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Monitoring of Soybean Planting System by Image Remote Sensing Technology

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Abstract: With the rapid development of China's economy and society, soybean, as the most important food and oil crops, is planted all over the country and widely distributed in a large scale. However, due to the high cost of traditional manual monitoring methods, moreover, it is inefficient to monitor the soybean planting system in an all-round way. The development of traditional agriculture and soybean industry has been greatly impacted, and the ability of soybean production and supply has been weakened rapidly, which has led to the gradual disappearance of its competitive advantage in the international market. The purpose of this paper is to use image remote sensing technology to detect and study soybean planting system. In view of the above problems and in light of the actual situation of the current development of science and technology, in this paper, image mosaic technology is used. Firstly, the image is corrected by image denoising and image interpolation, noise and distortion are eliminated effectively. Then image registration is carried out. Image registration is the core of image mosaic, which directly affects the quality of mosaic. Finally, the target image is obtained by image fusion. Experiments prove that, image remote sensing technology is helpful to monitor the growth period and planting area of soybean to a certain extent. In this paper, two image feature extraction algorithms, ORB and SURF, are used respectively. Comparing the extraction time consumption of the two algorithms for feature points, the results show that the ORB algorithm is 0.215849s and the SURF algorithm is 3.2189s. It can be seen that ORB algorithm has certain advantages in remote sensing monitoring of soybean planting.

1. Introduction

Soy, also known as soybeans, originated in China and have been planted for more than 5,000 years. Because soybean seeds are rich in plant protein and have high nutritional value, they have gradually become one of the most important food crops, oil crops and feed sources in the world [1]. For a long time, as a large agricultural country, China has been widely planted throughout the country and is also one of China's major export agricultural products. In the process of rapid economic and social development in China, the development of traditional agriculture and soybean industry has been greatly impacted, which has made China's soybean production and supply capacity weaken rapidly, resulting in the gradual disappearance of its competitive advantage in the international market. With the development of science and technology, remote sensing technology, as one of the important application methods in agricultural production, plays an increasingly important role in the comprehensive monitoring of crops [2]. Through remote sensing monitoring technology, the agricultural sector can be provided with rapid and accurate data on crop growth, development and planting, and provide accurate reference for relevant departments to make important decisions. In order to strengthen the monitoring of soybean planting, relying on remote sensing monitoring and ground agro-ecological network monitoring technology, real-time tracking and monitoring of soybean growth and environmental changes can be carried out, and GIS technology and various methods can be used to evaluate the soybean growth environment, promote the increase in soybean yield [3].

Remote sensing technology can complete the real-time receiving and processing of data information in large areas in a short period of time. It has the characteristics of large spatial resolution, low cost and strong timeliness, and it is in crop growth, planting area, natural hazard and ecological environment, other aspects of monitoring play an increasingly important role [4]. China uses NOAA satellite remote sensing technology to study the growth of crops, which plays an important role in ensuring the sound development of agriculture and maintaining food security. Image stitching technology is practical, and the development of digital image processing has made it a research hotspot in many disciplines [5]. After years of development, it has been widely used in all aspects of real life, and has formed a large number of popular technologies. Remote sensing image stitching technology has developed rapidly. Remote sensing image stitching refers to the process of splicing images of coincident regions obtained by remote sensing platform into a panoramic image through digital image processing [6]. Image stitching is mainly achieved through preprocessing, registration, and fusion, with registration and integration being the most important. The image mosaic method based on transform domain is registered in the frequency domain after Fourier transform, and has good anti-noise and anti-distortion ability [7].

Gao's team used the ratio vegetation index (RVI), normalized difference vegetation index (NDVI), soil adjusted vegetation index (SAVI), differential vegetation index (DVI) and triangular vegetation index (TVI) to establish the LAI search model. Verification is performed using the model with the highest calibration accuracy. According to the estimation accuracy of the model, the LAI inversion ability of these three kinds of remote sensing data was evaluated. They found that the model based on terrestrial hyperspectral and UAV multispectral data yielded better estimation accuracy (R2 over 0.69 and RMSE less than 0.4 at 0.01 significance level), while based on the WFV data model. The RVI logarithmic model based on terrestrial hyperspectral data has little better than the normalized vegetation index linear model based on UAV multispectral data (E (A) difference, R2 and RMSE 0.3%, 0.04 and 0.006, respectively). The model based on WFV data has the lowest estimation accuracy, R2 is less than 0.30, and RMSE is greater than 0.70. They also discussed the effects of sensor spectral response characteristics, sensor geometry and spatial resolution on soybean leaf area index inversion. They found that ground hyperspectral data has an advantage over soybean leaf area index inversion compared to traditional multispectral data, but it is not obvious [8]. Zhang and his team believed that crop biomass plays an important role in food security and the global carbon cycle. Achieving timely and accurate monitoring of biomass is essential for the precise and rational operation of agriculture. There is no doubt that remote sensing technology has proven to be an effective tool for estimating biomass. It reduces the actual operation and investigation of ground measurements compared to traditional methods. The order accurately estimates the accuracy and stability of crop above-ground biomass in the field and improves the in situ biomass inversion model of soybeans. They obtained SPOT-6 6-meter multispectral data for the July and August 2016 study areas. And the topographic slopes of different biomass of soybean aboveground. At the same time, the terrain data of the study area is measured, and terrain factors such as elevation, slope and aspect are extracted. His team intends to use the above measured data to establish traditional linear regression models, multiple regression models and neural network models [9]. The purposed of Huang's team was to determined the effect of glyphosate on non-GR bioresponse and to extract relevant vegetation indices (Vls) from aerial multispectral images. They found that after gavage treatment, the plant height, stem weight, and chlorophyll (HI) content decreased gradually with the increase of gastric perfusion, regardless of whether it was administered for several weeks. As a result, soybean production decreased by 25% and Al ha(-1) increased from 0 to 0.866 kg. Similar to the biological response, regardless of the WAA, the Vls of the normalized vegetation index, the soil regulation vegetation index, the ratio vegetation index and the green NDVI in the aerial image also decreased with the increase of glyphosate content. They found that Vls was highly correlated with plant height and yield, and (HI, not related to WAA. This indicates that the damage index of glyphosate to soybean can be determined by the difference in plant height, and can also be harmed by glyphosate to crops, to predict crop yield reduction [10].

The main innovations of this paper include: high real-time and robustness requirements for image mosaic for remote sensing, while SURF algorithm has high accuracy and slow calculation speed. ORB algorithm has outstanding computational advantages and low accuracy. SURF feature detection is proposed in this paper. An improved feature extraction algorithm combined with ORB feature description. After feature extraction, the feature points detected in the image are expressed by a binary code string. This paper proposes to use the Hamming distance to complete the similarity calculation and use the BF (Brute Force) algorithm to complete the feature rough matching. There may be mismatches for coarse matching, and RANSAC (Random Sample Consensus) algorithm extracts all data, which is computationally intensive and prone to bias. For the traditional image stitching, it is easy to produce stitching seams and ghost images. Sometimes the image information is blurred and lost. This paper uses Poisson fusion algorithm to complete image fusion.

2. Proposed Method

2.1. Image Registration Technology

Remote sensing image registration refers to the process of geometrically calibrating overlapping regions of images from different angles using the same or different sensors at different times. Image registration technology is the basis of other image processing technologies, and it has been widely used in image fusion, 3D image reconstruction, pattern recognition and other fields. Image registration technology is not a castle in the air. It has strict mathematical and computer-related theoretical foundations and is a combination of multidisciplinary and organic.

(1) Principles of image registration technology

The image is presented in the form of pixels, and the processing of the image can be transformed into processing of the pixels. The image is stored on the computer in a two-dimensional matrix, so the entire image can be thought of as a large two-dimensional matrix, each coordinate representing the position of the pixel in the image, and the coordinate value representing the gray value of the image. The image pixels are described below by mathematical symbols, and the remote sensing image is represented by a large matrix, where is the coordinate of the (x_0, y_0) pixel point, and $I(x_0, y_0)$ is the gray value of the coordinate point. Specifically, for two images $I_1(x, y)$ and $I_2(x, y)$, $I_1(x, y)$ is assumed to be the reference image, and $I_2(x, y)$ is the image to be registered. Registration between the two images is to find a transformation that satisfies the following relationship:

$$I_2(x, y) = g(I_1(f(x, y))) \quad \text{B} \tag{1}$$

Where f represents a spatial transformation of pixel points (x, y), and g represents a grayscale transformation of pixel points. This is an ideal image registration scheme in which f and g default to linear transformation, but are rarely used in realistic image registration processing. There is geometric distortion, noise, illumination, etc. between the two images, so the more attention paid to the actual processing is the minimum difference between the two images, namely:

$$\min \| I_2(x, y) - I_1(x, y) \| \tag{2}$$

(2) Basic flow of image registration method

The feature-based registration method in the image registration algorithm is widely used because it only utilizes the salient features in the image, has small computational complexity, strong adaptability, high registration accuracy, and robustness to complex deformations. Applications. Among many features, the feature point based registration method is the most commonly used because of the small amount of point feature data, more stability, and ease of extraction. The following is a description of the registration process based on the feature point-based registration method. Generally speaking, it includes four important steps: extraction of feature points, description of feature points, matching of feature points, and solving parameters related to the transformation model.

1) Extraction of feature points

In this step, feature points are extracted mainly by one or more feature extraction methods. To extract feature points, scale space needs to be established. According to different ways of establishing scale space, feature points can be extracted into linear scale space extraction method and nonlinear scale space extraction method. Commonly used linear scale space extraction methods are: Moravec algorithm, SIFT algorithm, SURF algorithm and so on. The nonlinear scale space extraction method can maintain the natural boundary of the image and has a certain smoothing effect on the noise.

2) Description of feature points

For the extracted feature points, it needs to be represented in a way, which involves the description of the feature points. The feature point description is based on the local pixel information around the feature point to represent the feature point feature, which is an important part of the image registration process. The ideal feature point descriptor should be unique and highly robust. At present, there are mainly three types of feature descriptors based on image gradient histogram statistics, spatial frequency based and differential invariant moments. Among these three types of descriptors, descriptors based on image gradient histogram statistics have been widely used in the process of establishing a gradient histogram to represent the local texture information and shape features of different images. Among them, the most classic is the perfect SIFT descriptor of Lowe in 2004, and then there are many other descriptors, such as acceleration robust descriptor, PCA-SIFT descriptor and shape context descriptor.

3) Matching of feature points

After the descriptors are established for the feature points in the reference image and the image to be registered, the next step is to establish a corresponding relationship between them, that is, a matching algorithm. At present, there are roughly two types of point feature registration algorithms, namely, matching based on local point features and matching based on global spatial relationships. The local feature-based matching algorithm mainly establishes the similarity measure according to the local feature descriptor of the image pixel, so as to match the feature points. Commonly used local feature-based matching algorithms are: nearest neighbor nearest neighbor ratio method NNDR, K nearest neighbor KNN, joint moment invariant similarity. The matching based on the global spatial relationship is to first form the feature point set by using the spatial relationship between the feature points, and then establish the global energy function between the reference image and the image to be registered as the similarity measure. Finally, the registration of the feature points The problem turns to solving the optimization problem. At present, the commonly used feature matching algorithms based on global spatial relations are: nearest point iterative method, probability based matching method, graph matching and random sampling consistent method.

4) Conversion model

For image registration technology, the spatial transformation model is a key part. In the whole process of image registration, it is looking for a model to solve related parameters, so that the two images are as identical as possible. At present, the most basic transformations are rigid body transformation and non-rigid body transformation. Some complex transformation models are obtained by rotating, scaling and beveling the two basic transformation models.

A rigid body transformation is an operation in which the size and shape of an object remain unchanged after an object has been rotated and translated. Expressed in a mathematical model is:

$$\begin{bmatrix} x' \\ y' \end{bmatrix} = \begin{bmatrix} \cos\rho \pm \sin\rho \\ \sin\rho \, \mu \cos\rho \end{bmatrix} \begin{bmatrix} x \\ y \end{bmatrix} + \begin{bmatrix} t_x \\ t_y \end{bmatrix} \tag{3}$$

Wherein, $\begin{bmatrix} x \\ y \end{bmatrix}$ is the coordinate of a pixel in the reference image, $\begin{bmatrix} x' \\ y' \end{bmatrix}$ is the coordinate of the pixel corresponding to the image to be registered, ρ is the rotation angle of the image, and $\begin{bmatrix} t_x \\ t_y \end{bmatrix}$ is the translation amount of the image.

Affine transformation: Defined from spatial geometry, in simple terms, the process of transforming one vector into another, specifically by linearly transforming and translating a vector M.

$$\begin{bmatrix} x_2 \\ y_2 \end{bmatrix} = \begin{bmatrix} m_0 \, m_1 \\ m_3 \, m_4 \end{bmatrix} \begin{bmatrix} x_1 \\ y_1 \end{bmatrix} + \begin{bmatrix} m_2 \\ m_5 \end{bmatrix} \tag{4}$$

Where m_0, m_1, m_2, m_3, m_4 is the scale and the amount of rotation, m_2 is the horizontal displacement, and m_5 is the vertical displacement. There are 6 degrees of freedom for this type of transformation, and at least 3 pairs of feature points are needed (any pair of points cannot be collinear) to find all the parameters.

Projection transformation: The process of projecting a geometric object from a high-dimensional space to a low-dimensional space is a so-called projection transformation. Projection transformation in three-dimensional space is similar to the imaging principle of a camera, and is a process of transforming objects in the real world into a two-dimensional plane through an imaging source. The projection transformation formula is as shown in equation (5):

$$\begin{bmatrix} x_2 \\ y_2 \end{bmatrix} = \begin{bmatrix} m_0 \, m_1 \\ m_3 \, m_4 \\ m_6 \, m_7 \end{bmatrix} \begin{bmatrix} x_1 \\ y_1 \end{bmatrix} + \begin{bmatrix} m_2 \\ m_5 \\ 1 \end{bmatrix} \tag{5}$$

Where $m_0, m_1, m_2, m_3, m_4, m_5, m_6, m_7$ is the scale and the amount of rotation, m_2 is the horizontal displacement as the vertical displacement, and m_5 is the horizontal and vertical deformation. There are 8 degrees of freedom for the projection transformation, and at least 4 feature point pairs (any 3 point pairs cannot be collinear) are required to solve all the variables.

(3) Feature-based remote sensing image registration algorithm

1) Image feature extraction algorithm

Feature-based registration often uses point features for registration. The registration algorithm based on point features not only has good noise immunity, but also has invariance for rotation and scale changes. Feature extraction includes two parts: feature detection and feature description. The extracted feature points have a direct impact on the image mosaic effect. The more commonly used feature extraction algorithms are SURF algorithm and ORB algorithm.

As an upgraded version of the SIFT algorithm, the SURF algorithm not only has the characteristics of high accuracy and robustness of the SIFT algorithm, but also significantly improves the speed. The ORB algorithm has a higher stitching speed than the SURF algorithm, and has anti-noise and rotation invariance, and is widely used.

The feature detection of the ORB algorithm is implemented by FAST corner detection. The algorithm uses the pixel points in the gray-scale search region where the gray value difference exceeds the threshold as the feature point. The number of feature points thus found is very large, and most of the feature points are adjacent and the distribution is extremely uneven. Such feature points are used in the case where feature matching is prone to a large number of unmatched and mismatched matches, which not only affects the accuracy of stitching, but also increases the amount of computation of subsequent feature matching. Although the FAST corner detection is faster, its noise resistance is poor. If the image is seriously polluted by noise, the detected feature points will have a lot of noise, which will affect the detection effect. Threshold selection has a large impact on detection. If the threshold is too large, sufficient feature points cannot be found. If the threshold is too small, the feature points will increase too much, which will affect the accuracy and speed of image stitching. Because the FAST corner detection has no scale invariance, the ORB algorithm has no invariance to the scale. In the case where there is a scale change between the two images, the correct matching feature point pairs cannot be found, and eventually an effective match cannot be made. However, the remote sensing image of the drone may be scaled, translated and rotated. Therefore, the ORB feature extraction algorithm is not applicable. The SURF algorithm generates a 64-dimensional feature vector in feature description, which is much smaller than the 128-dimensional SIFT algorithm. Therefore, the speed of image stitching is much faster than the SIFT algorithm, which is about 5 times.

2) Image feature matching

The two images will enter the feature matching link after the feature extraction is completed. Fast and accurate matching helps to obtain better transformation matrices and improve image stitching efficiency and quality. The image feature matching completes the search and matching process by calculating the similarity degree of the feature descriptors by a certain measurement method. The similarity calculation is done by using the Euclidean distance and the Hamming distance. The Hamming distance is only applicable when the feature descriptor is a binary string, and the Euclidean distance can be used simultaneously for the case where the feature descriptor is a binary string and a feature vector. Commonly used binary descriptors include Brief operator, BRISK (Binary Robust Invariant Scalable Keypoints) operator, FREAK (Fast Retina Keypoint) operator, ORB operator, etc. Commonly used feature vector descriptors include SIFT operator, SURF operator .

(4) Image registration method

1) Transform domain based registration method

The idea of registration based on transform domain is that the Fourier transformed image is registered in the frequency domain. Let the two images I_1 and I_2 have a displacement (d_x, d_y) in the horizontal direction to satisfy:

$$I_2(x,y) = I_1(x-d_x, y-d_y) \tag{6}$$

According to the Fourier transform:

$$F_2(\varpi_x,\varpi_y) = e^{-j(\varpi_x d_x+\varpi_y d_y)} F_1(\varpi_x,\varpi_y) \tag{7}$$

According to the Fourier transform:

$$F_2^*(\varpi_x,\varpi_y) = e^{-j(\varpi_x d_x+\varpi_y d_y)} F_1^*(\varpi_x,\varpi_y) \tag{8}$$

It can be found that the image with translation has the same magnitude after the Fourier transform. However, due to the translational relationship, the phase changes, and the phase difference is equal to the phase of the mutual power spectrum between the images, which can be expressed as:

$$e^{-j(\varpi_x d_x+\varpi_y d_y)} = \frac{F_1\ (\varpi_x,\varpi_y)F_2\ (\varpi_x,\varpi_y)}{|\,F_1\ (\varpi_x,\varpi_y)F_2\ (\varpi_x,\varpi_y)\,|} \tag{9}$$

After the image is Fourier transformed, its translation and rotation can be reflected from the Fourier transform. The algorithm itself is simple to implement, and has anti-noise performance, and is widely used.

2) Gray-based registration method

The transformation model is determined by the gray value based on the gray scale registration, thereby obtaining the pixels of the corresponding points after the transformation. The algorithm establishes a corresponding cost function as a similarity measure by overlapping the gray values of the regions. When the cost function obtains the extremum, it corresponds to the optimal parameter solution of the transformation model. SSD (Sum of Squared Difference) is generally used as a cost function, and the formula is as shown in equation (10).

$$E = \sum (I^{'}(x_i^{'}, y_i^{'}) - I(x_i, y_i))^2 = \sum e^2 \tag{10}$$

In the formula, $I^{'}(x_i^{'}, y_i^{'}), I(x_i, y_i)$ is the pixel gradation contained in the corresponding area of the two images, and e is the pixel gradation difference. Searching all gray information based on gray-scale registration, the implementation is simple and accurate, but the calculation amount is large, the gray scale dependence on the image is too large, and only the translation change is invariant. When scaling or rotation occurs, The registration effect is very poor.

3) Feature-based registration method

The feature-based registration method is the current mainstream. The algorithm extracts local invariant features for registration, has invariance to scaling, translation and rotation, and has good stitching robustness and accuracy. Image features include points, edges, contours, textures, image blocks, and the number is small, so the feature-based registration algorithm has robust and fast characteristics.

2.2. Remote Sensing Image Mosaic Technology

(1) Image stitching process

Image stitching is divided into five steps. First, arbitrarily select two images with overlapping regions, which are used as reference images and to be stitched separately. Secondly, because the conditions for acquiring the two images, such as equipment, environment and operation mode, may be different, resulting in different image quality. The gray level changes obviously, and some noise effects are obvious, so the image needs to be preprocessed. The selected image is denoised and interpolated to ensure the quality of image registration and fusion; then, the pre-processed image is registered. Feature matching is achieved based on the degree of similarity between the descriptors. Feature extraction consists of two links, one feature detection and two feature descriptions. The essence of feature matching is to pair all the features of the two images to find their corresponding points in the reference image. Therefore, the key to image registration is to find a transformation relationship, so that the features shared by the two images are accurately matched, and the non-coincident regions are directly spliced together; finally, the two images may be stitched after different stitching angles or different lighting conditions. The brightness difference is obvious, and it is easy to produce stitching seams and ghosting. It is necessary to further image fusion processing to ensure a smooth transition of the coincident area and finally obtain the target image. The flow chart is show in Figure 1.

(2) Image preprocessing

When collecting remote sensing images, due to the quality problems of the sensors themselves and the interference of image transmission, it is easy to make the collected images generate noise. If they are not processed, they will be used for image stitching, which will affect the image stitching effect. When the UAV acquires remote sensing images, because of the change of illumination and shooting angle, even two consecutive remote sensing images may have obvious chromatic aberration, which makes the brightness and saturation between the images different. In addition, the drone is not only small in size but also light in weight, and is easily affected by the external environment. The body is easy to shake, the flying height and the shooting angle are varied, and the obtained remote sensing image is usually distorted, resulting in information distortion. Therefore, pre-processing is required before splicing to lay the foundation for accurate image stitching.

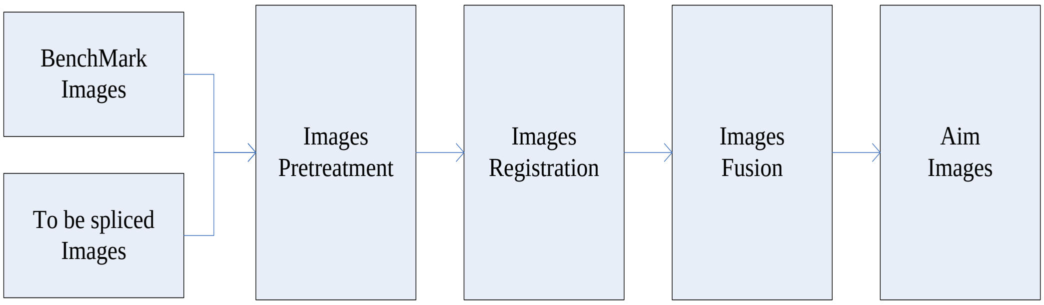


Figure 1. Image stitching process

1) Image Denoising

It is inevitable that remote sensing images are subject to a certain degree of noise pollution during the acquisition process. This will directly affect the quality of image stitching, and the image needs to be denoised before image stitching. Although low-pass filtering can achieve denoising effect, filtering may result in fuzzy feature edge information. Median filtering removes noise in a nonlinear form. The basic idea of filtering is to replace each pixel's gray level with the median of all pixel points in the vicinity of the point.

The advantage of median filtering is that both image denoising and information at the edges are protected. In order to ensure the integrity of the information to ensure the accuracy of image stitching, this paper adopts median filtering to complete the image denoising process. The median filter first sets the size determined window M to filter the image. The pixels in the window are arranged according to the gray value, and the median of the sequence is used to replace the pixel gray level at the center of the image. The formula is as follows:

$$g(x,y) = median\{f(m,n),(m,n) \in M\} \tag{11}$$

Where (x, y) is the center point of M, g is the center point filtered gray value, (m, n) is the pixel point coordinate in M, and f is the unprocessed sequence. The median filtering result should satisfy equation (12):

$$median\{u(a)+v(a)\} \neq median\{u(a)\} + median\{v(a)\} \tag{12}$$

Where u(a) and v(a) are two images of area a. If the noise pixel is greater than half of the sum of the image pixels, median filtering is not suitable for such image denoising because it is prone to image distortion. The window size of the median filter can be adjusted according to the complexity of the image information to control the speed and accuracy of the filtering.

2) Image interpolation

After calculating the values of each parameter of the transformation model, the two images can be transformed into the same coordinate system. However, the transformed coordinates are generally not integers. Such pixel values are not defined and cannot fall on the grid points of the image. Correction is required by image interpolation. The essence of image interpolation correction is to re-assign the gray level of the image. The principle is to calculate the corresponding integer coordinate gray scale according to the gray level between the adjacent pixel points. Classic image interpolation methods are: nearest neighbor interpolation, bilinear interpolation, cubic convolution interpolation.

(3) Image fusion

Due to different shooting angles or different lighting conditions, the two images have obvious brightness difference after splicing, and misalignment, stitching and ghosting may occur, and image fusion is required. A good fusion algorithm can eliminate the stitching seam after image registration, and realize the smooth transition of image overlap area under the premise of ensuring the complete image information. Image fusion is directly related to the effect of image stitching. The choice of fusion method is particularly important. There are three levels of fusion methods.

1) Pixel level fusion

Pixel-level fusion is the lowest in all fusion levels, but because it does not pre-process the image directly to all data fusion, although the calculation is large, the accuracy is very high, and can ensure the completeness of image information and avoid information loss. Pixel-level fusion is the most mature application in all fusion levels. UAV remote sensing generally uses this method to fuse remote sensing images. The main methods are PCA algorithm, pyramid method, ratio change method, Poisson fusion and so on.

2) Feature level fusion

Feature-level fusion first extracts image features, and secondly analyzes the extracted image information to select points that reflect the image texture distribution, and applies multi-sensor information for processing. The algorithm only fuses the feature information, the calculation amount is small, and the fusion speed is improved, but the information is more likely to be lost than the pixel-level fusion. The main methods are Bayesian estimation method, wavelet transform method, and so on.

3) Decision-level integration

The decision-level fusion first extracts the image features and identifies them, and then classifies the feature information. The algorithm has the characteristics of fast fusion, good effect and strong fault tolerance. Although decision-level fusion is an advanced image fusion, it is often used to provide various strategies, but it is easy to cause information loss and distortion of the fused image, which is not suitable for UAV remote sensing image fusion.

3. Experiments

3.1. Data Set and Experimental Environment

Experimental data comes from different geographical environments. Our experimental environment is two configurations for Intel Core i5-2450M 2.5 GHz, 4 GB of RAM, operating system 32-bit Windows 7 computer. The data set runs on Matlab (version: 2015b). In the experiment, in order to verify the performance of the proposed method, 30 high-resolution remote sensing images were selected as the test data set, and the size of each image was about 800*800 pixels. The datasets are collected by Google's search engine and include a variety of different types of remote sensing images.

3.2. Experimental Steps

Step 1: Obtain the original remote sensing image.

Step 2: Perform image preprocessing. In this step, the image is first removed, and the low-pass filtering and the median filtering are used to compare the deconvolution effects, and two degaussing effects are obtained. The bilinear interpolation algorithm is then used for image interpolation to analyze the interpolation effect.

Step 3: Image registration. In this step, the image feature extraction is first performed, and the most characteristic partial features of the image are selected from a large number of features of the image, and then the rough matching is realized according to the degree of similarity between the feature descriptors. Thick matches may have mismatches, need Purification is carried out to remove.

Step 4: Use the Poisson fusion algorithm to image stitching to ensure that the image information before and after is complete, and avoid missing image information during the stitching process.

Step 5: After the above steps, the final target image is obtained.

3.3. Performance Indicators of Experimental Analysis

After the image is removed and the image is interpolated, the restored image is registered in the cloud. Throughout the process, some performance indicators are needed to qualitatively and quantitatively measure these processes and operations to analyze their performance and effectiveness. Commonly used chaotic encryption and compression sensing technology evaluation indicators have peak signal to noise ratio, gray histogram, adjacent pixel correlation coefficient and scatter plot, image pick. The metrics that measure the effects of image registration have correctly matched logarithms, correct match rates, and root mean square errors.

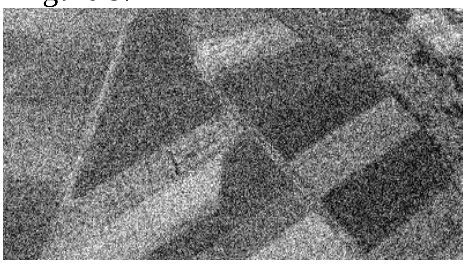
Calculate the correct matching rate of the image registration algorithm. The correct match number is the number of correct match points, the total match number is the total number of participating match points, and the correct match rate is the quotient of the correct match number and the total match number. A higher correct match rate indicates a higher registration accuracy. The coordinates of the feature points in the reference image are the coordinates of the feature points in the image to be registered corresponding to the reference image. The root mean square error is to compare the reference image with the coordinate values of the feature points in the image to be registered. The standard error between them is used as an index of registration accuracy. The smaller the value, the higher the registration accuracy.

4. Discussion

4.1. Image Preprocessing

(1) Image removal

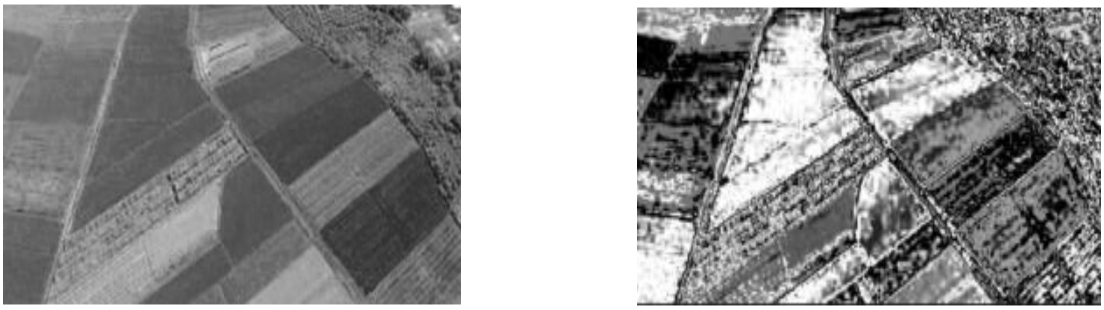
In order to reflect the denoising effect, in Figure 2 (a), artificially add salt and pepper noise, the black (0) point seen in the figure is pepper noise, and the white (255) point is salt noise. Comparing Figure 2(b) with Figure 2(a), it can be seen that black and white noise is not found in both figures, indicating that median filtering can effectively remove noise. Comparing Figure 2(a) with Figure 2(b), it is found that the median filtering removes the noise and ensures the image clarity without causing damage to the original information of the image.The effects of soybean planting remote sensing image through median filtering are show in Figure 2,the image segmentation effect diagram is shown in Figure 3.



(a) Noise effect diagram

(b) Median filter

Figure 2. Denoising effect diagram

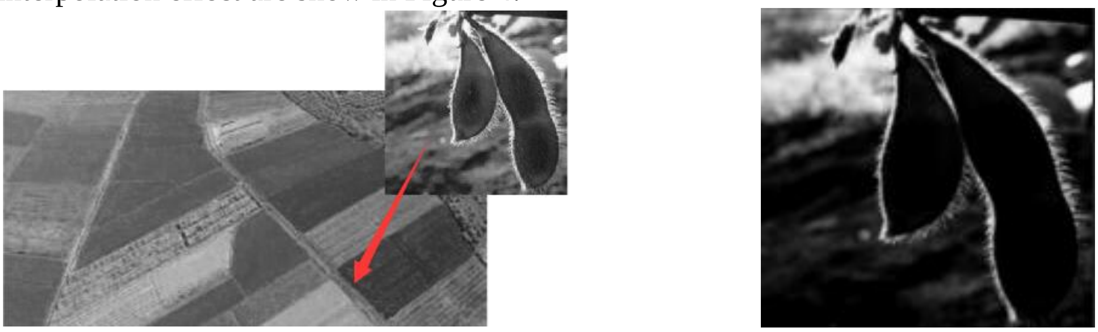


(a)Original image (b)Image segmentation effect

Figure 3. Image segmentation renderings

(2) Image interpolation

There are three methods for image interpolation, including nearest neighbor interpolation, bilinear interpolation, and cubic convolution interpolation. Since the image of the nearest neighbor interpolation is very blurred, the sawtooth effect is obvious and the interpolation effect is very poor. The bilinear interpolation effect is better, and no obvious quality problems are seen. After the cubic convolution interpolation, the image is clear and there is no obvious sawtooth shape or discontinuity, and the interpolation effect is better. However, the volume of cubic convolution is large and time consuming. Considering the bilinear interpolation, the image interpolation correction is completed. The interpolation effect are show in Figure 4:



(a) partial enlargement of the original image (b)Bilinear interpolation effect

Figure 4. Bilinear interpolation method renderings

4.2. Comparative Analysis Based on Different Image Feature Extraction Algorithms

The ORB algorithm extracts a small number of feature points, and the distribution is extremely uneven. The SURF algorithm is equivalent to the number of feature points extracted by the algorithm, which is significantly larger than the ORB algorithm, and the distribution is more uniform. When feature extraction, the number of feature points, dimensions, time and average number of feature points extracted per second are shown in Table 1 and Figure 5:

Table 1. Feature extraction effect comparison table

Algorithm	Number of feature points	dimension	It/s	The number of extraction per/s
ORB	500/493	32	0.215849	2300.21913
SURF	1328/1482	64	3.2189	436.484513

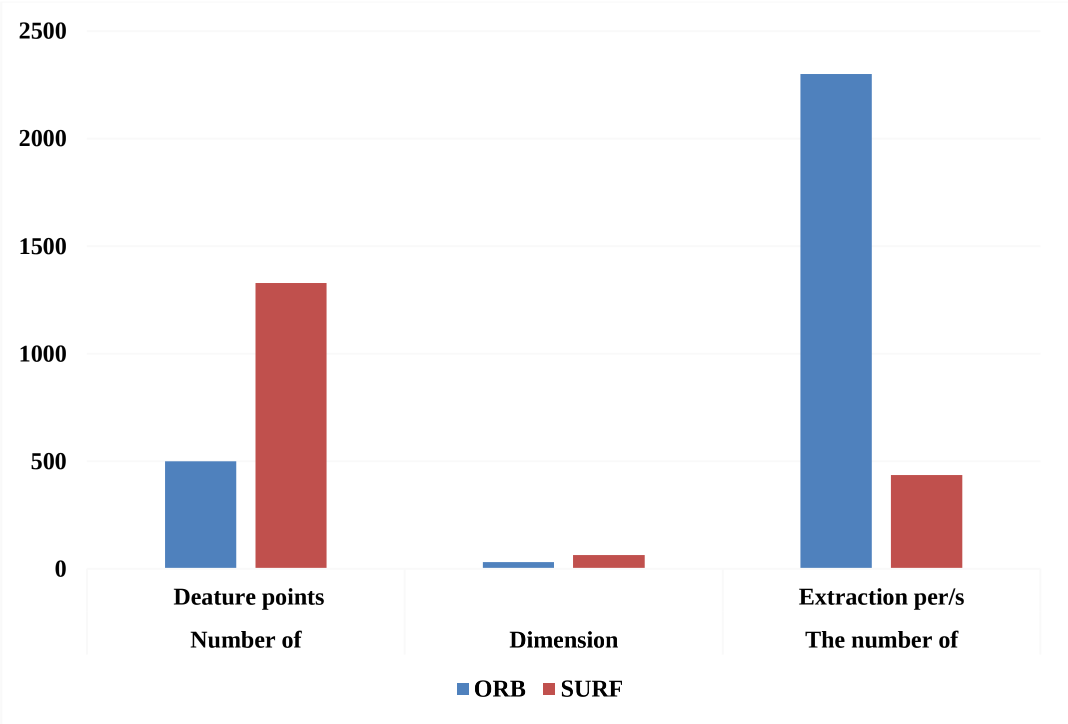


Figure 5. Comparison of feature extraction effects

It can be seen from Table 1 and Figure 5. The average number of feature points extracted by the algorithm is 5.63 times that of the ORB algorithm, which is equivalent to the SURF algorithm. The dimension is half of the SURF algorithm, and the extraction speed is 4.12 times that of the SURF algorithm. Obviously, the ORB algorithm has the characteristics of real-time performance.

4.3. Statistical Eigenvalues of Area Change Rate

It can be seen from Table 2 that in the 51 1:50,000 standard frame, the area change rate is concentrated in -47.23%~211.09%, the average value is 16.25%; the standard deviation is 42.11, indicating that the variation rate is relatively large. The data is relatively scattered; the skewness coefficient is 1.26, indicating that the data is non-normally distributed and the mean is to the right of the peak. There are 58 data with an area change rate of -40%~80%, accounting for 64.87% of the total data, that is, the rate of change of soybean acreage in most of the 1:50,000 standard maps in the monitoring sample area is not large; There are 17 data in the range of -60%~-40% and 40%~80%, accounting for 22.97% of the total data, that is, the rate of change of soybean acreage in this part of the standard frame is large; the rate of change of area exceeds 60%. There are 9 data, accounting for 12.16% of the total data, that is, the rate of change of soybean acreage in this part of the standard frame is very large. There are also two standard frames where the rate of change in soybean acreage exceeds 100%, and the rate of change in area is shown in Figure 6.

Table 2. Statistical eigenvalues of area change rate

Project	Range value /%	average value/%	Standard deviation	Skewness coefficient
Area change rate	-47.23~211.09	16.25	42.11	1.26

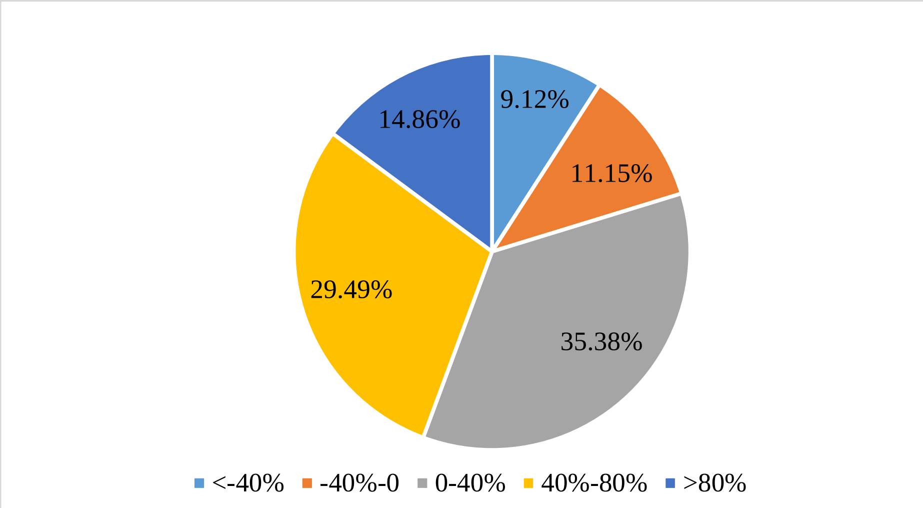


Figure 6. 1: 50,000 standard frame area change rate grading

5. Conclusion

(1) In order to achieve effective monitoring of soybean growth system, this paper introduces remote sensing image processing technology. In this paper, the remote sensing image is preprocessed, including image depreciation, image interpolation, and then image registration, image fusion and so on. It is important to improve the efficiency and accuracy of soybean identification.

(2) This paper uses image stitching theory research. Through in-depth study and learning the basic theory of image stitching technology, the current popular image stitching method is analyzed, and the implementation schemes such as preprocessing, registration and fusion are determined according to the stitching process. According to the image registration process, through the research of SURF algorithm and ORB algorithm, an improved feature extraction algorithm based on two algorithms is proposed. The practicality of the improved algorithm is proved by contrast experiments. Experimental results show that the proposed algorithm can effectively improve image processing efficiency.

(3) With the development of the economic situation, it is necessary to accurately analyze the soybean planting area, growth and development, and prediction of the disaster results. The use of remote sensing monitoring technology to analyze soybean acreage monitoring and environmental change development is conducive to assessing the ecological development conditions of soybean planting areas and effectively promoting the steady increase of soybean yield.

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Data Availability

Data sharing is not applicable to this article as no new data were created or analysed in this study.

Conflict of Interest

The author states that this article has no conflict of interest.

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