Remote Sensing Image Processing Assisted Based on Computer Digital Technology

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Abstract. With the rapid iteration of computer digital tech, the processing level of remote sensing image has made outstanding achievements and progress, which greatly improves the processing level and ability of remote sensing image. Therefore, the research on remote sensing image processing assisted by computer digital tech has important practical value. Based on this, this paper first analyzes the digital characteristics and properties of remote sensing image, then studies the remote sensing image processing process based on computer digital tech, and finally gives the development trend of remote sensing image processing based on computer digital tech.

Keywords: Remote Sensing Image (RSI), Computer, Digital Tech, AI

1. Introduction

With the iterative development of social economy, the infrastructure construction has made outstanding achievements and applications. The acceleration of urbanization and the rapid changes in all aspects of social life put forward higher requirements for the overall planning and decision-making. In this context, the application of Remote Sensing Image (RSI) has made great development opportunities. Based on RSI, it can provide decision-making basis and information integration for the use and planning of land and resources, the development of urbanization and infrastructure construction, so it has become the focus and hotspot of recent research. With the rapid iteration of computer digital tech, the processing level of RSI has made outstanding achievements and progress [1]. More and more new technologies based on computer are applied in the process of RSI processing, which greatly improves the processing level and ability of RSI.

In addition, with the continuous growth of Surveying and mapping requirements of the state and government, the demand for RSIs is also rising. On the one hand, in the quantitative level of RSIs, the application of many fields makes more and more RSIs need to be processed; on the other hand, some special and specific industries have higher requirements on the quality of RSIs, such as military, urban planning, earthquake resistance and disaster reduction industries have higher requirements for image quality.

As a tech based on obtaining physical attributes without direct contact with objects, remote sensing tech has a wide range of application scenarios. With the help of a variety of sensor equipment and
information transmission equipment, it can effectively extract the key attribute features of the sensed object. In this process, the electromagnetic radiation signal is usually transmitted, processed and extracted by means of the electromagnetic radiation characteristics of the observed object. The extracted key attribute feature information will be transmitted to the ground receiving station by the transmission equipment, and the ground processing equipment will process the data, and finally complete the recognition of the spectral characteristics of the ground objects.

With the rapid iterative development of computer digital tech, it plays a more and more important role and influence in RSI processing system. The application of computer digital tech in RSI processing is mainly reflected in two aspects: one is to obtain the image with the help of hardware equipment such as various sensors and processors, and the other is to realize the high-quality analysis and processing of the image with the help of relevant image processing software. It can be said that the RSI processing assisted by computer digital tech has gradually formed a systematic framework, and the quality and efficiency of RSI processing can be significantly improved by optimizing and reconstructing the software and hardware system. Therefore, the research of RSI processing based on computer digital tech has important practical value.

2. Digital characteristics and properties of RSIs

2.1. Digital features of RSIs

The digital feature of RSI is the RSI in digital form. As the basic unit of RSI, image pixel not only has spatial characteristics and attribute characteristics, but also has spatial location information and area. The expression of pixel attribute characteristics of RSI is realized by brightness, and the electromagnetic radiation intensity of ground target detected by sensor will determine and affect the specific pixel value of RSI. In addition, due to the different sensitivities of the sensors on the remote sensing equipment, there will be significant differences in the number of effective quantizations produced by different detection elements. This means that the effective quantization levels provided by sensor components of different remote sensing equipment are quite different, as shown in Table 1 below.

| Sensor type | Effective quantization series | Information content |
|-------------|-------------------------------|---------------------|
| MSS         | 64                            | 6                   |
| TM          | 256                           | 8                   |
| HRV(S)      | 256                           | 8                   |
| AVHRR       | 1024                          | 10                  |
| SAR         | 65536                         | 16                  |

In addition, the remote sensing digital image has the typical characteristics of easy computer processing, low loss of image information and strong abstraction. Among them, in order to facilitate computer processing, because of the use of digital images, it has a strong adaptability in the computer system. In the aspect of image information loss, digital RSI is not easy to be affected by transmission and distribution, so it is not easy to produce information loss and image distortion. The strong abstraction of digital RSI makes it more convenient to establish the analysis model, which is convenient to use the computer system for processing.

2.2. Digital expression of RSI

The digitization of RSI can be expressed as a matrix by sampling the continuous spatial variables into discrete values at equal intervals. According to the number of bands, remote sensing digital images can be divided into single band, multi band, binary and color digital images. In addition, multi band digital RSI is a kind of remote sensing digital image obtained from multiple bands based on sensor elements [2]. The storage and distribution of this kind of image often adopts three different data formats: BSQ,
BIP and BIL. Among them, BSQ data format is arranged according to the line number of each band, so it is more suitable for spatial access in a single spectral band. The BIP data format is based on the spectral band order for cross arrangement, so it can provide the best performance for RSI data spectrum access. BIL data format is a line by line and band by band format.

2.3. Sampling and quantization of RSI
Firstly, at the sampling level of RSI, the continuous gray information of RSI is transformed into a pixel combination with M cells in each row and N cells in each column, as shown in Figure 1 below. Secondly, in the attribute quantization level of RSI, the digital analog quantity of each pixel corresponds to the gray level of the corresponding position in the RSI. In addition, RSI can be digitized with the help of scanner, and the quality of RSI, sampling interval and attribute quantization accuracy will have a great impact on its digital quality.

![Image of spatial sampling of RSI](image)

Figure 1. Spatial sampling of RSI.

3. RSI processing based on computer digital tech

3.1. Multi feature extraction of RSI based on computer digital tech
In the RSI interpretation based on computer digital tech, in addition to the spectral features of the ground features, it also needs to use the shape features and spatial relationship features of the features, so it is necessary to extract other features of the image [3]. Boundary tracking is the premise of obtaining the morphological features of ground objects. According to the distribution characteristics of different objects, the boundary tracking methods are different. In the aspect of object boundary tracking algorithm, it mainly includes two aspects: the boundary tracking of point feature and area feature, and the boundary tracking method of area feature. The detection and tracking of linear feature information first needs to enhance the digital image. Through binarization, the pixels in the image are divided into linear features and background, and the initial linear feature map is obtained by noise elimination.

3.2. Shape feature description of RSI
A series of ordered boundary points can be obtained by boundary tracking [4]. These boundary points provide a lot of information about the shape features of surface feature elements. In order to facilitate the conversion between chain code and geographical coordinates, the origin of geographical coordinates is set at the upper left corner of the screen. The coordinate conversion method from chain code to pixel is shown in the following equation 1.
\[
\begin{align*}
X_n &= \sum_{j=1}^{n} a_{jx} + X_0 \\
Y_n &= \sum_{j=1}^{n} a_{jy} + Y_0
\end{align*}
\]

(1)

In which, \(X_0, Y_0\) is the coordinate of the starting point of the boundary; \(X_n, Y_n\) is the coordinate of the boundary point pointed to by the current chain code; and \(a_{jx}, a_{jy}\) is the \(a_j\) component in the \(x\) coordinate and \(Y\) coordinate respectively.

The conversion method from pixel coordinate to chain code is as follows:

\[
F(a_j) = \begin{cases} 
0, & (x_1 - x_0 = 1, y_1 - y_0 = 0) \\
1, & (x_1 - x_0 = 1, y_1 - y_0 = -1) \\
\vdots \\
7, & (x_1 - x_0 = 1, y_1 - y_0 = 1)
\end{cases}
\]

(2)

In which, \(x_1, y_1\) is the \(x\)-coordinate and \(y\)-coordinate components of the current point; and \(x_0, y_0\) is the \(x\)-coordinate and \(y\)-coordinate components of the previous point. At the perimeter level, the boundary information is recorded in the form of chain code:

\[
I_j = \left(\sqrt{2}\right)^n, \quad n = \text{Mod}(2, a_j)
\]

(3)

Curvature of linear features:

\[
C = \frac{L_a \times \sqrt{2}}{L}
\]

(4)

In which, \(L_a\) is the length of the line segment and \(L\) is the linear distance between the starting point and the end point of the line segment. In the level of spatial relationship extraction, the key to extract the inclusion relationship between point features and area features is to determine whether the point features are included in the area. Usually, the plumb line method and the ray method are used to determine whether the point features are in the area.

\[
D_{ij} = \sqrt{(x_i - x_j)^2 + (y_i - y_j)^2}
\]

(5)

3.3. RSI interpretation based on computer digital tech

RSI interpretation based on computer digital tech is mainly realized through the combination of pattern recognition and AI tech [5]. First of all, with the help of pattern recognition method to obtain a variety of features for RSI interpretation, and at the same time, AI tech is applied to simulate the specific thinking process of RSI visual interpretation for RSI interpretation. Secondly, RSI interpretation based on computer digital tech not only needs to process, classify and extract features of RSI, but also needs to form image interpretation knowledge base. Under the guidance of knowledge, RSI interpretation is completed by computer.

In addition, the RSI interpretation system based on computer digital tech is mainly composed of RSI processing and feature extraction subsystem, RSI interpretation knowledge acquisition system and RSI interpretation expert system. It should be pointed out that the RSI interpretation based on
computer digital tech cannot fully reflect the characteristics of ground objects in the image. Therefore, it is difficult to reduce the misjudgment rate if only relying on the hue or color features of RSIs. Therefore, it is necessary to extract multiple features of RSIs and comprehensively use these features to identify ground objects.

3.4. Development trend of RSI processing based on computer digital tech

The development trend of RSI processing based on computer digital tech mainly includes ANN network, wavelet tech, fractal tech and fuzzy classification method [6]. Among them, ANN has strong learning function, association function and fault tolerance function, which is suitable for simulating people's image thinking. The application of wavelet tech in RSI recognition mainly focuses on RSI compression, multi-resolution edge detection and stereo matching. Fractal tech can divide the RSI into two categories: regular man-made features and irregular natural features, and it can achieve good results in RSI data compression. In addition, the application of fuzzy classification method in RSI recognition is mainly to use the maximum likelihood ratio fuzzy classification method to classify the transition categories. From the process of computer aided digital tech, the processing process of RSI is shown in Figure 2.

![Image recognition](image-recogn.png)

Figure 2. Computer aided digital processing process of RSI.

4. Conclusion

In summary, thanks to the rapid iterative development of computer digital tech, it plays an increasingly important role and influence in RSI processing system. The application of computer digital tech in RSI processing has gradually formed a systematic framework. With the help of software and hardware system optimization and reconstruction, the quality and efficiency of RSI processing can be significantly improved. Based on the analysis of the digital characteristics and properties of RSI, this paper studies the digital expression of RSI and the sampling and quantization of RSI. Based on the research of RSI processing based on computer digital tech, the development trend of shape feature description, RSI interpretation and RSI processing is analyzed.

References

[1] Bian Yingchun, Zhou Jun, Zhu Wenjie. Application of remote sensing tech in hydrology and water resources [J]. Henan water conservancy and south to North Water Diversion, 2014, (01): 51-52.
[2] Chen Shiyu. On the application of Google Earth in land use monitoring [J]. Friends of science, 2012, (04): 158-159.
[3] Cui Jianghong. Application of RSI processing tech in surveying and mapping field [J]. Heilongjiang Science and tech information, 2015 (07): 18-19.
[4] Liu Tao, Chen Feng, Kang Jian, Zheng Yong. Application of remote sensing tech in hydrogeology [J]. Western exploration engineering, 2015 (04): 74-75.
[5] Pu Guoliang, Yang Wu Nian, Xu Ling, et al. New tech and method of digital regional survey [J]. Computer engineering and application, 2003; 39 (22): 53-55.
[6] Yu Ting. Discussion on the development and application of remote sensing tech in the field of Surveying and mapping [J]. Value engineering, 2014 (21): 52-53.