Research on Monitoring System Based on Crowd Sports Health and Regional Geological Environment

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Abstract. The paper proposes remote sensing on the monitoring of mine geological environment in important mining areas, the risk assessment of landslides in the mining area, the feasibility study of land reclamation in the mining area, the monitoring of tailing ponds and the safety assessment, etc. Monitoring and comprehensive evaluation methods provide new technical means for mine geological environment supervision, which can further strengthen the timeliness of mine geological environment supervision in China, and thus promote remote sensing technology to play a greater role in mine geological environment monitoring.

Key words. Mine geological environment, resource damage, geological disaster, early warning, risk assessment, movement, health.

1. Introduction

The geological environment of a mine refers to the distribution of rocks, groundwater and biosphere in the deposit and its surrounding area, and the overall situation of material exchange and energy flow with the surrounding environment. It is an important part of the geological environment and mining environment, and has a closer relationship with human production and life. The rapid development of China's mining industry, while providing important material guarantees for economic and social development, can accumulate many geological environmental problems for the health of people's sports, and is directly related to the safety of people's lives and property and the sustainable development of social economy. Monitoring the geological environment of mines can effectively prevent dangerous hazards that may occur in various mine areas. In view of the outstanding mine geological environment problems in the current important mine concentration areas in China, the author selects mine geological environment monitoring, mine area landslide monitoring, mining area land reclamation feasibility study, tailings pond monitoring and safety assessment, etc. to carry out remote sensing monitoring methods, Provide new technical means for mine geological environment supervision, and in this way promote remote sensing technology to play a greater role in mine geological environment monitoring, and further promote the timeliness of mine geological environment supervision in China.
2. Monitor target tasks
By carrying out mine geological environment monitoring, we will further understand the mine geological environment problems and their hazards, grasp the dynamic changes of the mine geological environment, and predict the development trend of the mine environment. Provide basic data and basis for restoration and reconstruction, implementation of mine geological environment supervision and management. Specific work tasks should include the following aspects: (1) Carry out geological environment monitoring of individual mines and mine geological environment monitoring of regional concentrated mining areas or group mining points; (2) Establish mine geological environment monitoring database and information system; (3) Analysis, processing and sharing of mine geological environment monitoring data; (4) Mine geological environment quality assessment and prediction; (5) Proposed mine geological environment management control measures and mine geological environment comprehensive management countermeasure suggestions; (6) Preparation of mine geological environment monitoring annual report; (7) Provide information services on mine geological environment to the society [1].

3. Monitoring data-driven technology

3.1. Concept analysis
Data drive originates from the computer field, which is mainly guided by the data in the database when programming. Starting from the facts of the existing problems, based on a large amount of intermediate data, combined with data processing and analysis methods (wavelet analysis, multivariate statistics, etc.) to obtain effective information from a large amount of raw data, to achieve data forecasting, data evaluation, data monitoring and diagnosis Multiple goals. This concept has only recently appeared in the field of geological disaster mitigation and prevention. Due to the complexity of geological information and the difficulty of model construction, it is necessary to comprehensively utilize massive geological disaster related data and achievement information, such as expert knowledge base, etc., and combine it with multi-source real-time monitoring data realized in recent years to realize the system The functions of early warning and forecasting, decision-making and optimization of geological disasters based on massive data are the application of dynamic data driving in geological disasters [2].

3.2. Conception of the geological environment monitoring system
The dynamic feedback between the measured data and the simulation system is the most obvious sign in DDDAS, which is mainly reflected in two aspects: one is to import the original data into the simulation system to reflect the original characteristics of the data; the other is to obtain the results To adjust the actual measurement points of the original system so that it can adapt to changes in the site environment. The main value of the design paradigm of DDDAs lies in the symbiotic feedback generated by the application system and the measurement system. The basic idea is shown in Figure 1.

![Figure 1. Conception of dynamic data-driven application system](image-url)
4. Remote sensing monitoring content of mine geological environment in mining area

4.1. Remote sensing monitoring factors
Starting from the sources and manifestations of mining geological environmental problems caused by mining activities, the ore material composition, solid waste material composition, stope / solid waste spatial distribution, landform slope, ground deformation damage degree, geological remains / landscape damage etc. as remote sensing monitoring factors for mine geological environment in important mine concentration areas.

4.2. Remote sensing monitoring factors for landslides in mining areas
In addition to the geological / geomorphological indicators, geographical indicators and ecological indicators that are closely related to landslides, the factors that affect the danger of landslides in the mining area are also the intensity of human activities such as mineral resource development.

4.3. Monitoring of the degree of surface deformation and damage
There are many techniques for observing surface deformation using traditional methods, such as subsurface fine observation methods such as bedrock marks, surface observation methods for levelling, and GPS technology. A set of more mature technical methods have been formed and the observation accuracy is higher. However, these methods require a lot of field work. Specifically, for Heilongjiang Province, due to the special geographical conditions, the operability of areas that are difficult to reach is poor, so higher requirements are placed on the monitoring technology of surface deformation and damage. Interferometric radar is a new technology developed in recent years to detect surface deformation and destruction, and has high detection accuracy [3].

4.4. Ground fissure identification and monitoring
The ground fissures generated by the mine development have changed the surface geometry, landform features and spectral features, such as slope and aspect changes. This change caused the difference in the reflectance spectrum of the ground objects, and the resulting weak change information can be reflected on the remote sensing image. Specifically, the generation of ground fissures changes the characteristics of the surface soil of the disaster body and its surroundings, resulting in changes in local image texture and spectral characteristics, such as changes in the spatial distribution and growth of plants, causing the ground fissure disaster body and its surrounding features Differences in image tone, etc.

4.5. Remote sensing monitoring of goof collapse
Goof collapse is one of the types of disasters that are easy to occur in the mine area. The main reason is that during the underground excavation, the soil and rocks above the excavation channel fall due to gravity, causing the ground to collapse. Due to the different mineral types and mineral content in the mining area, the degree of surface subsidence is also different. This can be clearly reflected in the remote sensing image. In the TM image, the image of the collapsed area will have obvious oval plates or ring-shaped spots. These plates and spots will appear light or dark due to different mineral element contents and different underground depths. As shown in Figure 2, it is the technical process of remote sensing monitoring of the mine geological environment in important mine concentration areas [4].
Figure 2. Technical process of remote sensing monitoring of mine geological environment in mining area

5. System implementation

To successfully build a geological hazard monitoring and early warning system based on dynamic data, it is necessary to solve the dynamic data-driven monitoring curve fitting analysis, dynamic warning model selection, real-time early warning analysis and feedback adjustment, and platform database on the overall architecture design of the system. And key technologies such as the construction of models and the management of early warning scheduling. 5.1 Dynamic data-driven monitoring curve fitting analysis

The most direct information response in the evolution stage of geological disasters is the monitoring curve; however, because the monitoring data is disturbed by various factors, the information displayed by the curve will be distorted or even wrong. Therefore, for the processing and analysis of historical monitoring data, a series of time series processing methods (such as error elimination, interpolation, etc.) must be used; in addition, statistical analysis and filtering can be used to achieve trend fitting based on historical monitoring data Analysis, and then through the real-time monitoring data to dynamically modify, to provide reliable data for the classification of disaster warning and its stability assessment. Table 1 shows the classification of landslide warning levels [5].

| Warning level | Grade IV | Level III | Grade II | Level I |
|---------------|-----------|-----------|----------|---------|
| Deformation rate $v / (\text{mm} \cdot \text{d}^{-1})$ | $\geq 3$ | $\geq 10$ | $\geq 20$ | $\geq 20$ |
| Rate increment $\Delta v$ | No judgment | No judgment | $\leq 0$ | $\geq 0$ |
| Landslide status | Non-hazardous | Basically stable | Low risk | Medium risk |
| Risk level | Stable | Under stable | On-site monitoring of landslides to determine the development of landslide macro-deformation and the development characteristics of cracks and stagger, and prepare for landslide avoidance measures | Unstable | High risk |
| Related measures | Pay attention to deformation development and monitor regularly | Pay attention to the development trend of landslide deformation and maintain a higher frequency of on-site periodic monitoring | While maintaining close monitoring, evacuate all persons within the possible impact area of the landslide to avoid landslide hazards | |

Table 1. Classification of landslide warning levels
5.1. Data monitoring algorithm
Firstly, model the geological data in scale space:

\[
L(x, y, t; \sigma_l^2, \tau_l^2) = g(x, y, t; \sigma_l^2, \tau_l^2) * I
\]  

(1)

Among them, \(I\) is geological data, \(\sigma_l^2\) and \(\tau_l^2\) are scale factors of space and time, \(g(x, y, t; \sigma_l^2, \tau_l^2)\) is separable space-time Gaussian smoothing filter, and convolution operator. Then construct a \(3 \times 3\) space-time second-order moment matrix [6]:

\[
\mu = g(\sigma_l^2; \tau_l^2) \begin{bmatrix} L_x^2 & L_xL_y & L_xL_t \\ L_xL_y & L_y^2 & L_yL_t \\ L_xL_t & L_yL_t & L_t^2 \end{bmatrix}
\]  

(2)

Among them, \(L_x, L_y, L\) are the first-order partial derivatives of \(L\) in the direction of \(x, y, t\) respectively, defined as

\[
L_\xi(\sigma_l^2; \tau_l^2) = \partial_\xi (g * f)
\]  

(3)

Get the spatiotemporal feature point detection function:

\[
H = \det(\mu) - k * \text{trace}^3(\mu) = \lambda_1 \lambda_2 \lambda_3 - k(\lambda_1 + \lambda_2 + \lambda_3)^3
\]  

(4)

Where \(\lambda_1, \lambda_2, \lambda_3\) is the eigenvalue, and the \(k\) value is determined by the ratio \(\alpha\) of the eigenvalues. To ensure that \(H\) takes the local positive value \(k \leq \alpha / (1 + \alpha)^2\), usually \(k\) is 0.04. If \(H\) is a large local positive value, the corresponding point \((x, y, t)\) in the video stream is the spatiotemporal feature point. The response function is defined as:

\[
R = (I * g * h_{ev})^2 + (I * g * h_{od})^2
\]  

(5)

Among them, \(I\) is geological data, \(g(x, y, \sigma)\) is a two-dimensional spatial Gaussian smoothing filter, and \(h_{ev}\) and \(h_{od}\) are one-dimensional Gabor time-domain filters.

5.2. Main R & D technologies of system construction
Based on the overall design of the dynamic data-driven geological disaster monitoring and early warning system architecture, on the basis of dynamic data-driven monitoring curve fitting method and real-time early warning dynamic feedback mechanism and other theoretical studies, database technology, geographic information system technology and web technology are used The technical realization of key issues in the construction of a dynamic data-driven real-time monitoring and early warning system platform for geological disasters. Figure 3 shows the functional block diagram of the geological disaster monitoring and early warning system [7].
The overall architecture design of the geological disaster monitoring and early warning system includes the basic database layer, data intermediate processing layer, general module layer, professional function business layer and user-end presentation layer. Through the WCF data service, the system constructed a monitoring data synchronization system to achieve data cleaning. Through the client technology, a data display system is constructed to realize dynamic data display. The processing of real-time monitoring data of geological disasters is the key to successful early warning. It mainly involves dynamic processing of monitoring data, real-time curve drawing, standardized processing of monitoring data, and design and implementation of data service flow. The main functions of the geological disaster monitoring and early warning system include real-time monitoring data integration module, dynamic data processing and analysis module, model calling and result display module [8].

6. Conclusion
In the face of numerous remote sensing data, it is necessary to scientifically select data sources in response to the monitoring needs of different mine geological environmental problems, and strive to maximize the "cost-benefit ratio". Build an efficient, universal, and reliable monitoring system, establish demonstration and related standard specifications for monitoring and comprehensive evaluation of mine geological environment, and comprehensively promote the comprehensive application of spatial information technology with remote sensing and geographic information system as the core in remote monitoring of mine geological environment, directly serving the sustainable development of the mining area, has important practical significance.

References
[1] Ning, D., Zhao, X., & Hu, J. Monitoring method of waste rock field slope of gongchangling open pit mine. Journal of Liaoning Technical University, 36(2) (2017) 132-136.
[2] Özhatay, N., Koçyigit, M., Brullo, S., & Salmeri, C. Allium istanbulense, a new autumnal species of, a. sect. codonoprasum, (amaryllidaceae) from turkey and its taxonomic position among allied species. Phytotaxa, 334(2) (2018) 152.
[3] Bithin Datta, Frederic Durand, Solemne Laforge, Om Prakash, Hamed K. Esfahani, & Sreenivasulu Chadalavada. Preliminary hydrogeologic modeling and optimal monitoring network design for a contaminated abandoned mine site area: application of developed monitoring network design software. Journal of Water Resource & Protection, 8(1) (2016) 46-64.
[4] Paul Ebenebe, Karabo Shale, Moosa Mahmood Sedibe, Matthew Achilonu, & Tikili P. South african mine effluents: heavy metal pollution and impact on the ecosystem. International Journal of Chemical Sciences, 15(4) (2018)18-22.
[5] Kieninger, E., Yammine, S., Korten, I., Anagnostopoulou, P., Singer, F., & Frey, U., et al. Elevated lung clearance index in infants with cystic fibrosis shortly after birth. European Respiratory Journal, 50(5) (2017)1700580.
[6] Gwendolyn E. Davies, & Wendy M. Calvin. Quantifying iron concentration in local and synthetic acid mine drainage: a new technique using handheld field spectrometers. Mine Water & the Environment, 36(2) (2016) 1-11.
[7] Tianbo Yu, &Xin Chen, &Yue Wang. Effect of Organic Food Vitamin Protein Supplementation on Athletes’ High-intensity Energy Consumption Recovery, ARCHIVOS LATINOAMERICANOS DE NUTRICION, 69(6) (2020) 141-148.
[8] Úmran Seven Erdemir, Hülya Arslan, Gürçan Güleyüz, & Şeref Güçer. Elemental composition of plant species from an abandoned tungsten mining area: are they useful for biogeochemical exploration and/or phytoremediation purposes? Bulletin of Environmental Contamination & Toxicology, 98(3) (2016) 1-5.
[9] Kumari Soniya, & Amalendu Chandra. Free energy landscapes of prototropic tautomerism in pyridoxal 5'-phosphate schiff bases at the active site of an enzyme in aqueous medium. Journal of Computational Chemistry, 39(21) (2018) 13-22.