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Development and Utilization of Marine Resources Based on Neural Network Algorithm

Mateev Valentin*

University Greifswald, Germany

**corresponding author*

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Abstract: The sustainable development of human beings relies on the ocean to solve the problems related to environmental degradation, resource shortage and unreasonable population growth currently faced by human beings. It is particularly important to rationally develop and utilize marine resources. The purpose of this paper is to study the exploitation and utilization of marine resources based on neural network algorithm. Put forward corresponding suggestions for the development and utilization of marine resources, put forward an improved PCNN model, list its corresponding discrete mathematical expressions, expound the principle and basis of the improvement, and explain the parameter settings of the improved PCNN model. By using the underwater images collected by detection AUVs such as the seabed and tunnels to conduct experiments, a reasonable sonar image stitching experiment is set up to test the performance of different algorithms. Through the specific experimental results, the performance of different algorithms is analyzed and compared from both subjective and objective perspectives, which verifies the practicability and accuracy of the proposed method in underwater image enhancement and stitching.

1. Introduction

Water resources are increasingly becoming a key factor affecting economic development. Industrial sewage, agricultural water and domestic sewage make land freshwater resources continue to decrease, and the development and utilization of marine resources provide channels for seeking new water sources. Therefore, the development and utilization of marine resources can alleviate the shortage of freshwater resources [1-2]. Countries have successively carried out projects such as desalination to solve the problem of water shortage. The environment is deteriorating and pollution is increasing day by day. Air pollution, water pollution and solid waste pollution are constantly appearing around us, which has affected our normal life and work. The development and utilization of marine resources has become an urgent requirement of the current social and economic sustainable development [3-4].

As a key factor in the composition of marine ecology, marine resources play an important role in promoting the development of marine economy [5]. In view of this, in response to a series of problems in the development of marine resources, Sumantra K used literature review to put forward suggestions for marine resource development and implementation measures of management paths to escort marine resource development in the new era [6]. With the growth of the papermaking economy in the Bohai Rim region in recent years, the environmental pollution in the region has become increasingly serious, resulting in a substantial reduction and deterioration of marine resources. In view of this severe situation, the ways of sustainable development of marine resources in Bohai Sea are discussed. Darma R put forward practical measures and feasible suggestions to prevent and control environmental pollution and natural disasters, and ultimately achieve the purpose of sustainable development of marine resources in the region [7]. It is of practical significance to study the development and utilization of marine resources based on neural network algorithm [8].

The first part of this paper mainly introduces the main research content of this paper. The second part is the theoretical basis of the main marine resources. By focusing on the path of development and utilization of marine resources, it is fully prepared for the next work on the theoretical basis. An autonomous underwater robot is introduced, and an improved pulse-coupled neural network model is proposed. The third part is the experiment of marine resource collection, which mainly introduces the parameter settings based on the improved pulse coupled neural network model. The fifth chapter concludes, summarizes and evaluates the full text, and puts forward a research prospect for the further utilization of image stitching.

2. Research on the Development and Utilization of Marine Resources Based on Neural Network Algorithm

2.1. The Path of Development of Marine Resources

Innovation, as a key part of future development, guides the direction of China's future development and provides strategic support for enhancing China's international competitiveness [9-10]. Therefore, in the future marine development of China Ocean, efforts should be made to transform the extensive economic development model at the expense of the environment into a high-quality development model driven by technological innovation, increase investment in marine science and technology funds, and promote various social Funds are concentrated, and actively mobilize the enthusiasm of marine enterprises for marine science and technology research and development, implement a reward mechanism for enterprises with scientific and technological innovation, provide risk protection for enterprises with research and development risks, and encourage enterprises in the research and development of scientific and technological innovation. and promote the integration of marine science and technology into the collaborative innovation of various elements, and use innovation to promote the construction of China's marine power [11].

2.2. Autonomous Underwater Robots

The ocean contains rich mineral resources, and the detection of deep-sea landforms, exploration and development of marine resources is an important strategic space for maintaining the sustainable development of human society [12-13]. Underwater visibility is low, the environmental terrain is complex, and the underwater pressure is strong, which is not suitable for human operations.

Therefore, underwater operations need to be completed with professional underwater equipment. Due to the limitations of special underwater environmental conditions, underwater robots are born in response to demands and play a very important role in performing underwater tasks, bringing the development and operation of underwater resources into a new era [14].

An autonomous underwater vehicle (AUV) is an underwater unmanned equipment that integrates a variety of high-tech and can complete tasks independently. AUV can realize untethering operation underwater, and can carry out long-term and large-scale autonomous navigation and detection underwater. The pressurized water conveyance tunnel detection AUV is shown in Figure 1. When the AUv is operating in an underwater water conveyance tunnel, the underwater camera around the midbody of the AUV is used to take 360-degree shots of the internal structure of the tunnel, and then the obtained images of the tunnel wall are used. For crack detection, combined with GPS positioning information of AUV, the shape and position information of cracks can be accurately obtained, and tasks such as underwater terrain detection and underwater pipeline detection can also be completed [15-16].

Figure 1. Pressurized water tunnel detection AUV

2.3. Improved Pulse Coupled Neural Network Model

This paper aims to realize the binarization of the sonar image by using the synchronous pulse firing characteristics of the PCNN model, and detect the corners of the sonar image on this basis [17-18]. There are a large number of pixels whose normalized pixel gray value is 0 or close to 0 in the sonar image. Therefore, when Fi, j(n)=Ii, j is 0 or close to 0, the synchronous pulse discharge characteristics of PCNN It also loses meaning.

$$L_{i,j}(n)=\sum_{k,I}W_{i,j,k,I}Y_{i,j,k,I}(n-1) \tag{1}$$

Among them, the L channel also adopts the method of directly summing the pulse output Yi, j, k, l of the neighboring neurons and the corresponding connection weight Wi, j, k, l, as shown in formula (2).

$$U_{i,j}(n)=F_{i,j}(n)(1+\beta_{i,j}L_{i,j}(n)) \tag{2}$$

In this paper, a circular template is used to determine the threshold. The 37 small cells in the template correspond to 37 pixels in the image, which also correspond to the 37 neurons in the PCNN. The center m of the circular template and the pixel to be detected (i , j) aligned, these 37 neurons constitute the set C(i,j). Using the synchronous pulse firing characteristics of the PCNN model, the pixels with similar gray values in the image are pulsed synchronously. The undetermined coefficient a determines the threshold, which reduces the number of parameters in the threshold expression and improves the adaptability of threshold selection.

3. Experiment of Ocean Resources Collection Based on Neural Network Algorithm

3.1. Experimental Data Collection Process

The underwater pressurized water conveyance tunnel is selected as the experimental site, the experimental data is collected by the tunnel detection AUV, and some of the captured scene images inside the tunnel are selected for image enhancement and panoramic image stitching verification. The AUV has 5 underwater high-definition cameras, which are distributed near the mid-body of the AUV, each with a 72-degree interval, and there are searchlights next to each camera to provide lighting with appropriate brightness as needed; the bow end of the AUV is provided with a self-contained light source The front-view camera is equipped with a propeller main thruster at the tail, and a depth gauge is provided at the end close to the main thruster. The AUV bow and tail are equipped with four ranging sonars, vertical thrusters and lateral thrusters. The thrust direction is the same as that of the ranging sonar, in order to move forward and detect smoothly in the tunnel, with strong maneuverability and state retention ability, which is conducive to shooting stable and clear images of the tunnel wall.

3.2. Experimental Design

In order to test the performance of the algorithm in this paper, we used it and several classical corner detection algorithms introduced earlier in the same sonar image stitching experiment. Through the specific experimental results, we analyzed and compared their performance from both subjective and objective perspectives. The experimental steps of this paper are described below:

The first step: the acquisition of the image to be spliced: a complete sonar image is captured by the PS software into two images to be spliced with the same size and a common area;

The second step: detection and description of corner points: Harris algorithm, SUSAN algorithm, SIFT algorithm, FAST algorithm, and the algorithm in this paper are used to detect the corner points of the image to be stitched.

The third step: registration of corner points: all 5 algorithms first use the nearest neighbor algorithm to calculate the corner point pairs participating in the matching between the images to be spliced, and then use the corner point pairs participating in the matching as the data set to complete the image. registration.

Step 4: Image fusion: The five algorithms all use the fade-in and fade-out weighted average image fusion method to make the registered images smoothly transition at the seams to complete the image stitching.

Step 5: Output the stitched image.

3.3. Parameter Setting

In this paper, in order to make the pixels with similar gray values in the image emit pulses synchronously as much as possible, the connection strength between the F channel and the L channel of all neurons in the improved PCNN model is set to 1, that is: $\beta=1$

When the PCNN binarizes the sonar image, the number of iterations is large, and the image processing time will naturally become longer. If the number of iterations is too small, the neurons in the PCNN cannot fully emit pulses. In this paper, these two factors are considered comprehensively, and the number of iterations n is set to: $n=10$

4. Analysis and Research on the Development and Utilization of Marine Resources Based on Neural Network Algorithm

Count the number of corners detected by different corner detection algorithms, the number of pairs of corners participating in matching and the number of correctly matched corner pairs in the image group to be spliced, and calculate the matching rate of various algorithms. As shown in Table 1 (before the "/" symbol is the number of corner points detected by image 1 in the image group to be spliced, and after the "/" symbol is the number of corner points detected by image 2 in the image group to be spliced), the detection result is shown in Figure 2 shown.

Table 1. Performance comparison of various algorithms

Algorithm type	Number of detected corners	The number of pairs of corner points involved in matching	Correctly matched corner pairs	match rate
Harris algorithm	185/201	37	34	92%
SUSAN algorithm	287/311	33	31	95%
FAST algorithm	204/226	59	55	94%
SIFT algorithm	311/295	38	34	90%
Algorithm	304/327	28	28	100%

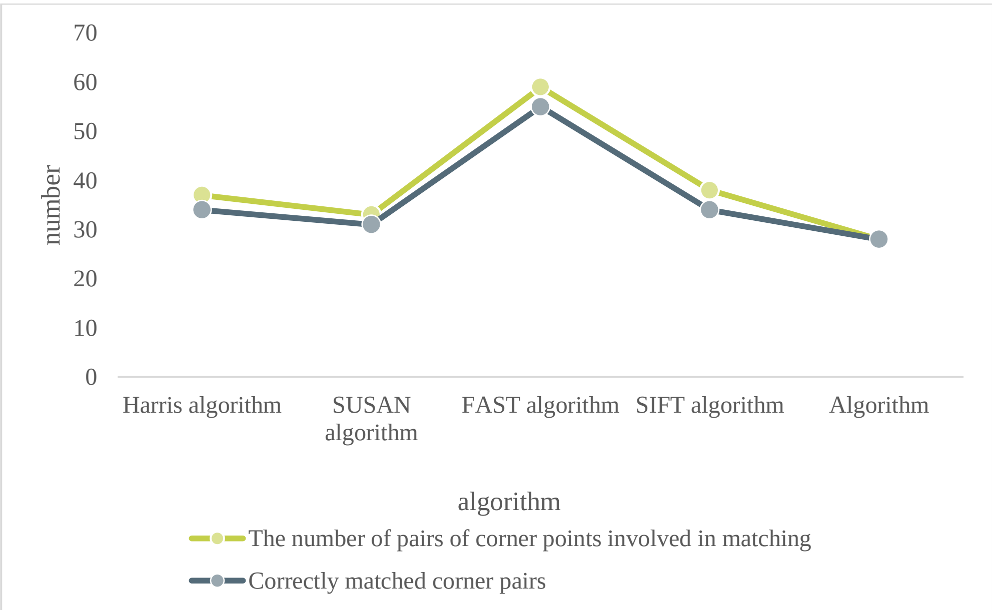

Figure 2. Test results

In the process of collecting seabed images, the sonar system will inevitably be affected by factors such as ocean waves, and the sonar images collected two times before and after may have a certain degree of relative rotation. Typically, the angle of relative rotation is small. In order to truly simulate the sonar image stitching scene and further test the performance of different algorithms, we rotate the image 1 in the figure by 5 degrees counterclockwise and 2 by 5 degrees clockwise for the stitching experiment. The results are shown in Table 2.

Table 2. Performance comparison of various algorithms after image rotation

Algorithm type	The number of pairs of corner points involved in matching	match rate (%)
Harris algorithm	15	88
SUSAN algorithm	30	87
FAST algorithm	32	90
SIFT algorithm	17	84
Algorithm	19	100

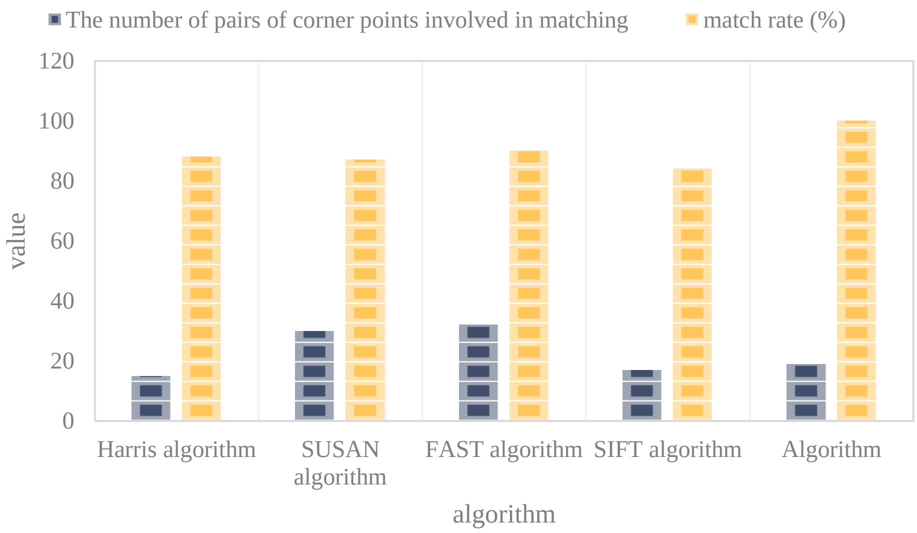

Figure 3. Detection results after image rotation

From the perspective of the accuracy of corner detection, the corner points detected by the algorithm in this paper have the highest degree of accuracy, and only a few misdetected corner points are in the reverberation area of the sonar image, and the accuracy of the corner points detected by the FAST algorithm is also relatively high. However, the number of corner points detected by this algorithm is the least, and the accuracy of the corner points detected by the Harris algorithm and the SIFT algorithm is relatively poor; when there is no relative rotation between the images to be stitched, the matching rates of the six algorithms are relatively high, but The algorithm in this paper has the highest matching rate, as shown in Figure 3.

5. Conclusion

With the continuous development of social economy, it is more and more necessary to develop and utilize marine resources, which plays an important role in promoting the rapid, efficient and healthy development of the national economy. We must make reasonable predictions about the limited nature of marine resources, and do a good job in planning and coordinating development and utilization in advance, which has far-reaching significance for the sustainable development of my country's future economy. This paper mainly studies the autonomous underwater robot, and uses the improved pulse coupled neural network model to try to stitch images. There are still some shortcomings and shortcomings that need to be further improved and researched: lack of real-time performance, both for underwater image enhancement and stitching. It is done offline, and cannot achieve real-time shooting enhancement and stitching on AUV. With the increase in the number of stitching, the stitching time is getting longer and longer. In the future, it is necessary to improve the speed of underwater image stitching to realize underwater real-time image stitching.

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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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