optical fibre nanotechnology in power communication transmission. The network for power communication has 27 links and 18 nodes [7]. The success of the strategy is evaluated by counting statistics such as service communication delay and the number of link failures on the network management equipment of the power communication network, assuming that the network's service demand is 10.

DISCUSSION

Satellite, microwave, and optical fibre make up the majority of the components of the power communication network. In order to create a multi-user and multi-functional integrated communication network, each branch makes full advantage of the power system's special communication technique and uses a variety of communication tools and equipment. Power frequency current is primarily transported over power lines. Power line carrier communication is the process of converting voice and other data into high-frequency weak current by a carrier and transmitting it over a power line [8]. It benefits from quick results, inexpensive investment, good channel dependability, and synchronization with power grid development. An insulated ground line carrier that sends a carrier signal over an overhead wire of transmission is also a part of power line carrier communication [9]. In comparison to the usual power line carrier, the insulated ground line carrier is not impacted by transmission line ground faults or line power failure maintenance, and the ground line is insulated to significantly reduce power loss.

CONCLUSIONS

People now have increased expectations for the speed of power communication due to the quick development of modern information [10-11]. The reliability of power communication transmission is improved by the strong third-order optical nonlinearity technology and optical soliton communication technology based on optical fibre nanotechnology. These technologies are applied to optical transmission networks and optical fibre nanotechnology. Numerous tests have been performed to confirm the reliability of the approach. According to the experimental findings, optical fibre nanotechnology can be used to transmit power communications, choosing the best route quickly and improving communication efficiency. This demonstrates that the small capacity, resource shortage, and poor stability of the current communication equipment can be effectively solved by the power communication network using optical fibre nanotechnology, which can meet the needs of various production and business information in the transmission process of power communication in the future [12].

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Conflict of Interest

None

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