Automatic Identification and Evaluation of Rural Landscape Features Based on U-net

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***Abstract*—The study delves into the landscape feature identification method and its application in Xijingyu Village, investigating landscape composition elements. Analyzing rural landscape structure holistically aids in dividing landscape characteristic zoning maps, essential for guiding rural landscape and territorial spatial planning. By utilizing GIS software for superposition analysis based on topography, geology, vegetation cover, and land use, the village range of west well valley undergoes further refinement. To address the inefficiencies of common foreground extraction algorithms relying heavily on rural landscape images, a novel approach is introduced. This new algorithm focuses on directly extracting foreground areas from rural landscape interference images by leveraging stripe sinusoidal characteristics. An adaptive gray scale mask is established to capture the sinusoidal changes in interference stripes, facilitating the direct extraction of foreground areas through a calculated blend of masks. In evaluating the results, the newly proposed algorithm demonstrates significant improvements in operation efficiency while maintaining accuracy. Specific enhancements include classifying pixel gray values into intervals and recalibrating them to enhance analysis metrics. Compared to traditional methods, the algorithm showcases advantageous enhancements across various parameters, such as PRI, GCE, and VOI. Moreover, to address challenges in unwrapping low-quality rural landscape phase areas, a ResU-net convolutional neural network is employed for phase unwrapping. By constructing image datasets of interference stripe wrapping and unwrapping alongside noise simulations for model training, the network structure's feasibility is verified. The study's innovative methodologies aim to optimize rural landscape analysis and planning processes by enhancing accuracy and efficiency in landscape feature identification, foreground area extraction, and phase unwrapping of rural landscapes. These advancements offer substantial improvements in quality and precision for territorial spatial planning and rural landscape management practices.**

Keywords*—*Rural landscape; foreground area extraction; deep learning; phase unwrapping; ResU-net

I. Introduction

In recent years, it has been faced with many ecological problems in its development. First, a large number of spontaneous rural construction and rural reconstruction under the lack of overall planning, many of the arable land has been converted into construction land, Forest land is changed to cultivated land [1, 2]. China's original harmonious rural ecological environment has been destroyed; Second, excessive exploitation and deforestation, Causing large-scale soil erosion and desertification phenomenon, Such as rural farmland sand and stone accumulation, The decrease in soil fertility, water loss and soil erosion [3, 4]. This also further affects the development of the rural economy and aggravates the deterioration of the ecological environment, Reduce the villagers' production income, Reducing the quality of rural life; Third, the discharge of harmful waste and waste liquid into the nature in the production process, Seriously polluting the environment, Industrial production for the discharge of solid waste containing sulfur dioxide and fuel dust, Disrupted the ecological balance of the countryside, These algorithms use variability between different image features to set thresholds and detect different image features by classification to identify foreground and background regions [5, 6]. The image extraction algorithm based on gray threshold is mainly used for images with target and background occupying different ranges of gray level. Among them, the maximum inter-class variance method proposed by Otsu is a common threshold calculation method. In addition, the best entropy threshold method proposed by Kaptur et al. The main work of image extraction by the threshold method is to select the appropriate threshold value [7]. The cluster-based extraction method enables the extraction of various pixels by classifying pixels with the same or similar features, which can be divided into classification clusters and block clustering methods [8]. The pixel-based extraction algorithm has the advantages of high efficiency, stable algorithm and simple operation, but the extraction effect largely depends on the selection of threshold and the prior knowledge of the operator. In addition, the pixel-based algorithm only analyzes a single pixel attribute, and does not consider the internal characteristics of the image frequency domain [9]. The algorithm is relatively shallow, which makes the image extraction result very sensitive to noise.

In the image foreground extraction algorithm based on the model features, the deformation model has two categories: geometric deformation model and parameter deformation model. The deformation model is robust the definition of the energy function, and the setting of the termination conditions [10]. Therefore, the selection and setting of these factors need to be carefully considered carefully when using the algorithm to improve the stability of the algorithm and the accuracy of segmentation results. With the development of algorithms, model-based extraction methods change to feature extraction methods, which include unsupervised feature extraction algorithms, such as principal component analysis [11, 12]. By finding a set of orthogonal transformations, and minimizes the sample reconstruction errors generated during the process. Also include supervised learning algorithms, such as linear discriminant analysis, typically used to divide data into two or more categories to find a low-dimensional linear space to maximize variability between categories and minimize variability within the same category [13, 14]. However, these algorithms prefer to target the images with obvious features, while the rural landscape interference stripe belongs to a kind of image without regular change, so it is difficult to effectively extract the foreground area through such methods. The extraction method based on the image edge feature is to find the boundary of the target area in the image according to the assumption of the boundary, and then segment the image along the boundary [15, 16]. Most of the algorithm to image gray gradient change direction and in x direction and y direction partial derivative trend data analysis, through the change rule set threshold of the image pixels, finally to different area pixel properties and feature recognition to complete the effective area edge segmentation, the algorithm field appeared many famous operators, based on edge extraction methods such as Canny operator, Sobel operator and Laplacian operator in extracting the overall target area in the image. But in the study of the interference stripe image stripe light and dark distribution, there are very obvious connected domains between the stripes, so through this kind of image edge algorithm will foreground area into many strips area, cannot realize the correlation between the connected domain, it is difficult to accurately obtain the edge of the foreground area. Therefore, such methods are not applicable in the foreground area of rural landscape interference images in this study [17].

The region growth-based image extraction method divides the image into multiple small regions and gradually merges pixels with similarity into a single region through a series of iterative processes. Each iteration will form a new area until the entire image is completely covered [18]. On the regional growth rules and order, and on setting the regional growth termination conditions. To solve the problem of initial seed point selection, developed an algorithm without seed point can realize automatic image extraction, fuzzy theory and optimization algorithm applied to regional growth algorithm, regional growth method combined with anisotropic filtering technology and algorithm, and add adaptive parameters in the regional growth algorithm, realize the automatic extraction of medical images [19, 20].

II. Data Processing Methods for Laser Interferometry in Rural Landscape

A. Typical Method for Identifying the Foreground Regions of the Interferograms

Large-angle oblique incidence of irradiation. Two identical optical wedges are placed symmetrically on both sides. The front wedge deflects the light at a small Angle, and the light incident to the measured at a large Angle. As shown in Eq. (1) and Eq. (2), I_m is the measured light wave intensity, I_r is the reference light wave intensity, the reflected light is deflected by the small angle of the back light wedge, and the main direction of the deflection light is the same direction as the light before the front light wedge.

$$I_i(i,j)=I_m(x,y)+I_r(x,y)+2\sqrt{I_m(x,y)I_r(x,y)}cos\left[\Delta\phi(x,y)+\delta_i\right] \quad (1)$$

$$I_i(x,y)=a_0+a_1\,cos\,\delta_i+a_2\,sin\,\delta_i \quad (2)$$

Using the above large Angle oblique incidence scheme, and for the convenience of experimental operation, such as Eq. (3), Eq. (4), I is the sequence number for introducing phase modulation, E is the grayscale distribution value, the interferometer designed the interferometric measurement system for the model. The light in the measured light path and phase shift in the reference light path.

$$\Delta\phi(x,y)=-arctan\frac{a_2}{a_1} \quad (3)$$

$$E=\sum_{i=1}^{N}[a_0+a_1\,cos\,\delta_i+a_2\,sin\,\delta_i-I_i(x,y)]^2 \quad (4)$$

The point light emitted by the laser becomes a flat wave beam with uniform light intensity distribution. The beam meets the polarization spectroscopic prism, and the s-polarized path, and the p-polarized light transmitted perpendicular to the long axis of the incident surface enters the reference light path. As shown in Eq. (5), and Eq. (6), P_{RI} is the refractive fiber value, *I()* is the measured optical path function, in the measured optical path, s polarized light uses the double optical wedge combination to complete the measured large angle oblique incidence, and then enters the imaging co-optical path through the semi-reverse and semi-lens.

$$P_{\mathrm{RI}}(S,\{G_N\})=\frac{1}{C_n^2}\sum_{i<j}[c_{ij}p_{ij}+(1-c_{ij})(1-p_{ij})] \quad (5)$$

$$I(S,S_{\mathrm{test}})=\sum_{k=1}^{N}\sum_{k'=1}^{N'}P(k,k')log[P(k,k')/P(k)/P'(k')] \quad (6)$$

The semi-reverse lens to make it into the imaging common path. As shown in Eq. (7), Eq. (8), *VI()* is the imaging common path function, $L_{RE}()$ is the interference optical path function, the measurement light and the reference light meet here and produce interference on the photosensitive surface of the CCD camera after the imaging lens. The computer controls the camera to collect and control the PZT in the reference light path to realize phase shift.

$$VI(S,S_{\mathrm{test}})=H(S)+H(S_{\mathrm{test}})-2I\left(S,S_{\mathrm{test}}\right) \quad (7)$$

$$L_{\mathrm{RE}}(S,S_{\mathrm{test}},X_i)=\frac{\left|P(S,X_i)/P(S',X_i)\right|}{\left|P(S,X_i)\right|} \quad (8)$$

Relying on rural landscape non-interferometric image mask indirectly extract rural landscape interference image foreground information, cannot achieve directly for rural landscape interference image extraction method and change of measurement conditions will lead to great difference in threshold value, even if the same group phase interference stripe threshold extraction is not interlinked, such as Eq. (9), Eq. (10), $G_{CE}()$ is the threshold calculation function, and m is the modulation ratio calculation formula, and the increase of the measurement link will not guarantee the consistency of the extraction results, at the same time, the measurement light path has certain limitations, can only be used for non-common light measurement system.

$$G_{\mathrm{CE}}(S,S^{'}) = \frac{1}{n} min\left\{\sum L_{\mathrm{RE}}(S,S^{'},X_i),\sum L_{\mathrm{RE}}(S^{'},S,X_i)\right\} \quad (9)$$

$$m = \frac{m_1 + m_2}{2} + m_1 \quad (10)$$

B. Rapid Identification Method for the Foreground Area of the Rural Landscape Interference Image

After the helium-neon laser, there is the polarization direction and the optical axis of the polarization spectroscopic prism, as shown in Eq. (11) and Eq. (12), *n* is the angle optical axis selection ratio, and *E()* is the grayscale calculation function, thus changing the light intensity ratio between the p light entering the measured light path and the s light entering the reference light path.

$$n = \frac{n_{min} + n_{max}}{2} + n_{min} \quad (11)$$

$$E(X) = \frac{Gray_L + Gray_R}{2} \quad (12)$$

Even if the light intensity loss in the measured light path is different from the reference light in the reference light path, the measured light intensity can still be adjusted by the rotating half-wave sheet to ensure that the resulting interference stripes have the best contrast. As shown in Eq. (13) and Eq. (14), *m* and *n* is the size of the interference image, *x* and *y* are the coordinates of the interference point, the interference fringe image contains the phase difference caused by the surface topography of the tested rural landscape and is an important way of presenting the measurement information. Through a series of calculations, we can recover the physical properties contained in the measured object, using the characteristics of the light and shade changes in the interference stripe image.

$$\sigma^2 = \frac{\left(\varphi_i(x,y) - E(X)\right)^2 + \sum_{i=1}^{m\times n-1}\left(\varphi_i(x,y) - E(X)\right)^2}{m\times n} \quad (13)$$

$$\phi(x,y) = \varphi(x,y) + 2n\pi \quad (14)$$

The interference phenomenon of light is an important feature of light volatility. It is a phenomenon that meets the interference conditions overlap each other when they meet in space, which always strengthen or weaken in some areas, forming a stable strong and weak distribution. As shown in Eq. (15) and Eq. (16), *J* is the momentum of the light wave, *U* and *V* are the directions of the light wave vector, respectively, only the vibration direction of the coherent light source is the same, the frequency of the two light waves is the same and the phase difference is constant.

$$J = \varepsilon^p = \sum_{i=0}^{M-2}\sum_{j=0}^{N-1} |\phi_{i+1,j} - \phi_{i,j} - \Delta_{i,j}^x|^p + \sum_{i=0}^{M-1}\sum_{j=0}^{N-2} |\phi_{i,j+1} - \phi_{i,j} - \Delta_{i,j}^y|^p \quad (15)$$

$$\left(\phi_{i,j} - \phi_{i-1,j} - \Delta_{i-1,j}^x\right)U(i-1,j) - \left(\phi_{i,j} - \phi_{i,j-1} - \Delta_{i,j-1}^y\right)V(i,j-1) = 0 \quad (16)$$

The overall process of the foreground area recognition and extraction algorithm is to obtain the processed mask the measured image, as shown in Eq. (17), Eq. (18), *M* and *N* represents the number of refractions, *U(i,j)* represents the mask image threshold, and then the smooth mask image is obtained by smoothly adjusting the image-by-image morphology processing or linear fitting. Finally, the mask image treats the measured image to obtain the image containing only the effective information in the foreground area.

$$J = \varepsilon^2 = \sum_{i=0}^{M-2}\sum_{i=0}^{N-1}\left|\phi_{i+1,j} - \phi_{i,j} - \Delta_{i,j}^x\right|^0 + \sum_{i=0}^{M-1}\sum_{i=0}^{N-2}\left|\phi_{i,j+1} - \phi_{i,j} - \Delta_{i,j}^y\right|^0 \quad (17)$$

$$U(i,j) = \left|\phi_{i+1,j} - \phi_{i,j} - \Delta_{i,j}^x\right|^{-2} \quad (18)$$

At present, there are many prospect area recognition algorithms in the field of image algorithm, but in the highly targeted research field, the processing results and performance of the algorithm are not satisfactory. Due to the large number of connected areas in the foreground area of the rural landscape interference image and the irregular noise shadow of the gradient in the background area. As shown in Eq. (19) and Eq. (20), *V(i,j)* is the edge algorithm value, *i* and *j* are the cyclic factors, and the results of Canny algorithm cannot connect a large number of connected domains in the rural landscape interference image.

$$V(i,j) = \left|\phi_{i,j+1} - \phi_{i,j} - \Delta_{i,j}^y\right|^{-2} \quad (19)$$

$$\rho_{i,j} = \left(\Delta_{i,j}^x - \Delta_{i-1,j}^x\right) + \left(\Delta_{i,j}^y - \Delta_{i,j-1}^y\right) \quad (20)$$

III. Design Algorithm for Automatic Recognition Of Fore Landscape Image of Landscape Image

A. Adaptive Threshold Foreground Region Extraction Algorithm Based on Object Image Grayscale

In a set of phase-shift interference maps, the relative modulation regime of pixels refers to the ratio of the amplitude of the AC component to the amplitude of the DC component. When high-precision data or data processing tasks are required, the image quality can be evaluated directly through quantitative analysis, and the relative modulation system can be used to identify the foreground region and the background region in the distinguishing interferogram [21, 22]. The basic basis of the judgment method is: the proportional operation of the AC component amplitude and DC component amplitude can be realized by adjusting the system algorithm. The gray value information of each pixel can be mapped within the range of [0, 1] by the two amplitude proportions [23, 24]. The larger the amplitude of the AC component, the more effective information contained in the pixel, and the higher the regulation value obtained by this algorithm. Therefore, the foreground area can be distinguished from the background area, which can be distinguished from the background area by threshold setting [25, 26]. Fig. 1 is the detailed diagram of the U-net model architecture, and the relative modulation system value can be filtered. Because the path tracking method can be separated from the phase discontinuous integral, the local phase deviation can be prevented from spanning the whole integral region. The operation speed is fast, and more accurate results can be obtained in the region under the influence of low noise [27, 28]. Therefore, the foreground area of rural landscape interference image can be extracted by evaluating the phase gradient continuity of rural landscape interference image. In the interference field, the interference intensity changes sinusoidal with space, forming an interference stripe between light and dark.

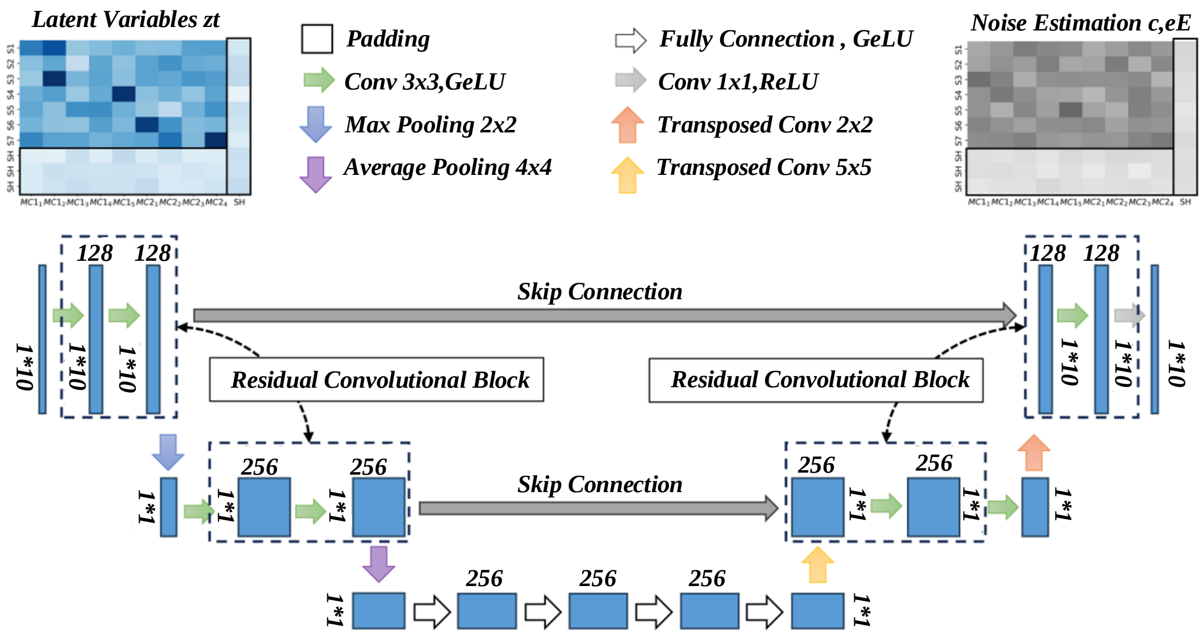

Fig. 1. Detailed diagram of the U-net model architecture.

Therefore, if a single interference stripe image is filtered by gray-scale thresholding, the dark stripes in the foreground region will also be filtered, although the background region can be removed. According to the optical wave shift phase interference formula, the interference intensity of the fixed position in the interference field will change according to the sinusoidal law as the phase shift goes on. This shows that the brightness of any pixel in the interference region changes alternately in a set of phase-shifting interference images. This means that, in a set of phase-shifting interference images taken, the pixel has at least one chance to be captured in its higher brightness state. Considering the above two aspects, a method based on the common filtering of similar interferograms is proposed to distinguish between regions and non-regions in the measured interferograms. Fig. 2 is the graph of feature extraction and fusion strategy. In the common filtering method of the same group of interference graphs, because it is necessary to control the two variables to extract the foreground region simultaneously, so the algorithm extraction results with thresholds of 30,50 and 70 when the flicker times are 1, 2 and 3 are selected. When the flicker number is more than 1 and the threshold is set to 50, the extraction results of the algorithm are still relatively normal, but the right part of the gray value and the background region are not well extracted, the extraction effect of the right part is getting worse and worse, so the algorithm also needs to adjust the parameters for the target image for a long time.

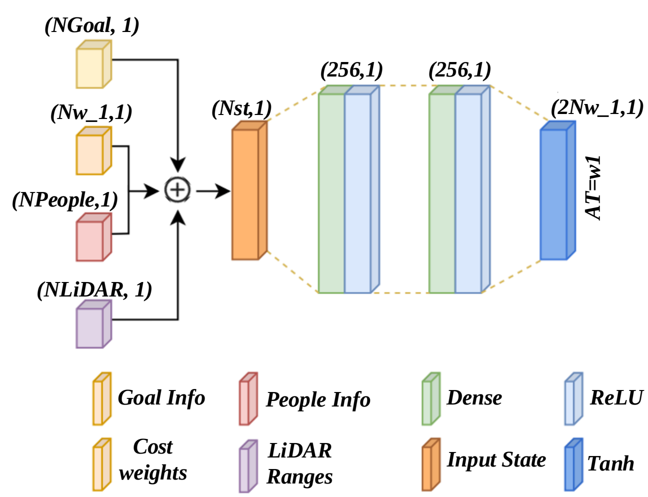

Fig. 2. Feature extraction and fusion strategy plots.

B. Direct Extraction Algorithm for the Foreground Area of Rural Landscape Interference Image Based on Stripe Sinusoidal Characteristics

Unlike the idea of guiding the unwrapping path through the branch cut line, the mass graph guidance method. The algorithm utilizes a tool called a "mass graph" to guide the choice of the mass graph guidance method is the need to define the neighboring solutions. The mass map is a two-dimensional image, where each pixel represents a combination of the search direction and the step size, while the color and direction can be selectively adjusted to achieve a more efficient search process. The idea of path tracking of mass graph guidance method is similar to that of diffuse water filling method, Starting point selection first performed by phase quality evaluation parameters, The starting point is the point with the highest pixel quality in the parcel phase map, then establish the neighborhood window and its growth ring, Where the neighborhood window can be a cross or a field shape, Common neighborhood window size is 33, Unpackage the adjacent pixels in each direction, Fig. 3 shows the evaluation diagram of the training set and test set, And the phase mass of each point in the neighborhood window is stored in the growth ring from high to low, The highest mass point in the adjacent to each pixel. Cycle this operation until the image completes phase unwrapping. Application of this method need to pay attention to growth ring memory, if the package image size is larger, in the process of cycle package growth ring internal pixel number will increase rapidly, this will lead to the algorithm of package efficiency decreased significantly, the need to pass the algorithm of growth ring processing, on the one hand, to ensure that the pixels solution package order does not change, on the other hand to control the size of the growth ring, said this process for growth ring dressing program.

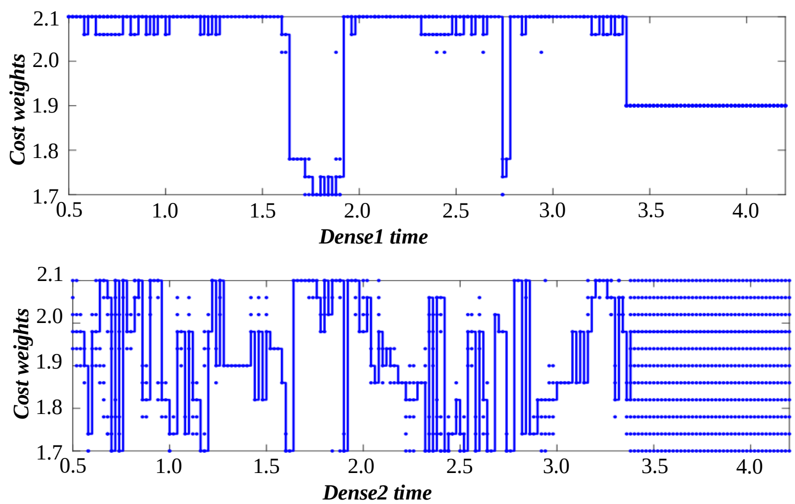

Fig. 3. Evaluation plot of the training set and the test set division.

In order to control the size of the growth ring, the value size needs to be pre-set. For MN size images, the growth ring size can be controlled by the size of MN. Next, the growth ring dressing procedure will work with the number of the pixels in the growth ring. When the number of points exceeds the preset value, the point with the mass value in the growth ring will be removed, and the lowest quality value in the remaining points will be set as the new mass threshold of the growth ring. The removed points were marked with special signs indicating that they were delayed points and would back into the growth ring in the subsequent process. In the next step, only those points with mass values above the threshold are deposited into the growth ring, while those below the threshold are labeled as deferred points. Points in the growth ring are constantly extracted for unwrapping until the growth ring is empty, when the growth ring threshold needs to be lowered (take 0) and the delayed points are put back into the growth ring for unwrapping. Table I shows the GSA pixel matching accuracy evaluation, and the above process is repeated until all points are unwrapped. There are three main parameters reflecting the phase quality: pseudo-coherence coefficient (PSD), phase derivative deviation (PDV) and maximum phase gradient (MPG). At present, the most widely used and most effective is the phase derivative deviation. The main influencing factor of the quality guide method for solving the package result is the image quality of the package image (including the accuracy of the foreground extraction technology and the stability of the shooting equipment), and the image quality will directly affect the accuracy of the final quality map guide. With good image quality, the phase solution of the mass graph guidance method will be better than the other traditional path tracking algorithms. In the mass graph guidance method, there is also a technique called "taboo search", by recording and avoiding the previously searched solutions.

TABLE I. EVALUATION OF PIXEL MATCHING ACCURACY IN GSA

Appraise	Consult	The GSA algorithm results	Results of the method in this paper
Picture	Bear fruit	Pixel number	Accuracy
A group	408000	387681	73.67%
B group	408000	384975	72.98%
C group	745608	724625	75.81%

The mask cutting method, also known as the mask-based cutting algorithm, is a segmentation method based on image edges. The core idea is to divide the image into different regions according to the edge information in the image. The method can be seen as a combination of the pruning method and the mass graph guidance algorithm. It requires searching for residual debris and placing the branch cut line, but the difference from the branch cut method is that the branch cut line placement is guided by the mass map. The brief step is as follows: Select a mask to traverse the entire image, usually select a square or circular mask; move the mask along the edge of the image and calculate the difference of pixel value in the mask; divide the image according to the obtained boundary position, such as algorithms based on the threshold value and area growth. The process of creating the mask cut line is similar to the pixel diffusion in the higher mass area, but the difference is that the process starts with a residual miss without equilibrium and then gradually spreads into the surrounding low mass area. Fig. 4 evaluates the graph as the loss function changes with the number of iterations. This process continues until the connected residue almost reaches equilibrium or reaches the image boundary. In fact, the process of generating the mask cutting line is a process of regional growth, so the generated mask cut line is rough and needs further refinement. Whether the point on the mask cut line needs to be removed depends on two points: whether the point is close to the handicap; whether the point removal affects the connectivity of the mask cut line. The detection of near disability is simple, while the detection of connectivity needs to be conducted in the 33-neighborhood centered on this point. If the coordinates of this point are (i, j), the point can be removed from the mask cut line if any of the following cases exist.

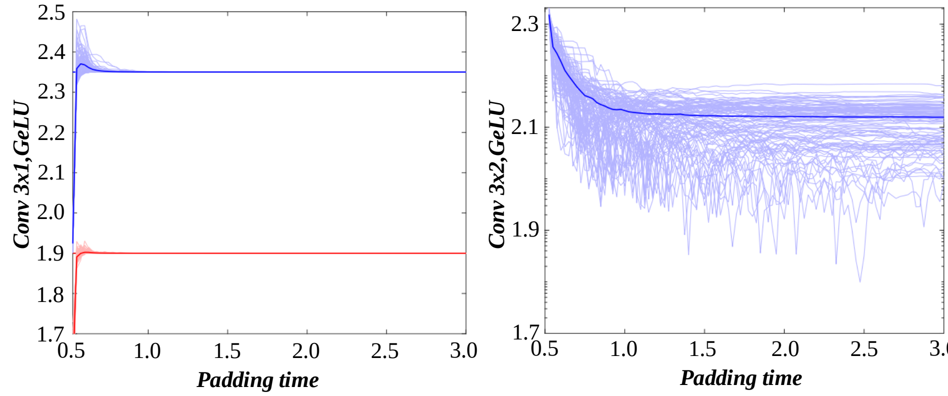

Fig. 4. The loss function changes with the number of iterations.

IV. Automatic Identification and Evaluation of Rural Landscape Features Based on U-Net

Phase solution package is optical interferometry structure light projection measurement is a common problem in the field of contactless measurement, phase solution package algorithm in the 80s to 90s in the rapid development stage, this stage appeared a lot of for all kinds of phase solution algorithm, for the subsequent further development provides an effective theoretical basis, phase solution package algorithm basically can be attributed to algorithm reduces the unwrapping problem to the problem of optimal path selection, which uses the correlation of adjacent pixels in space. The classical algorithms based on path tracking mainly include: branch cutting method, mass graph guidance algorithm, mask cutting method and minimum discontinuity algorithm. Fig. 5 is the confusion matrix evaluation graph, which connects the detected positive and negative residues into branch tangents and then bypasses them to unwrapping. The difficulty lies in the setting of the branch, doing a lot of work on the connection strategy of the branch, and proposing many improvement methods, and the effect is obvious. The quality map guide algorithm does not identify the residual or set the branch, but guides the solution path through the phase mass map. The mask cutting method combines the first two methods to guide the setting of branches by mass diagram, without rigorous process and detailed algorithm, which is the first feasible algorithm: minimum discontinuity algorithm. This method draws on the relevant theories of computer graphics, clever conception, solution accuracy and algorithm stability; moreover, proposes the regional growth algorithm, using the phase information of the surrounding pixels to predict the solution results and make consistency test, thus selecting the optimal solution path, achieving success in processing complex SAR phase data.

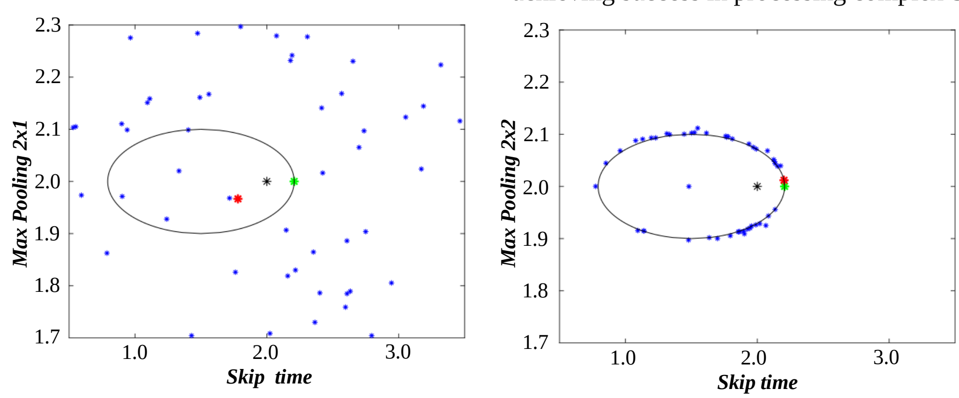

Fig. 5. Confusion matrix evaluation.

The problem of finding the minimum by calculating the minimum of the p power of the difference between the synthetic phase gradient and the wrapping phase gradient. Initially, this method was limited to the least squares method, divided into weighted least squares and no right least squares method. The concept of minimum norm is proposed, the least squares method is incorporated into this concept, and the significance of different norm values is clarified from the mathematical perspective, and the specific algorithm steps are given, which greatly enriches the understanding of parcel theory. After entering the new century, phase disassembly has entered the stage of diversified development. On the one hand, AI algorithms such as deep learning, genetic algorithms and ant colony algorithms were introduced into the branch method. Table II shows the RMA pixel matching accuracy evaluation to optimize the placement of branches. Compared with previous methods, the artificial intelligence algorithm can better place the branch line, but the characteristics of the branch method are difficult to work in the residual close density area. On the other hand, the network planning algorithm is introduced into the minimum norm method to try to solve this optimization problem through this optimization algorithm. The network planning method has better stability in the accuracy of these algorithms is still not high, and the efficiency is also general. In addition, filtering the parcel phase diagram is also a new development direction. Before unsolving the parcel, the parcel phase diagram is filtered first. While fully retaining the useful information, the noise is filtered out as much as possible to obtain the nearly perfect parcel phase diagram, so as to reduce the difficulty of unwrapping. The effect of this method is very significant on the images with severe noise interference. Different application fields have different requirements for unwrapping results. General algorithms have not appeared in the field of rural landscape interference image phase unwrapping. However, with the gradual iterative progress of neural network structure.

Traditional interferometry obtains useful information by directly analyzing interference stripes, but due by noise interference, stripe density and manual operation error. Phase shift technology is applied to optical interferometry. This new technique analyzes the phase difference to obtain the information of the measured surface. The measurement accuracy is higher. In phase shift interferometry, the inverse triangle function is used to obtain the phase. Due to the nature of the inverse triangle function, the recovered phase information is limited to a fixed interval, so the phase data discontinuity caused by the restriction problem should be eliminated to obtain the real data. Therefore, it is necessary to find the discontinuous cutoff point in the parcel image through the algorithm and restore it to continuous phase information. This process is called phase unwrapping. After decades of optimization, the basic phase unwrapping algorithm is specifically divided into two categories: path tracking method and minimum norm method. Fig. 6 is the ROC assessment diagram, where the path tracking method is a local algorithm. The core idea of this algorithm is to search for another target pixel by evaluating the polarity of the pixel data and determining the polarity, and establish a connection during the search process. If the two pixels have opposite polarity, stop the search; if the polarity is the same, expand the search range and build connections based on their data quality and polarity until the two pixels have the same polarity or the search range reaches the maximum. Then, repeat to override all unconnected pixels throughout the image until the target pixels are searched. The path tracking method mainly includes branch cutting method, mass map guide method, mask cutting method and minimum discontinuity method.

TABLE II. EVALUATION OF PIXEL MATCHING ACCURACY OF RMA

Appraise	**Consult**	**The RMA algorithm results**		**Results of the method in this paper**	
Picture	**Bear fruit**	**Pixel number**	**Accuracy**	**Pixel number**	**Accuracy**
A group	475000	392478	92.21%	348272	98.14%
B group	464000	382577	97.53%	347864	97.25%
C group	737808	747816	96.42%	747884	98.31%

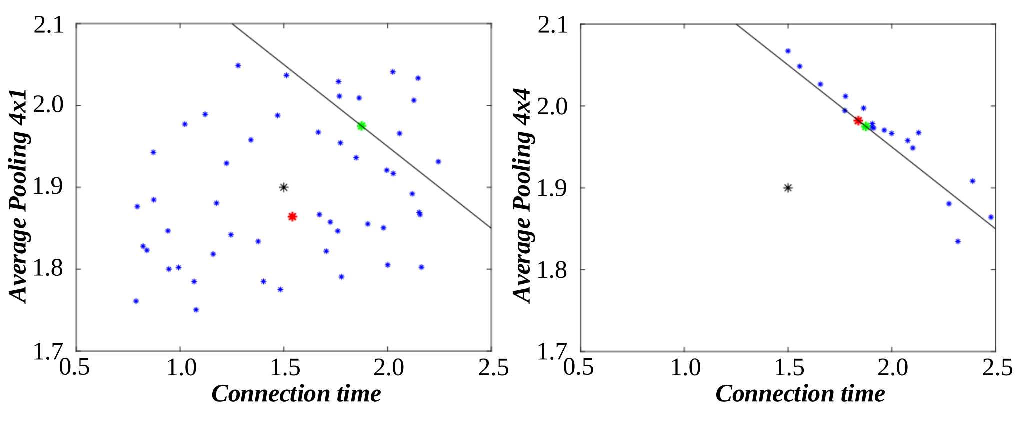

Fig. 6. ROC assessment.

Boundary function to cut down the subspace that is impossible to reach the optimal solution, so as to improve the search efficiency. First, determine the specific functions and constraints of the branch processing target, and then initialize the search queue and the current optimal branch point. The search queue contains the branch point to be expanded, and the current optimal branch point can be set to positive infinity. Secondly, for each unexpended node, the upper and lower bounds corresponding to the node are calculated and sorted according to this bound value, and then each node is expanded in the sorted order. Again, when extending a node, first check if a better solution appears, if so, update the current optimal solution and compute the bound value of all possible extended nodes of that node and insert it into the search queue. Finally, the above steps are repeated until the wrapping image completes the branch tangent arrangement and the phase unwrapping. After sorting all the residues, the first round of search was started from the first residue in the sequence. Set a search window of size 3 around the remnant close, and traverse the pixel information at the edge of the window. The position of the edge was determined by searching for the residual handicap. First, two adjacent residues are found and connected to form an approximate branch tangent. Fig. 7 evaluates the graph of the feature importance ranking, and then, determines. If so, the branch is considered to be equilibrium, you can stop the search; if not, find a new stump in the adjacent area and connect it to the existing branch and continue the search. When the whole search window is traversed, if still did not reach balance, expand the size of the search window, and on the edge of the search, until find the line balance conditions, size every 2 until to set the maximum size value, after completing the maximum size of the search, whether to achieve balance, will end the round of search. Furthermore, if the edge of the image is reached during the search, the search round also ends.

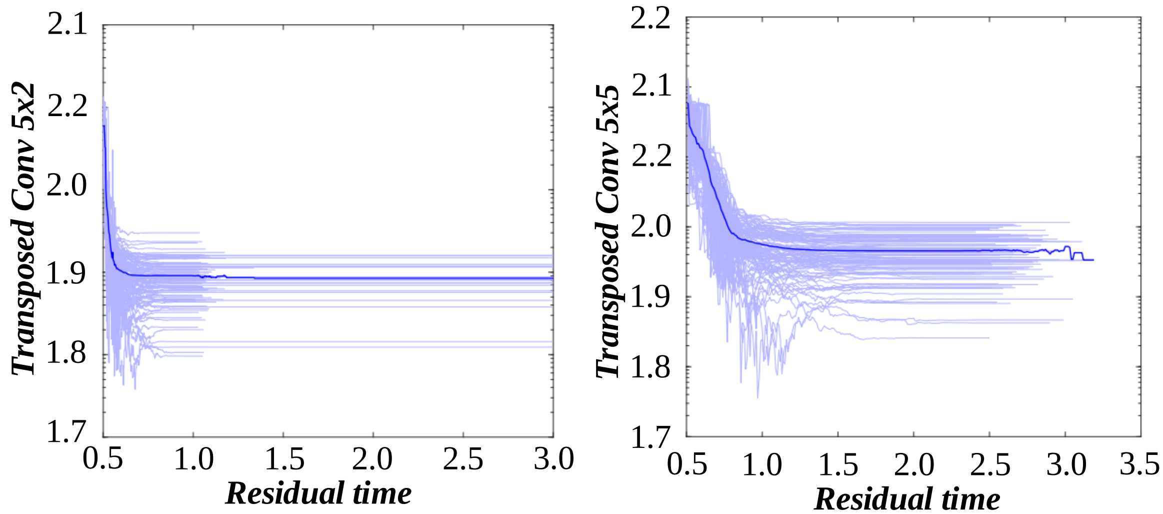

Fig. 7. Feature importance ranking evaluation.

In the phase unwrapping algorithm, starting from a point on the non-branched, unwrapping to the periphery. Before performing unwrapping, a series of judgments are required, including checking whether the point is at the edge of the image or the mask point and whether it has been unwrapped by another path. If none of the above conditions hold and the point is not branch, the solution can be performed. From the point where the package is completed as the starting point, judge again, and choose the appropriate path step method. Tra-walk through the entire image iteratively and untangle its normal parcel phase. An "island" is generated when the branch tangent forms a closed loop. These points are distributed on the branches and need to check if there is phase information that has been successfully unwrapped. If so, use this information to disentangle; otherwise, these points are "exceptions". By this way, we get the real phase distribution map, which effectively solves the error transfer problem caused by noise. The biggest advantage of branch cutting is it's very computationally efficient. In the case of less disability loss, the solution results are relatively credible. However, when the residue is dense, the algorithm will produce a large number of unreasonable branches and lines, which is easy to produce closed areas that cannot unwrap, and can easily lead to errors in the unwrapping results. In addition, this method only uses residual missing information and ignores other information, so the placement of branch tangents lacks convincing criteria.

V. Experimental Analysis

In the rural landscape interferometry, the phase is moved with a fixed step size, so the gray scale of the phase shift interference stripe shows a certain periodic change. Under ideal conditions, to simulate the phase-shift interference stripe image, it can be seen that when the phase shift is different, the difference of the pixel gray value at the same position reaches the maximum. Fig. 8 evaluates the model performance comparison, which has very obvious sinusoidal change characteristics. Simulated phase-shift interference stripe image after adding noise. It can be seen that under the influence of Gaussian noise such as noise, salt and salt noise (PSNR=13.3035) and the phase error of the interference stripe caused by the common light path, the interference stripe still has obvious sinusoidal change characteristics, which ensures that the algorithm logic can be stable in real situations.

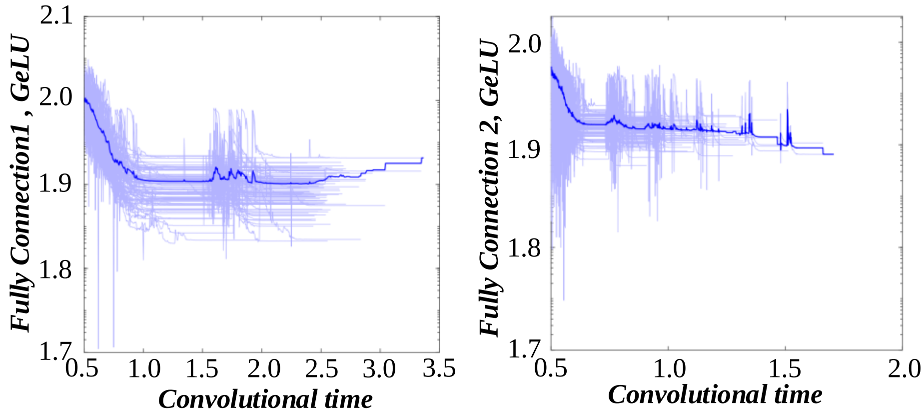

Fig. 8. Model performance comparison evaluation.

Rural landscape interference stripe image groups of rows 150 of all pixels and observe the change in gray scale. In the measured rural landscape interference image, the sinusoidal variation of the interference fringe. The gray value of false foreground pixels in the background area does not change much by phase shift. Fig. 9 shows the overfitting detection evaluation diagram, so the characteristics of the pixels at different phases can be used to eliminate the wrong foreground information, while connecting the connected domain and improving the. The treatment is divided into grayscale mask M1 and repair mask M2 stages. The target image needs to undergo preprocessing, difference operation, gray scale set allocation, threshold extraction, neighborhood local variance analysis and other steps, to realize the direct extraction of the foreground area of the final rural landscape interference image, to avoid the blur of image details.

To obtain the gray value of the processed image to extract the foreground area and take the image segmentation task. For example, the threshold needs to be set to extract the foreground area information of the rural landscape interference image. Mask cutting method is suitable for various types such as target detection, face recognition, medical image analysis, etc. Fig. 10 is the evaluation diagram of IoU index. Although the algorithm is simple and easy to understand, its dependence on edge information, the segmentation effect may be disturbed for some complex images, which needs to be optimized in combination with other image processing methods.

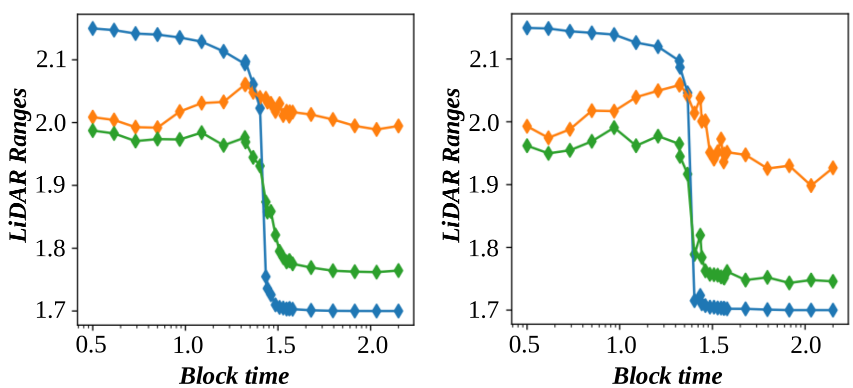

Fig. 9. Overfitting detection assessment.

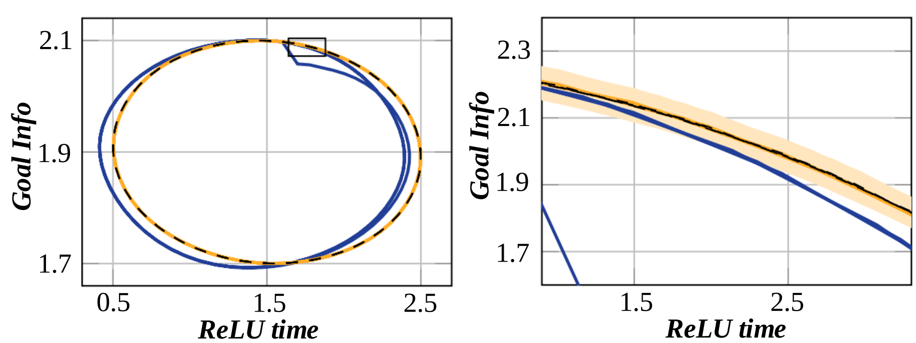

Fig. 10. IoU index evaluation.

VI. Conclusion

In the process of feature identification, we should not only pay attention to the decomposition of landscape feature elements, but also the grasp of the overall landscape structure. Using landscape perception, field research detailed records of local survey information, combined with residents' interviews, increase a lot of subjective observation, this method can more accurately identify and understand the landscape features, help people understand the landscape characteristics of different landscape area, to manage the change of landscape characteristics, help local policy for its landscape change. In the path tracking method, the phase reciprocal deviation is used between the mass map and the weight parameters. The black pixel area appearing in each image represents the absolute value of its phase difference, which belongs to the discontinuous breakpoint appearing when the algorithm phase unwrapped the rural landscape interference image. Such points will have some impact on the restoration accuracy when the final rural landscape morphology error is restored. Longlong branch lines appeared in some areas, The reason for this kind of branch line is the failure to form a good closed ring or some area noise when calculating the phase difference value of adjacent points, The branch tangent has not formed the closure of the wrong package; The mass map guidance method is the good algorithm of phase unwrapping in the path tracking method, Unsuccessful discontinuous points in the unpacking results, However, since the phase quality evaluation parameters can be adjusted appropriately, Make the solution quality of the algorithm in the rural landscape interference image is better than the branch method; The image unwrapping quality of mask cut line method and mass map guidance method is similar, Although part of the branch fails to undergo good phase unwrapping, However, you can see the integral traces of the algorithm; The unwrapping mass of the minimum weighted discontinuity method is similar to the above method, Failure to solve the discontinuity problem in the unpacking process.

In order to further analyze the prospect extraction results, the segmentation results of all the pixels in each group of images are extracted, and the reference segmentation results of the three groups, the comparison algorithm segmentation results and the proposed algorithm segmentation results. The number of pixels in groups A and B was 408000 and 745608. Image similarity reached 97.84% in group A, 96.21% in group B, and 99.33% in group C. The accuracy of GSA algorithm is improved by 2.82%, 5.18% over ICF algorithm, 1.54% over RMA algorithm; GSA algorithm by 1.86%, 4.92% over ICF algorithm, 2.76% from RMA algorithm; GSA algorithm by 2.14%, 2.77% compared with ICF algorithm, and 1.27% over RMA algorithm. By comparison, the maximum accuracy of the algorithm is 2.82% and the minimum increase is 1.86%. Compared with the ICF algorithm, the maximum accuracy increased by 5.18% and 2.77%, the maximum accuracy increased by 2.76% and the minimum improvement by 1.27%.

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