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Study of the Integrated Environmental Monitoring in Mining Area Based on Image Analysis

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Abstract

The mining area environment is a complex and dynamic system and is effected by mining activities. Therefore, knowing the dynamic change of the mining area environment is very important for mining and management of the mining area. But the traditional ground investigation always needs a lot of work and incomprehensive, it also takes a long period and lacks of real time. In recent years, the remote sensing monitoring method which has been applied widely to the mining area has been improved, but it still contains deficiencies, such as the singleness of the monitoring contents, the difficulties in the synthesized analysis of the new data with existing information. This paper integrates various remote sensing explanation methods and brings forward the concept about integrated environment monitoring in mining area based on image analysis, and discusses the strategy and technique of comprehensive information extracting, such as atmosphere pollution, earth covering and sinking, underground structure, etc.

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1. Introduction

Exploitation of mineral resources is usually accompanied by damage of environment and pollution. It is essential to know the environmental status of mining area to achieve “green exploitation” and to guide the production and the recovery after mining activities. Remote sensing has become a necessarily key method in monitoring and evaluation of the mining area because it is capable of gathering ground information promptly, fast, objectively and seasonally [1,2]. Mining has great effect on surrounding environment and it is complicated in space and time, involving the air, ground and underground. However, recent applications of remote sensing on monitoring of the environment of the mining area are only

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emphasized on limited fields and there are few researches which are from multiple directions, which mean that remote sensing is not fully employed. As remotely sensed imagery is developing towards high resolution, high spectral and multi-cycle, it is possible to make environment monitoring of mining area unidirectional based on photogrammetry and remote sensing.

2. Technical Framework on Integrated Remote Sensing Monitoring of Mining Environment

Environment of mining area is a solid and active system. Mining activity affects three aspects of the environment: underground, ground surface and air. For the underground environment, the gob area will show in the form of ground collapse before long. It will also cause the level change of the ground water, which will affect the enrichment rule of the surface water. New arrangement and move of underground water resources may occur in severely affected areas and further change the climate of that region. For the ground surface environment, mineral exploitation and construction of relevant auxiliary projects will greatly change the appearance of ground surface, such as caving in, watering, pileup and many other typical changes of surface appearance of the mining area. Moreover, this process will lead to destruction of the surface vegetation, water pollution, changes of soil nutrition and water containing, which badly influence the structure of the surface appearance; for the atmosphere environment, the process of mineral exploitation and transport produce a lot of dust. The gangue can burn itself and bring vast fog and dangerous gas contaminant that not only threaten people's health in and around the mining area, but also influence the functions and behaviours of the surrounding environmental system and its subsystems and bring changes of regional environment and climate.

3. Remote Sensing Interpretation of Integrated Thematic Environmental Information in Mining Area

3.1. Atmosphere pollution monitoring

Atmosphere environment is one of the important factors in environmental evaluation. Atmosphere contaminants mainly contain aerosol and gas pollutant. Aerosol contaminant consists mostly of solid and liquid granules or their suspensions, which are coagulated by powders, dust and fog. Gas contaminants are mainly made up of sulphide, nitride, carbohydrate and halide, which exist in the form of molecules. Atmosphere pollution in mining area has the characteristics of powdery, dusty and foggy, which requires proper mathematic model according to the spectral identity of the gas contaminants [3].

3.1.1. Spectral characteristics of gas contaminants

The common gas contaminants in mining area consist of SO₂, NO_x, CO₂ and powders. Spectral characteristics of gas are expressed on absorbing and scattering. SO₂ and NO_x have similar spectral characteristics. There is no obvious absorbing within the spectral bands of visible light and near infrared in the detected spectrum range from the remote sensing instruments use, thus they are both observed as colourless and transparent. However, both of them will have Raleigh Scattering and the intensity is not only in direct ratio of the atmosphere concentration but also the negative quartic of the wavelength of the electromagnetic wave ($R \propto \lambda^{-4}$, R-scatter index, λ -wavelength). So the scattering of SO₂ and NO_x is intensive in the spectrum range of blue light which has short wavelength, and depresses quickly with the increase of the wavelength. There is nearly no scattering caused by SO₂ and NO_x when the wavelength is longer than 1 μ m. So the information of SO₂ and NO_x is most intense in TM1 amongst the TM data, followed by TM2 and TM3, in which there is only slight responses, responses in TM4、TM5、TM6 and TM7 are hardly found. This characteristic makes gas contaminant spectrally different from the other

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