

Progress of Ecological Environment Research in Mining Areas based on Remote Sensing Technology

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Abstract

Significant progress has been made in the application of remote sensing technology in the study of ecological environment in mining areas. Using technologies such as hyperspectral remote sensing, multispectral remote sensing, low-altitude remote sensing by unmanned aerial vehicles and the construction of monitoring indicator systems, it has been widely applied to mine development and land use, monitoring of vegetation cover in mines, monitoring of the geological and hydrological environment in mines and monitoring of environmental pollution in mines. In the future, with the continuous emergence of new technologies and the optimization of remote sensing technology, the application of remote sensing technology in the monitoring and protection of mining ecological environment will be more extensive and in-depth, which can provide stronger support for mining ecological environment protection and sustainable development.

Keywords

Remote Sensing; Mining; Ecology; Monitoring.

1. Introduction

Since the 21st century, the continuous large-scale development of mineral resources has provided important energy and material conditions for China's rapid economic and social development, however, the continuous and drastic exploitation of mineral resources has triggered a series of ecological and environmental problems such as surface subsidence, land destruction, vegetation degradation, soil quality degradation, water contamination, air pollution, etc. [1-3], which has attracted extensive attention from all walks of life. In this context, future mining development activities increasingly need to take into account both resource extraction and ecological environmental protection and governance, and the scientific monitoring of mining ecological environment is a prerequisite for protection and governance [4-5]. The most important way of mine ecological environment monitoring is to use remote sensing technology to quantify the ecological environment indicators, and carry out efficient and accurate monitoring of mine ecological environment. The application of remote sensing technology is becoming more and more common in the existing means of mine ecological environment monitoring. The diversified applications of remote sensing technology in mine ecological environment monitoring are becoming more and more important, from single geological environment monitoring to comprehensive ecological restoration assessment. With the development of technology, future mine ecological environment monitoring will be more accurate, efficient and intelligent.

Environmental information such as mine conditions, land use, farmland coverage, vegetation growth, soil erosion, etc. can be obtained from remote sensing images. At the same time, image

data can be processed according to the image inversion model, which can get more accurate information of environmental parameters, such as land use type, soil moisture, rainfall, temperature and so on. The use of remote sensing technology for mine ecological environment monitoring can quickly and non-invasively obtain multi-dimensional information reflecting the mine ecological environment, so as to provide an effective basis for the management and protection of mine ecological environment. Remote sensing technology in ecological environment monitoring has the advantages of good timeliness, wide monitoring range, and fast data acquisition [6-7], so obtaining the spatial and temporal distribution characteristics of all kinds of parameters in the mining area through the means of remote sensing monitoring technology has become an important technical means of research in the mining area. Combined with multi-temporal remote sensing image data, it can also predict the future environmental development trend in the region, and also provide relevant data and technical support for the management, planning and decision-making of the mining area by the local government departments, which are of great significance to the political and economic development of the society and the evolution of the natural environment.

2. Application of Remote Sensing Technology in the Ecological Environment of Mining Areas

Remote sensing technology has a wide range of applications in mine ecological environment monitoring. Through the interpretation and analysis of remote sensing images, a variety of information needed in ecological environment monitoring can be extracted, such as the vegetation coverage of mines, the heavy metal content of soils, the pollution status of water resources, and land destruction. This information can help environmental protection departments and mining enterprises to monitor the changes in the ecological environment of the mining area and assess the impact of the environment around the mining area.

2.1. Mine Development and Land Utilization

The development of mines is inevitably accompanied by changes in land utilization, so how to accurately monitor land utilization in the process of mine development has become the focus of research. The use of remote sensing technology can effectively obtain information such as land use type, land cover, forest cover and land landscape type. At the same time, the use of high-resolution remote sensing image data for land use type classification and change detection can accurately reflect the impact of mine development on the land, so as to better guide mine development management.

2.2. Monitoring of Vegetation Cover in Mines

Vegetation cover in the mining environment is one of the important indicators reflecting the ecological environment of mines, and remote sensing technology is undoubtedly the most effective and convenient means for obtaining and monitoring vegetation cover information. Through the classification and analysis of remote sensing image data, we can obtain information such as vegetation coverage, vegetation growth, afforestation area of vegetation, etc., and can track and evaluate the changes of vegetation coverage in the process of mine ecological restoration. In addition, through the vegetation index inversion model, more parameters closely related to the growth of vegetation can be obtained, such as the vegetation leaf area index, photosynthetically active radiation, and so on, so as to deduce the growth of vegetation and changes in the ecological environment.

2.3. Mine Geology and Hydrology Environment Monitoring

Mine geohydrological environment monitoring is to monitor groundwater, surface water, soil moisture and other aspects. By utilizing remote sensing technology, it is possible to obtain

water body information, surface cover type, soil moisture content and other parameters in the mine area. In addition, it is also possible to use remote sensing technology to invert the model to project the changes in the hydrological system inside the mine, the utilization of water resources, the changes in the hydrological cycle, the process of water transport and evaporation, etc., so as to provide references for the management and protection of water resources.

2.4. Monitoring of Environmental Pollution in Mines

Problems such as atmospheric pollution and water pollution often occur in the ecological environment of mines, and these pollution problems have a great impact on the ecological environment. The use of remote sensing technology can obtain the mine area of atmospheric pollution information, water pollution information and other environmental information, and the use of inverse modeling data processing, can provide effective pollution monitoring data for the environmental management department.

3. Development Direction of Remote Sensing Technology

3.1. Hyperspectral Remote Sensing Technology

Hyperspectral remote sensing technology has been widely used in environmental monitoring of mining areas because of its fine resolution and ability to provide comprehensive maps. Hyperspectral remote sensing technology can effectively identify the physical and chemical parameters of the mining area, and by analyzing the spectral response of vegetation, it can monitor the growth status of vegetation, biomass, and chlorophyll content and other indicators; by analyzing the spectral characteristics of the soil, it can be deduced that the concentration of hazardous elements in the soil, so as to assess the degree of soil pollution and ecological risk; by analyzing the spectral characteristics of the water, it can be assessed that the water in the mining area is polluted. .

3.2. Construction of Monitoring Index System:

In order to promote the ecological restoration of mines, researchers have carried out research in terms of the basic content of monitoring and the selection of indicators, which involves water environment, soil environment, surface environment, geological environment and ecological environment. And the remote sensing ecological index is constructed, which is used to assess the ecological environment of the mining area more accurately.

3.3. UAV Low Altitude Remote Sensing Technology:

UAV technology is used to collect real-time information on mine ecological restoration, construct a three-dimensional live model, and obtain information on topography and geomorphology, the degree of vegetation development, and the structural condition of the rock body through deciphering and analyzing. Compared with the traditional investigation methods, the drone technology is simple and easy to implement and the data accuracy is higher.

3.4. Application of Remote Sensing Technology in Mine Geological Environment Monitoring

Remote sensing technology is used to monitor mine collapses, mudslides, subsidence zones and mine pollution. It can clearly show the geological environment of mines and provide information basis for solving problems in mine production. Through multi-source and multi-temporal high-resolution domestic high-fraction satellite data, combined with the real-time dynamic monitoring of remote sensing by unmanned aerial vehicles, the various evaluation indicators of green mines are identified and systematically researched and analyzed, and the technical system for the application of remote sensing technology in the construction of green mines is established.

4. Conclusion

In the management of mining ecological environment, the application of remote sensing technology has become an essential means. Remote sensing technology can obtain a large amount of environmental information data, providing a more comprehensive, detailed and reliable data base for mine environmental management departments. In the future, with the continuous emergence of new technologies and the optimization of remote sensing technology, the application of remote sensing technology in the monitoring and protection of mining ecological environment will be more extensive and in-depth, which can provide stronger support for mining ecological environment protection and sustainable development. At the same time, in order to better play the role of remote sensing technology in mining environment monitoring, it is also necessary to strengthen and improve the following aspects. Develop remote sensing data processing and analyzing techniques, test the accuracy and validity of remote sensing data, and improve the reliability and accuracy of the data. Improve the standards and norms for the application of remote sensing technology to mine ecological environment monitoring, establish a scientific, standardized and complete data management and application platform, and ensure the reliability and accuracy of monitoring data. Combine remote sensing technology with other technologies to build a diversified mine ecological environment monitoring system, so as to realize comprehensive monitoring and refined management of the mine ecological environment. Strengthen data exchange and sharing, establish an open mine ecological environment monitoring system, realize data normalization and sharing, and improve the efficiency of information resource utilization.

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