Application of Remote Sensing Technology in Land Use Survey of Mining Area

Zhang Yao1, 2, Guo Shaoqiang1, Yuan Kekuo1, Han Shunli1, Hu Zaiqiang*1

1Shaanxi Key Laboratory of Safety and Durability of Concrete Structures, Xijing University, Shaanxi, Xi'an, 710123, China.
2Institute of Water Resources and Hydro-electric Engineering, Xi'an University of Technology, Xi’an 710048, China.
*Corresponding author’s e-mail: huzq@xaut.edu.cn.

Abstract. Land Use and Cover Change (LUCC) survey is an important content to understand and study regional ecological environment change. The production and construction of coal mine will have an impact on the local ecological environment. The application of remote sensing technology to select high-resolution images, man-machine interactive interpretation method combined with field investigation verification was used to carry out LUCC in the study area. The current situation investigation can quickly and accurately grasp the land use types and distribution characteristics of the study area, and provide a reference for the rational land development and ecological environment protection in the process of coal mine production and construction in the future.

1. Introduction
Land use and Cover Change (LUCC) has been recognized as the main factor of human activities affecting global change. Land use and Cover Change (LUCC) caused by human activities is the main driving force of ecological environment and climate change, and also has a significant impact on the sustainable development of human society. The diversity and intensity of land use types have led to local and regional climate change, soil degradation, and changes in ecosystem services. With the development and maturity of remote sensing, GIS and other technologies, the combination of satellite remote sensing data with traditional maps and ground survey is widely used in LUCC research, which significantly speeds up the classification, monitoring and evaluation of land use and cover change. For the coal mining area, due to the intense role of mine construction and mining activities, the regional land use situation will inevitably change.

2. Overview of the Study Area
Fangjiapan coal mine is located in the middle of Yushen mining area in Northern Shaanxi, at the junction of Yuyang District and Shenmu county in Yulin City, about 70 km away from the northeast of Yuyang District, with a mining area of 32.6987 km². The study area covers an area of 46.94 km². The study area is located in the middle reaches of the Yellow River Basin arid and semi-arid climate transition zone, the southeast edge of the Mu Us sandy land, the ecological environment is fragile, land desertification is the most prominent, seriously restricting the sustainable development of the regional economy.
3. Preparation of Remote Sensing Data

3.1 Selection of Remote Sensing Data
Taking the ZY-3 satellite image on May 3, 2014 as the information source, the remote sensing image has no cloud cover and has good quality, which is conducive to land use information extraction. At the same time, the vector data also uses 1:50000 Topographic Map.

3.2 Remote Sensing Image Production
In order to make full use of the high spatial resolution of the panchromatic band of ZY-3 satellite and obtain satellite images with rich color and high spatial resolution, envi image processing software and image fusion technology are used. The image processing process is shown in Figure 1.

Based on the characteristics of ZY-3 satellite image, the bilinear interpolation method is used to correct the 2.1 m panchromatic image.

\[ X = a_0 + a_1 + a_2 y + a_3 x + a_4 xy + a_5 y^2 \]  \hspace{1cm} (1)

\[ Y = b_0 + b_1 + b_2 y + b_3 x + b_4 xy + b_5 y^2 \]  \hspace{1cm} (2)

Where: X and y are the coordinates of the original image before correction; x and y are the coordinates of the image after correction. \( a_n \) and \( b_n \) (n = 1, 2, 3, 4, 5) are quadratic polynomial coefficients, \( a_0 \) and \( b_0 \) are quadratic polynomial constant terms. Bilinear interpolation (Bilinear) is used to resample pixels, and the correction error is less than 0.5 pixels. In order to more truly reflect the ecological and environmental factors on the surface, this work selected the true color band synthesis scheme of 3, 2, 1 + PAN, and used ENVI and Photoshop software interactive adjustment method to adjust the image color, and make the basic image of remote sensing interpretation.

3.3 Establishment of Remote Sensing Interpretation Marks
According to the classification standard of land use status issued by the Ministry of land and resources (GB/T21010-2007), combined with the actual situation of field investigation. The land use/land cover types in the study area are divided into 9 categories: cultivated land (including irrigated land and dry land), forest land (including woodland, shrubbery and other woodland), grassland, industrial land, mining land, rural residential land, transportation, water and water conservancy facilities land, and other land (including idle land and sandy land) in the study area.

4. Results and Analysis
The study area is located in the middle of the farming pastoral ecotone in North China, which is the transition zone between desert grassland ecosystem and dry grassland ecosystem. The land use pattern is closely related to the local natural environment. The main land use types are woodland and grassland, and other types of land use account for a small proportion. The statistical results are shown in table 1.
Figure 1. Flow Chart of Image Fusion Processing

Table 1. Statistical Results of Land Use Type Area

| Land Use Types                           | S/km²  | η/(%) |
|-----------------------------------------|--------|-------|
| Cultivated Land                         | 2.72   | 5.80  |
| Woodland                                | 22.66  | 48.27 |
| Grassland                               | 16.05  | 34.19 |
| Industrial Land                         | 0.39   | 0.83  |
| Mining Land                             | 0.22   | 0.47  |
| Residential Land                        | 0.33   | 0.70  |
| Land for Transportation                 | 0.54   | 1.15  |
| Land for Water Area and Water Conservancy Facilities | 0.52   | 1.11  |
| Other Land                              | 0.51   | 7.48  |
| Total                                   | 46.94  | 100.00|

The forest land is distributed on the sand covered loess beam surface and semi mobile and semi fixed sand dunes. The vegetation is mainly Pinus tabulaeformis, Robinia pseudoacacia, Sabina vulgaris, Artemisia annua and Caragana korshinskii, covering an area of 22.66 km², accounting for 48.27% of the study area. Grassland is also widely distributed in the study area. The vegetation is dominated by long grass, with an area of 16.05 km², accounting for 34.19% of the study area. Agricultural production is the main production in this area. The cultivated land is mainly concentrated in the river terrace in the middle of the study area, with an area of 2.72 km², accounting for 5.8% of the research area. Due to the production and processing of coal, industrial land and mining land also account for a certain proportion. Mining land is distributed in the middle and east of the study area, which is used for coal mine surface production facilities and for quarrying and sand excavation. The mining area is small, and the mining area is small, and the mining area is small. Other land includes free land and sandy land, which are mainly distributed in the northern part of the study area, for planning and building use, and has not yet started construction; the sandy land is mobile sand land, basically without vegetation growth on the surface, distributed in the southern and eastern boundaries of the evaluation area.
At present, the distribution area of woodland and grassland is large, but the overall vegetation coverage is not high. Moreover, the study area is located in the Gobi desert and sandy sand area of "Three North", with strong wind erosion. There are certain mobile sand dunes distributed in the southern and eastern boundaries. Therefore, in the future production and construction of coal mines, it is necessary to strengthen the management and protection of ecological environment in the mining area, and around the mobile sand dunes it is necessary to plant sandy vegetation to prevent the expansion of mobile sand dunes. Water retaining coal mining measures should be used in underground production. Vegetation restoration should be carried out in the subsidence area of coal mining in time, so as to reduce the damage of local ecological environment caused by coal mining.

5. Conclusion

1) The processed remote sensing images of ZY-3 satellite were used to understand and translate the land use status of the study area. The remote sensing image characteristics of various land use types in the area were summarized. Combined with the field investigation and verification, the land use situation in the study area was identified. Among the various land use types in the study area, the distribution area of woodland and grassland was the largest, and the overall vegetation coverage was medium, and there was flow. In the future, the mobile sand dunes should be transformed in the coal mine production and construction, and the surface vegetation should be restored to maintain the sustainable development of the local ecological environment.

2) Remote sensing technology has the characteristics of wide coverage, strong macroscopicity and small limitation by ground conditions, which plays a great advantage in practical work. Through image processing, abundant ground information can be intuitively presented from the image map, which greatly reduces the workload of field investigation and improves the efficiency and accuracy of work. Land use survey based on remote sensing technology can intuitively, quickly and accurately grasp the current situation of land use in mining area, and provide a decision-making basis for reducing the impact of coal mine production and construction on the environment.

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