

# Application of Remote Sensing monitoring Technology in Mine Development

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**Abstract:** From the Remote sensing data source, technical route, and method, the remote sensing interpretation method for Different mining methods, and different types of remote sensing data in remote sensing monitoring for mine development A Re mainly discussed and summarized. The main conclusions are:for Open-cut mines, in the high and medium spatial resolution RE Mote sensing images, the direct interpretation method is adopted, and in the low resolution remote sensing images, the Direct Interpretationmethodis adopted;for underground mines, in the High resolution IM Age, the direct interpretation method is adopted, and in the medium and low resolution image, the indirect interpretation Method is adopted! The using multi-phase images for comparison analysis is an important indirect method. Finally, some suggestions are given for the problems of the application.

**Keywords:** mine development ; Remote Sensing monitoring! Remote Sensing interpretation method ; Images contrast analysis

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## Introduction

Remote Sensing technology has a macro , Dynamic , Objective Advantages <sup>1</sup> , Using remote sensing technology , Develop Remote Sensing survey and monitoring of mineral resources development , Get Mineral resources development like condition \_ hand data , to provide skills for rectifying and standardizing mineral resource development orders support , Achieving effective supervision of regional mine development order , Promote mine health and sustainable development the [2-3].

the variety of remote sensing data currently used in mine development survey , space is divided into resolution from 0.5 m to 5 m unequal , has analog true color images and Black-and-white shadow like , same \_ class mining mining in different remote sensing image features often not \_ like , at the same time different mining types , Mines of different mining methods on the same kind of remote sensing images behaves differently .. so , Mine Development Status Remote Sensing survey and monitoring Interpretation flags varied , Interpretation methods diverse . This article takes the mining environment monitoring item of Guangdong province Mesh As example , discusses data sources for remote sensing monitoring of mine development conditions , Technical route and Skills Method , and focuses on and summarizes different mining methods , different remote sensing data types Mine Development Status Remote sensing interpretation method ,finally put forward the problems in the application has some suggestions .

## 1. Remote sensing data source

Remote Sensing survey and monitoring of mining development status in Guangdong province ' , ' Guangdong Mining Ring Border monitoring " items from 2012 year start , currently in session 3 year , its remote sense data from national land Change survey and monitoring remote sensing data , for forward correction

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Data , data types include : Pleiades 1 (P1), W . rldview1 (WV1), W. rld- View2 ( WV2),WorldView 3

( WV3), GeoEye1 ( GE ), QuickBird ( QB ), Ikonos ( IK ), spot5, spot 6, high score 1 ( GF 1 ), Resource 3 ( ZY3 ), Day Painting ( TH 1 ), Resource 1 no c ( c ), RapidEye ( RE ), Remote Sensing 2 ( YG 2 ), Remote Sensing 8 ( YG 8 ), Remote Sensing ( YGa ), and so on . Large by Space resolutions small , roughly divides the above data into 3 class :

1) High resolution data : Space resolution better than 1 m data , including P 1, WV 1, WV 2, WV 3, GE , QB , IK . This class of data has good overall quality , Textured Clear Blur , color uniformity , Contrast moderate , not only to identify open pit mining , yard , Mining construction , for underground mining mine also has a good reflection <sup>[4\_5]</sup>.

2) Medium resolution data : Spatial resolution 1.5 m ~ 2.5 m , includes spot5, spot 6, GF 1, ZY 3, TH 1, C . The solution of this kind of data to underground mining translation more difficult , But there is a more intuitive reflection of open mining <sup>67</sup>.

3) low-resolution data : Spatial resolution 5 m, including RE , YG 2, YG 8 , YG 14. This class data spatial resolution is lower, texture information poor .

## 2. Technical Route

on the basis of the set up interpretation flags , to extract using human-computer interactive interpretation Mine development status information , in the annual mining rights with Guangdong province , Prospecting right composite to score analysis based on , Extract annual mineral suspected illegal survey , mining spot type , Quantity ,, involving mines etc , and field verification , formation of suspected illegal map statistics Summary table , compiling suspected illegal maps of minerals <sup>[8]</sup>. Mine development status information Extraction Technical Process , the is shown in Figure 1.

## 3. Remote Sensing information extraction method

### 3.1 Information Extraction

The interpretation of the Remote Sensing survey of mineral resource exploitation mainly includes :

- 1) Mineral mining point ( or face ) location ( wellhead , ) Cave , open field , Live Mining area ;
- 2) mining status ( mining , shutdown or shutdown ;
- 3) Mining seed ( iron , lead and zinc ;
- 4) Mining method ( open air , Underground , Union ;
- 5) Mining order ( cross-border mining , undocumented mining .

### 3.2 To interpret flags to establish

based on remote sensing image color , Shape , size , Shadow pattern , location, and so on , To establish a mineral capital Source Mining point ( or face ) location , Mining Status ( Mining , To stop or close the ), Mining Interpretation flags for minerals such as mines . due to remote sensing data diversity , Mining diversity , so no possible to establish interpretation of all remote sensing data for all mines , can only be established \_ like , Pass with interpreter sign , details below :

1) Mining mine : Open- Pit Mining mining face on remote sensing image hue render white , lime , gray tones , lower than surrounding terrain , pattern roughness , Mining mine Mountain has a road interspersed with a mining site , visible on high-resolution images transport vehicles and excavators ,, Mining construction etc . on low-resolution images , for small mines or not directly determine mining status , can be judged by multi-phase image comparison .

2) shutdown or abandoned mines : first , in General, the water content of the shutdown site is more than positive in mining stope high , pits are visible , Remote sensing images are more tonal than you are. mining field Dark , second , not visible hook machine , vehicles . Multi-phase image contrast does not change or not very significant .

3) cave position judgment : Underground mined cave location is more discreet , To directly sentence more difficult , can be judged by indirect flag , such as the decapitation track near the cave or roads , section building a strip

shed , ore heap , Solid Waste yard , freight car, and so on ( See figure 2) .

### 3.3 Remote Sensing interpretation method 3.3.1 Direct Interpretation

for opencast mining , on high-resolution remote sensing images , Mining Site , mine Mountain Construction , Mining Road , solid waste and so on have a clear interpretation sign , mining Mine also visible transport vehicles , Mining Machinery , hook up and so on , image features are significantly , Combined Mining rights ,prospecting rights information , generally can directly determine whether or not suspected illegal mining mines Mountain . on Medium resolution remote sensing images ,stope of large opencast mining , mine building , mine roads etc also more obvious , can be interpreted directly by means of a no suspected illegal mines . on low-resolution remote sensing images , mining scars trace not obvious , usually interpreted by indirect interpretation .

for underground mining , on a high-resolution image , Mining Building , Mining Road way , Transit site , Clear interpretation of solid waste such as , with strip rails , The solid waste yard at the cave site determines the location of the cave , and can sometimes be directly delineated Cave location , A small shadow on the edge of the mountain is likely to be a cave. , through image Tint , The vehicle on the image can directly determine the mining status and whether it is suspected illegally exploiting patches . in the ,low-resolution image on , Mining in underground mines state hard to determine directly , requires indirect interpretation of .

### 3.3.2 Image contrast analysis

Mine development situation that is difficult to interpret directly , Multi-phase Image contrast analysis is an important way to determine the status of mine development . Multi-phase image contrast analysis method main needle on two cases : \_ is new spot , Two is to enlarge the speckle . New patches are on the top one year without peeling marks , and in that year there are peeling marks , and can determine that the stripping soil is not due to wasteland cultivation , geo-hazards etc cause . New patches generally have roads access . table 1 top row image for new two phase image contrast change and field photo

Slice , The previous year is 2013 Year , The next year is 2014 Year , from image contrast Change to see , top row Patch Two image contrast unchanged , Next patch two Image contrast to new patches , and road access , From the spot mining traces of the map to the Tao Clay , Field investigation the surface of the patch is fresh . , hook Machine traces clear , is undocumented Mining ceramic soil . Enlargement of the speckle means that the annual patch range is greater than the previous year with a significant extended , and the patch tint is rendered white , Gray , is exploiting a large probability . table 1 next row image to enlarge the two-phase image contrast and field photo of the speckle , previous year 2013 Year , The next year is 2014 Year , you can see from the diagram that 2014Year Chart patches are significantly enlarged , and image tint White , has access to the road , mining traces from patchesjudged ceramic soil , field Survey the surface of the patch is freshly mined . , hook machine trace Clear show , for undocumented mining of ceramic soil .

### 3.3.3 Mining mine decision

The determination of mining species is mainly combined with mining rights , prospecting Rights , Guangdong Mineral Resources distribution features , Comprehensive decision on remote sensing image features . open pit Mining more sand , stone , Clay , Ceramic soil , rare earths , iron ore, etc. , Underground mining is lead-zinc mine ,Tungsten Ore etc , Rock Farm , Ceramic Soil , rare earths , The image features such as iron ore are significantly , Mining decisions are more tolerant of Easy , Indoor interpretation cannot be determined , to further determine the based on field investigation .

## 4. Problems and recommendations

### 4.1 has a problem

through the 3 Annual Remote Sensing survey and monitoring of mine development in Guangdong Province open Fair , achieved a series of results , But there are also \_questions , main :

1) Interpretation result Accuracy Reconciliation Translator professional knowledge , Image resolution etc there are Big Relationship . same area , Same class remote sensing image data professional knowledge lack people to interpret , interpretation results often wrong , angered high rate , and a solid knowledge of the "" "Interpretation of the result is often higher. " . for high-resolution image distribution area , each class interpretation flag obvious , Interpretation Results High accuracy , Medium resolution image range domain , Open-pit mining mine interpretation results high accuracy , and underground mine interpretation results less accurate , Low resolution image distribution area either for Open-pit mines Mountain or underground mining mine interpretation results angered , error rates are relatively large .

2) mining cycle short , process simple ores , such as building materials , Ceramic soil , rare earths etc , the end of the Field survey is often mined or no staff , , devices , not and Use remote sensing monitoring when . Building Material class , Ceramic soil , Rare earth mines , Mining week period short , process simple , often takes months to exploit , and field survey One in the end of the year and the beginning of the second year of the . so , field survey , suspected illegal exploitation Point no miners or devices ,causes illegal subject to be unknown , to effectively crack the law Mining people with difficulty , also failed to play the role of remote sensing monitoring in time .

#### 4.2 recommendation

for the above problem , The author makes a few suggestions :

1) for interpretation results Reconciliation Translator Professional Knowledge , Image resolution etc There are more questions , Recommendations on the one hand establishing systematic remote sensing survey of mine development status with monitoring technical standards , enhancing professional training , on the other hand launch field The field investigation intensity of the middle and low resolution image distribution area is increased in the survey , Special Don't be for underground mining area <sup>9</sup>.

2) for mining cycle short , process simple mines , recommended dynamic monitoring , which region collects data , which region gives priority to remote sensing monitoring , You do not have to wait until All province data is collected , at the end of the year, the, strive to have the 3 ~4 Secondary test . with more domestic satellite data ,as resource number C <sup>ten</sup>, High- grade columns " Resources 3 number , Day-painting series , Remote Sensing satellite series , ability to obtain remote sensing data getting bigger , This requirement can be fully met , can also greatly promote domestic satellites apply .

## 5. Conclusion

This paper describes the types of data sources for remote sensing monitoring of mine development status , Technical Road Line and technical methods , and focus on different mining methods , different remote sensing data types Mining Status Remote sensing interpretation methods and problems existing in application and construction, come to the conclusion :

1) for opencast mines , on high , Medium Resolution remote sensing images , can be adopted with direct interpretation method , on low-resolution remote sensing image , The uses the indirect interpretation method .

2) for underground mines , on high-resolution images , can take the direct Interpretation method , in , low-resolution image on , the uses the indirect interpretation method .

3) Multi-phase Image contrast analysis is an important indirect solution to determine the status of mine development translation Method .

4) to increase the accuracy of interpretation by remote sensing , Strengthening technical standards in work , strengthening Professional training , , , low-resolution image distribution is appropriate to increase field investigations .

5) on mining cycle short , process simple mine recommended domestic satellite

count dynamic monitoring , for each year to have the 3 ~4 monitoring .

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