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The Application of Artificial Intelligence Technology in the Safety Monitoring System of Oil and Gas Ground

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Abstract

With the advent of a new era and continuous improvement of the technological level, AI technology has gradually come to the people's vision. In the context of a new era, with the continuous promotion of digital construction of oil and gas surface engineers and the rapid development of information technology, oil and gas surface engineers have begun to enter the stage of intelligent construction. An important research topic is the application of artificial intelligence technology in the safety supervision of oil and gas surface technology. In response to the frequent occurrence of safety accidents in oil and gas surface construction and the low level of intelligence of existing safety oversight systems, an AI-based safety oversight system for oil and gas surface construction has been developed, the greatest feature of which is to apply AI technology throughout the process of safety oversight of oil and gas surface construction. Through the continuous research, improvement and application of new technologies, a gradually built information and intelligent management system for oil and gas surface construction has been established. The ultimate goal of intelligent construction is to achieve panoramic visualization, real-time perception, intelligent analysis, automatic control and potential prediction. Artificial intelligence technology provides targeted research and practical construction ideas for intelligent exploration of oil and gas surface technology, through systematic analysis of management and control problems such as fragile ecological environment, frequent geological disasters and severe corrosion. Based on the actual situation of surface technology in specific areas, professional technology is applied to improve the oil and gas surface technology integrity management information system, which can achieve database accuracy, standardized data models and control processes. The three main objectives of system analysis to reduce manual dependence provide important technical support for the safe operation of oil and gas surface design.

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1. Introduction

Due to factors such as the global political and economic situation and market competition, the oil and gas industry has experienced greater volatility and has undergone significant changes in its structure. Global energy trends are geared towards diversification and low carbon emissions [1]. As the growth rate of oil and gas demand decreases, the efficiency of oil field operations decreases and the pressure on operating costs increases year by year. The oil industry faces serious challenges. With the advent of the 5G era, technologies such as the Internet of Things, Big Data and Artificial Intelligence are changing the global industrial landscape. Since 1970.Since the end of the years, AI research has penetrated various fields and achieved rapid development both nationally and internationally. Oil and gas surface technology is an important force for supporting China's economic development [2]. PetroChina has a large number of assets, difficult to use new and old oil and gas fields, high production costs and difficult to improve benefits. Therefore, it is urgent to promote intelligent development by digital transformation through the upstream business. Oil and gas research and development intelligence has become a hot topic and development trend of industry excellence, which is expected to significantly improve the efficiency and quality of oil and gas research and development, reduce costs and risks, and increase the level of research and development of complex oil and gas reservoirs. Today, with the rapid development of modern oil and gas companies, the number of important ground projects is increasing [3]. There are always different safety issues in the development process of oil and gas companies, which cause enormous economic damage and safety risks to companies and people. Therefore, the production of safety is based on scientific and effective monitoring and early warning. In the oil and gas production process, real-time monitoring and abnormal warning of surface technology can significantly reduce the incidence of accidents and ensure safe production of surface technology [4]. This article examines in depth the scientific status of artificial intelligence in the field of oil and gas surface engineering. Together with the real needs of oil and gas surface engineering, the development and application of artificial intelligence will be developed in five areas: logging, geophysical exploration, drilling and completion, reservoir design and surface engineering. Prospects for the application of intelligent technologies in oil and gas surface engineering will be analysed, which can provide references and inspiration for the intelligent construction of domestic oil and gas surface engineering.

2. Artificial Intelligence Technology

After 2010. Most industries have been profoundly affected by the application of big data in the online environment since 2008, and people's demand for AI has increased. Artificial intelligence (AI) is a cutting-edge discipline in the current evolution of science and technology, as well as an emerging discipline in the constant emergence of new ideas, concepts, theories and technologies [5]. Artificial intelligence, also known as intelligent simulation, is the use of computer systems to simulate human cognitive activities such as perception, thinking, and thinking. Its research and application fields include expert system, machine learning, pattern detection, natural language understanding, robotics, game, artificial neural network and other research fields. Artificial intelligence covers a number of disciplines such as computer science, psychology and philosophy. As an interdisciplinary and integrated discipline, both theory and technology are becoming increasingly mature and widely applied in a number of fields. The process of generating artificial intelligence is: to stimulate and react to human problems and things, as well as to think, solve problems, decide, into the thinking and decision-making process, these processes are broken down into some stages and then simulated or formulated through programming to simulate or formulate a human problem-solving process so that computers can have a systematic method to design or deal with more complex problems. This software system that can handle problems is called artificial intelligence. Artificial intelligence is by its very nature a simulation of the information process of human thinking, and its ultimate goal is to create intelligent computers. Throughout the entire AI development process, it has mainly gone through three important stages. In the first phase, the relevant concepts of AI were presented, with the focus still on machine translation of logical reasoning. The main principles of application are the presentation of knowledge and the search algorithm. In the second phase, concepts related mainly to expert systems were proposed. At this time, algorithmic research has

advanced, and by improving the capabilities of semiconductor technology and computer hardware, artificial intelligence technology has received further breakthroughs in various countries. In addition, the deployment of distributed networks has also reduced the costs of AI computing. In the third phase, more emphasis was placed on the application of data, resulting in the concept of in-depth learning and greater emphasis on the cognitive capacity of artificial intelligence for autonomous learning.

3. Safety Issues in Oil and Gas Surface Engineering

3.1 Problems in Engineering Design

In the actual design process of rural construction, some design units often cannot use advanced building technology and advanced building materials in the actual construction of relatively complex tectonics and natural environment, which is very easy to endanger the construction safety of the project and leads to high potential safety risks. However, the project cannot achieve dynamic monitoring and management of building safety in the actual construction process, there is no time to develop effective solutions in case of safety problems, which makes it difficult to provide sufficient technical support for safe construction.

3.2 Existing Problems During the Construction Phase

At present, a large number of oil and gas fields are located in a relatively poor geographical environment and there is no development in the transport industry. For large-scale production and development, it is necessary to increase the scope of construction of the construction team. However, due to the lack of business capacity and the introduction of team technology and equipment, the risk of safety management in the construction phase is high, the difficulties of quality control are improved, and quality problems are constantly recurring. Currently, large oil fields are increasing the speed of capacity development and construction, so several projects are being carried out simultaneously. Therefore, there are high requirements for the management and distribution of construction equipment. However, for the management of equipment, the personnel concerned have not been able to repair and maintain the equipment in time, resulting in the aging of equipment parts and frequent failures of construction equipment in practical applications, It has affected the progress of construction and increased project costs and increased construction risks for workers.

3.3 Weak Safety Awareness Among Relevant Personnel

At present, most oil and gas surface construction units have no safety awareness and are indifferent to building safety issues because of their emphasis on building efficiency, making it difficult to integrate the actual state of engineering to create and improve a safety management system. At the same time, construction companies have a weak safety awareness and a unilateral effort to maximize profits. During the construction process, they may place too much emphasis on quality management, cost management and project schedule management, while seriously neglecting safety management, so they cannot effectively secure investments in safety management. Safety awareness of construction management personnel in engineering is insufficient and the prepared construction task plan is not reasonable enough. In the case of an engineering safety check, they will only be written two slogans or required to wear safety helmets and will be able to cope with the inspection. However, contract project managers attach importance only to the design schedule and cannot strongly emphasize safety management, because it is not possible to form a reliable engineering safety management system during the actual construction period, resulting in a continuous violation of regulations during the construction period.

3.4 Problems in the Development of Oil and Gas Pipelines

The geological and geomorphological characteristics of the oil region are complex, pipelines are arranged along highlands, rivers or motorways, and the landscape along the road is complex and fragmented. By extending the development period, some pipelines passing through the region will be affected by natural disasters, which can

easily cause leakage. After the leak, it is easy to collect along the slope in sensitive areas such as rivers and ditches, and due to landscape restrictions, it is difficult to maintain and repair. As some major oil reservoirs reach the middle and late stages of development, the overall water content of the oil field increases to the medium and high water content stage, and environmental changes cause accelerated corrosion, resulting in frequent pipeline corrosion perforation. As shown in Figure 1. Some oil fields are located in areas with special geological conditions prone to geological disasters. For example, the quaternary primary lair on the Loess Plateau has an open structure, numerous pores, vertical joints and rich in soluble minerals. When in contact with water, it is easy to sink, causing geological disasters and endangering the safe operation of pipelines. As shown in Figure 2.

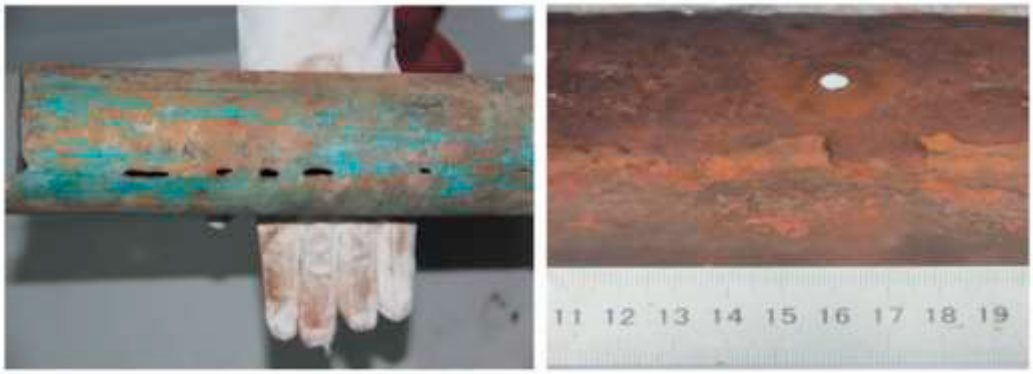

Fig.1 Corrosion and perforation of pipeline

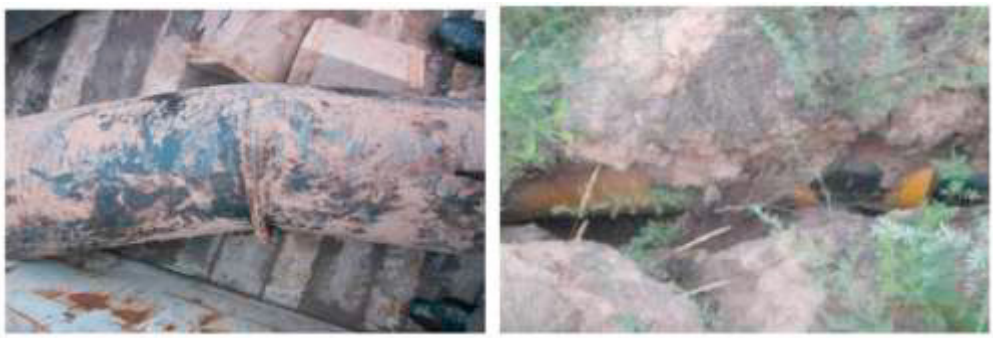

Fig.2 Schematic diagram of pipeline failure caused by geological disasters

3.5 Security Issues with the Monitoring System Database

With the continuous development of intelligent monitoring technology, intelligent monitoring systems for oil and gas technologies have become more complex and a huge amount of monitoring data has been created. Security of oil and gas technology databases has become a necessary issue. At present, oil and gas surface technology is still at an early stage of AI. Technologies such as the Internet of Things, cloud computing and big data mining have enabled local oil fields to be monitored and perceived, and intelligent assessment and forecasting functions can be achieved through data analysis and processing. However, the lack of depth and adaptability of oil field monitoring equipment limits the perception of oil field safety. Developing technologies such as systematic cooperation to monitor information sharing.

4. Current status of Artificial Intelligence Application in Oil and Gas Surface Engineering

Artificial intelligence is the continuous updating of the "acquisition, transfer, storage, management and use" of data. Therefore, the intelligence stage is to build a data center on a digital basis, integrate several types of data, implement information technologies such as big data, cloud computing, virtual reality and artificial intelligence, and achieve intelligent construction of oil field ground systems. Although significant progress has now been made in safety monitoring and early warning technology for oil and gas surface technology, relying on various technologies such as robots, voice and video communication, 3D visualization, virtual reality and expert systems, the use of AI technology is at an early stage and the development of safety monitoring technology for oil and gas surface technology is not sufficiently integrated based on human intelligence. It can be seen from the current state of development of intelligent monitoring and early warning technology for oil and gas surface technology based on artificial intelligence that there is an urgent need to improve in-depth training, enhanced learning and adaptability of underground monitoring and early warning equipment for oil and gas fields, to meet awareness, information sharing monitoring and other needs of the safety situation in the mining area.

4.1 Logging Data Collection

Given the heterogeneity of reservoirs, the complexity of detection sites and the diversity and complexity of logging environments, there is an urgent need to explore new measurement methods and working methods for collecting underground formation parameters, transmitting logging data and other aspects. Foreign oil companies have developed commercial products in data collection, telemetry and other fields. In China, some oil companies and research institutions have already made breakthroughs in key technologies such as networked ground, intelligent winches and remote cutting, and have started small-scale applications. The development of intelligent underground robots has been initiated.

4.2 Intelligent Exploration and Development Technology

In the field of oil and gas research, Chinese and foreign researchers have for many years deepened their understanding of the six main sources, reservoir, cork, transportation, recycling and storage factor. In recent years, with the development of relevant algorithms and computer software and hardware, the application of big data and artificial intelligence technologies to solve the problems of integrated research has become a hot topic of research [6]. At present, most of China's oil field development has achieved the promotion and implementation of integrated modelling, digital and analogue research. However, the geological conditions of China's old onshore oil fields are complex, and most of them have reached a late stage of development. Different process measures are often adapted. How to quickly, dynamically and accurately update the geological model of the reservoir, direct deeper understanding of remaining oil and optimize development plans has become a key factor influencing the quality of development of oil fields. In recent years, the application of artificial intelligence in intelligent research and development has mainly focused on automatic depth correction, automatic report generation, intelligent stratification, curve reconstruction, lithological identification, reservoir parameter prediction, oil and gas bearing evaluation, shear wave velocity prediction, identification of fracture and cavity filling material, etc.

4.3 Artificial Intelligence Optimization of Human Resources

The control of foreign drones/robots has reached the stage of commercial application. Robots inspect wells' pillows, booster points, gas collection points, joint stations and processing plants, and drones regularly patrol pipelines. Image recognition and big data analysis identify risks, achieving intelligent early warning and alarm [7]. The accuracy of the certificate reaches 95%, improving the working environment and conditions of employees. However, China national investigation and implementation have only just begun. Artificial intelligence can intelligently analyze and process software in oil and gas surface design, improve manual interpretation and processing efficiency, reduce reliance on expert experience, optimize human resources and save labor costs.

4.4 Safe Operation of the Oil and Gas Official Website

With regard to oil and gas pipeline networks, the collection and transport of oil and gas pipelines is an important step in the development and transportation of oil and gas fields, the composition and flow pattern of the actual oil and gas field production environment is complex, and there are risks such as wax deposition, corrosion and erosion, and pipeline network failure. The process connections are numerous and complex, significantly affecting the safe and stable operation of the oil and gas field collection and transport pipeline network. Some foreign software can basically achieve the power guarantee and achieve the control of corrosion and erosion rate monitoring, squeezing, and stop and restart operations. Some domestic software can simulate the complex flow situation of oil and gas flow collection and transportation pipelines, but it is not yet integrated with production to carry out the flow guarantee business of oil and gas pipelines. Research and implementation of related technologies must be monitored.

4.5 Implementation of video surveillance at oil field production sites

With the continuous improvement of security requirements and the development of information technology, China's large oil field production sites have achieved extensive video surveillance coverage, reducing the time and cost of on-site well inspection. However, with the continuous generation of multi-channel massive video data, as we continue to use manual mode to analyze and evaluate videos, higher requirements will be placed on the number of staff, personal experience and analytical ability of the followers, which will greatly affect the overall performance of video applications. Therefore, video-based intelligent detection technology is rapidly evolving. Through deep learning algorithms, structured processing of videos is carried out directly from homework sites, extracting different key attributes from the scene and comparing and analyzing them with 7 standard structured models to achieve intelligent detection of violations. Used in business scenarios such as oil field production and operation, safety and environmental protection, comprehensive control and stability maintenance, emergency management, etc., the standardized detection and alarm accuracy rate for direct operation is 75%, the regional invasion accuracy rate is 90%, and the behavior detection and analysis accuracy rate is 65%. Figure 3

Downhole operation

Earthmoving operation

Working at heights

Personnel standing on the pumping unit

Fig.3 Intelligent video recognition in various oil and gas operation scenarios

5. National and International Technological Developments

5.1 New developments in AI technology in foreign oil and gas engineering research

At present, oil and gas surface technology researchers have not adopted artificial intelligence to completely replace the demand for human labour. Therefore, their attention to the branches of artificial intelligence technology, such as computer vision, understanding natural language, intelligent robots, automatic design of computer programs, deduction and proof of formula, opposing games, etc., is relatively low. However, they are interested in automatic search and solution models, dynamic forecasting, decision support, machine learning, big data mining analysis, knowledge rationale I have a great interest in areas of artificial intelligence technology, such as game management in precarious conditions. The research and application of AI technology in oil and gas surface construction is still at a difficult stage of development, although some successful cases have been reported, there are still many problems in solving complex situations and improving the compatibility of algorithms. Therefore, it is unrealistic for computers to fully represent the work of oil and gas surface scientists, and it is more possible to limit the focus of technological R & D on restricted AI that meets specific needs.

5.2 New developments in AI in domestic oil and gas engineering research

Domestic oilfield companies attach great importance to research and construction of intelligent oilfield technology. From 12. From the five-year plan period, intelligent oilfield construction has been seen as a strategic transformation and renewal of companies based on digital and network construction and have successively launched research and pilot applications of intelligent oilfield technologies. Faced with the digitalisation, networking and intelligence development goals of the petroleum and petrochemical industries, many companies are actively researching and developing new online platforms, forming a new model and business form that deeply integrates traditional industries and information technology, directing oil and gas construction to lead the field of intelligent manufacturing applications in the Chinese process industry. By directing business scenarios such as research and development, we carry out the functional design, technical implementation and functional R&D of intelligent oilfields, providing strong technical support to intelligent oilfields. Facing the entire lifecycle of oil and gas fields, from extensive exploration, on-site operations, business management to strategic decision making, focusing on four typical scenarios "transparent oil reserves, unmanned operations, collaborative operations and knowledge-based decision-making", using advanced IT tools to create a new R & D model for oil and gas fields, achieving efficient operation and value enhancement of the oil field.

6. Conclusion

Currently, studies on the impact of the application of artificial intelligence in oil and gas surface construction have made some progress, making a significant contribution to accident and accident prevention in oil and gas surface construction [8-10]. Applying AI to safety oversight in oil and gas field design is a long-term task that requires cooperation between business personnel, IT technicians and AI technicians. Enterprise employees propose intelligent application requirements developed and applied by artificial intelligence and IT technicians. Through continuous iteration, extensive coverage of ground engineering intelligence is achieved. Therefore, we should follow the principles of openness, cooperation, joint construction and sharing, follow the construction stages of cutting-edge design, long-term planning, gradual implementation and iterative improvement, and follow the construction strategy of holistic thinking, looking to the future, laying a solid foundation and promoting, in major steps, the intelligent construction and implementation of surface engineering for oil and gas fields.

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