Full Convolutional Network Algorithm Improves the Accuracy of the Boundary of Orthographic Composite Images

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Abstract. In the past several "five-year plans", China has basically established the national, provincial and regional streets of basic geographic information database, and on this basis has carried on a certain degree of improvement. Based on deep learning, this paper aims at improving the boundary accuracy of the orthographic composite image based on the convolutional neural network algorithm. It mainly compares the effects of different parameters on the performance of the network model, and describes the training and testing performance of the model through the corresponding performance evaluation method. In the research and test, the detection accuracy statistics of internal industry encryption points and field control points with different scale accuracy were adopted. The results showed that the error in the DOM detection of new aerial images and satellite images was less than 3m and 9m, which met the technical requirements and improved the boundary accuracy compared with the plane accuracy of existing digital orthophoto images. Thus, it can be seen that the new production technical scheme of aerial image/satellite shadow DOM generated by enhancing the precision of the orthographic composite image boundary based on the full convolutional network algorithm under deep learning is efficient and feasible. The study not only improves the relevant theories, but also has some practical inspirations for future research.

Keywords: Full Convolutional Network Algorithm, Deep Learning, Orthographic Composite Image, Boundary Accuracy

1. Introduction
With the rapid development of information technology in recent years, image acquisition methods have become more and more flexible and convenient [1]. The synthesis and acquisition of useful information relies more on computer intelligence, and algorithms help us obtain and synthesize images [2]. So far, image processing has been playing an increasingly important role in the fields of information science, engineering technology, biomedicine, psychology and neuroscience [3]. The demand for intelligentization of computers promotes the continuous development of computer image algorithms, and the enhancement of computer processing capability provides a powerful hardware foundation for analyzing the content of image scenes, making image processing more efficient and
intelligent [4]. Among them, the accuracy of image boundary of orthographic synthesis is a very important issue in the field of computer vision, and it is also one of the foundations and keys of image analysis and understanding [5]. It can be used for target detection, image editing, image compression, image clipping, pedestrian positioning, etc. [6].

For a picture, human eyes can accurately distinguish the boundary of an object. The full convolution network algorithm based on deep learning to improve the accuracy of the boundary of ortho-synthetic images is to imitate the human brain and visual mechanism, accurately detect the boundary of an image, and accurately detect and segment objects [7]. In the early stage of the research, traditional detection methods generally adopt the contrast of low-level data feature information between pixels or pixel blocks, so as to judge the boundary [8]. However, for objects similar to the background, only some low-level pixel-based information is considered, while the deep semantic information and boundary accuracy of the whole object itself are ignored [9]. Therefore, the full convolutional network algorithm based on deep learning can improve the accuracy of image boundary of ortho synthesis [10].

In this paper, using basic geographic information database and related computer science professional information, based on the existing digital orthogonal projection as the new aviation image and remote sensing satellite image automatic registration for photo control point, and the image matching, regional net adjustment, image corrected quickly generate new method of digital orthogonal projection as are discussed in this paper. It is of certain theoretical and practical significance to analyze the accuracy difference of images with different resolutions under the condition of no field control, and to improve the accuracy of image boundary of ortho-synthesis based on full convolution network algorithm under deep learning.

2. Introduction of Relevant Theories

2.1. Human Visual Perception

Visual perception is the basic tool for human beings to know and perceive the objective world. Through the visual system, human perceiving and understanding the observed objects, the height, position, shape, size, direction, area and other geometric and physical elements of the scene, and understanding the spatial relationship and physical manifestation between human and the environment through objects and the color and brightness distribution of the scene and other elements. Among them, the overall cognition of human body to image is reflected by the distribution of image brightness and main tone. The distribution of image luminance includes the statistical distribution of the spatial distribution and dynamic range of the illumination during the imaging, while the dominant hue of the image refers to the overall color performance under the influence of the environment and the chromaticity of the light source. The human vision system forms the light source through the image, observes the object geometry and the surface reflection characteristic, the human eye and the brain together action forms the visual perception to the observed object or the scene.

2.2. Full Convolutional Network Algorithm

Convolutional network algorithm, originally designed to solve the problem of image recognition, has made breakthroughs in speech recognition, face recognition, motion analysis and other aspects in recent years. CNN mainly consists of four layers: convolutional layer, pooling layer, full connection layer and output layer. Each two-dimensional vector can be treated as an image and has a strong spatial correlation, and using individual pixels as input would break those correlations. Therefore, the input image is convolved with a number of different convolution kernels, and the bias is added to extract the local feature map, and each convolution kernel maps out a new two-dimensional graph. The output of convolution operation is processed by nonlinear activation function, and then pooling is carried out to retain the most significant features and improve the distortion tolerance of the model. After multiple convolutional layers and pooling layers, the obtained significant features are passed
through the full connection layer. Finally, mathematical statistics method or classifier is used to output the corresponding results. Where, the size of the output image is obtained by the formula.

\[ y = \frac{x - k}{\text{stride}} + 1 \]  

(1)

The mean square error function of the output layer is

\[ L(x, y) = \frac{(x - y)^2}{2} \]  

(2)

The loss function formula of CNN model for multiple training samples is

\[
J(w, b) = -\frac{1}{m} \sum_{i=1}^{m} [xt \log yt + (1 - xi) \log (1 - yi)]
\]  

(3)

3. Study the Technical Route

Based on the image update technology of existing geographic information and based on the existing digital orthophoto results as the image control foundation, the new aerial image/satellite image is automatically registered, matched and adjusted with the existing digital orthophoto results, and combined with the existing digital elevation model results, the digital orthophoto is quickly corrected and generated. Then the existing digital orthophoto is superimposed and compared with the newly generated digital orthophoto of aviation and satellite respectively, and the accuracy of the two newly generated digital orthophoto is detected and compared. Data processing cluster distributed parallel remote sensing image data processing module is used in multi-machine and multi-core mode. The interconnected workstations in LAN (including PC and high performance cluster computer) are communicated and cooperated by software, and the distributed processing of image data is completed jointly with certain task scheduling strategy, so as to realize the high degree of automation of image processing.

4. Accurate Boundary Analysis of Orthographic Composite Images

4.1. Orthophoto Nesting Inspection and Analysis

Using 1:50,000 framing as the basic unit, the new aerial image/satellite IMAGE DOM was checked for nesting with the existing orthoscopic image results, and the nesting accuracy was counted. The results were shown in Table 1 and Figure 1. It can be seen from Table 1 that the new aviation image/satellite IMAGE DOM generated by the method of improving the accuracy of the boundary of the orthographic composite image based on the full convolutional network algorithm under deep learning has a very small nesting error with the existing digital orthographic image, and the plane accuracy of the newly generated technology is equivalent to that of the existing digital orthographic image.

Table 1. The accuracy of plane position boundary nesting inspection is compared with the existing orthophoto results

| Serial number | Terrain category | Check points | Error in the frame |
|---------------|-----------------|--------------|--------------------|
|               |                 | Aerial images | Satellite imagery |
| P12           | The ground      | 38488        | 1848               | 1.860  | 6.219 |
| P13           | The ground      | 18414        | 1678               | 2.748  | 5.244 |
| P14           | The ground      | 19736        | 562                | 2.076  | 6.616 |
| P21           | The ground      | 19621        | 2532               | 2.088  | 4.835 |
4.2. Boundary Accuracy Detection and Analysis

4.2.1. Boundary accuracy detection scheme. DOM is a digital orthophoto data set generated by digital elevation model (DEM) through pixel by pixel projection correction and Mosaic in accordance with the scope of national basic scale topographic map. Orthophoto accuracy detection USES high-precision field control results as the basic data of sampling detection and comparison, and randomly selects 4 digital orthophoto images according to different factors such as terrain category for precision detection. The detection point should be selected as far as possible in the boundary areas such as road crossings with clear and predictable images. Among them, E31 map aviation DOM adopts 3 sets of data with two different scales for detection, and the accuracy statistics are calculated according to the mean error formula in high-precision detection according to GB/T 24356 "Provisions on Inspection and Acceptance of Surveying and Mapping Results".

4.2.2. Accuracy detection. Precision detection using the region 1:10000 encryption results and 1:2000 field control points, respectively, based on deep learning under the entire convolution network algorithm is improved synthetic image boundary precision method to generate new/satellite images shadow DOM test accuracy, all pass two levels of acceptance check level, conforms to the...
The accuracy of image boundary is a key step of computer processing such as image segmentation, image editing, image retrieval, target recognition, video tracking, scene analysis, etc., which can provide valuable reference information for its subsequent processing technology. The convolutional
neural network (CNN), is developed in recent years, and cause extensive attention of a highly efficient identification method, can be said to be the deep learning algorithm is one of the most successful field, its value lies in to the picture of the large amount of data dimension reduction effectively into small amount of data and does not affect the results, at the same time is similar to human visual principle, CNN can relatively intact image features. The convolutional neural network includes one dimensional convolutional neural network, two dimensional convolutional neural network and three dimensional convolutional neural network. One dimensional convolutional neural network is mainly used in sequence data processing, two dimensional convolutional neural network is often used in image text recognition, and three dimensional convolutional neural network is mainly used in medical image and video data recognition. With the development of multimedia technology, pictures and images have higher requirements for accuracy and will be more widely used in our real life. Therefore, it is of great significance to improve the boundary precision research of ortho-composite images based on full convolutional network algorithm under deep learning. In this study, the boundary precision study of orthographic composite images is combined with deep learning and comprehensive convolutional network, and good results are obtained.

5. Summary
As can be seen from the above researches, the deep learning method has a significant improvement compared with the traditional method in solving practical pattern recognition problems. In the research on the enhancement of the accuracy of the boundary of the orthogonal composite image by the full convolutional network algorithm based on deep learning, more attention is paid to the real-time performance, such as unmanned driving, which must be obtained in a very short time. However, the real-time performance is not always guaranteed by the huge server. Therefore, in the future, relevant research will gradually start to chip, which can greatly improve the accuracy and efficiency.

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