Monitoring Islands and Reefs Area Based on Satellite Remote Sensing Image

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ABSTRACT: The distribution of islands and reefs is wide, and the field survey cost is high and difficult. After the identification of islands and reefs, how to carry out effective monitoring is also a problem. By comparing three remote sensing monitoring methods, this paper analyzes the advantages of satellite remote sensing image to obtain islands and reefs area monitoring methods, and puts forward three methods based on satellite remote sensing to monitor islands and reefs area, so as to provide reference for islands and reefs area monitoring.

1. Introduction
Island is the base and fulcrum of human marine development. China's sea area is vast, and the whole sea area covers 38 latitudes and 24 longitudes. There are many islands. The topography and terrain of China's islands and reefs is complex. The coastline field survey is difficult and scattered, and it is difficult to carry out the mapping according to the conventional way. The remote sensing image has the advantages of high spatial resolution, large synchronous observation area and short acquisition time. The role of measuring the area of islands and reefs in the mapping of islands and reefs is gradually highlighted.

2. Extracting Islands and Reefs Area
The essence of extracting islands and reefs area is a problem of identification. At present, there is no unified extraction method. With more and more satellite launch, remote sensing data acquisition means are rich, remote sensing sources are diverse, and using remote sensing images to identify islands and reefs is different from traditional land mapping and marine mapping. In particular, the differences of electromagnetic wave spectral characteristics received by different source satellite sensors are used to identify the types of islands and reefs, so as to realize the extraction and accurate recognition of islands and reefs. It involves the islands and reefs remote sensing image preprocessing, image interpretation and other technical content. The extraction of islands and reefs area is based on the results of islands and reefs recognition and confirmation, and discriminates and analyzes semi-automatic or full-automatic islands and reefs recognition targets on high-resolution images. Because the complex surface features and large ships in the ocean are similar to the shape of islands and reefs, they will have a certain impact on the identification process of islands and reefs. Therefore, by using multi temporal images, through the comparative analysis of the target images in the same area, and combined with the wake characteristics of moving ships, we can confirm that the detection results are ships or islands.
3. Selection of Remote Sensing Means for Monitoring Islands and Reefs Area

The islands and reefs area is characterized by shallow water, many reefs, long shoals and mud siltation, and is greatly affected by tides and sea conditions. At present, the main measurement methods include conventional field measurement, satellite remote sensing, aerial remote sensing and low altitude UAV remote sensing. The field measurement has high precision, but it has high cost and low efficiency, so it has been less used in a large area. At present, satellite remote sensing is widely used in coastal monitoring at home and abroad. Compared with a variety of remote sensing monitoring means, the background conditions of different monitoring means are analyzed from the following three aspects.

3.1. UAV remote sensing image monitoring

Some scholars have conducted research on the selection of sensors according to the requirements of aerial photography of coastal zones and islands and reefs and the requirements of marine surveying and mapping indicators; other scholars have conducted two different airborne laser sounding system tests, and the results show that the airborne laser. The sounding system can reach the nominal sounding capability in the South China Sea, and can realize the integration of sea and land geospatial data acquisition. It compares the advantages and disadvantages of existing satellite remote sensing, aerial remote sensing and unmanned aerial vehicle remote sensing technologies, and uses rotary-wing drones. Remote sensing technology has obtained high-precision or the photos of micro-islands, and UAVs are used in regional water pollution surveys, which make up for the shortcomings of field measurements and satellite and manned aircraft measurements. Others use drone low-altitude remote sensing to monitor ocean red tides and oil spills, and carry out feasibility analysis. Taking into account the wide distribution of islands and reefs in my country, aerial images acquired in island areas cover a large area of water, and may even fall completely on the water surface, making aerial image matching impossible. In addition, UAVs cannot achieve long-term monitoring of changes in the area of islands and reefs due to issues such as the flight endurance of UAVs and the greater impact of weather.

3.2. Radar monitoring

LiDAR integrates laser ranging technology, computer technology, and inertial measurement unit (IMU)/DGPS differential positioning technology. This technology has produced a major breakthrough in the real-time acquisition of 3D spatial information, and provides high spatial and temporal resolution for the acquisition of geospatial information. The development and application of LiDAR technology abroad has a history of more than ten years, but China’s research and application in this area is still just starting. The system is mainly used in the acquisition of 3D information in urban areas and local topography information, especially in sand. The acquisition of terrain information in difficult areas such as land, wetlands, and forests plays an important role in application areas that require high-density, high-precision measurement and rapid response, such as natural disasters and band-shaped feature monitoring. Its advantage is that it is not restricted by weather conditions and realizes no ground control mapping. It breaks through the bottleneck of traditional aerial survey operations, and achieves extremely high operating efficiency at a very low cost. However, the technical difficulty of its spatial attitude calculation is not suitable for long-term large-scale data processing.

3.3. Remote sensing satellite monitoring

The survey of islands and reefs changes based on remote sensing optical images has become one of the hot spots in ocean research in recent years. The islands and reefs recognition technology based on remote sensing images has no mature algorithm yet. Literature uses[1] wavelet transform and mathematical morphology to identify and extract area features and residential areas from high-resolution remote sensing images. However, the selection of structural elements and the degree of automation need to be further improved; the literature [2] proposed a background image spot extraction method based on the region growing method, but did not further elaborate on the surface extraction; the literature [3] proposed the use of mathematical morphology methods to research and discuss the segmentation technology of IKONOS multispectral images, to demonstrate the effectiveness of
morphology methods in remote sensing segmentation. Remote sensing satellite imagery has the advantages of high spatial resolution, large area for simultaneous observation, short acquisition time, and intuitive display of results. Combined with my country’s numerous islands and reefs, scattered objective conditions, and reduced labor and resource costs, remote sensing satellite imagery should become. The main selection method of islands and reefs area monitoring is this.

4. Selection of Satellite Image Monitoring Methods

After selecting the appropriate satellite data, the original data of remote sensing satellite should be preprocessed, and the steps of satellite data processing are roughly the same. This paper summarizes the specific technical process as follows:

![Remote sensing satellite data processing flow diagram]

From Figure 1, we can see that the key technical problem of remote sensing satellite data processing is how to select the monitoring method to achieve the purpose of monitoring the islands and reefs area change after the similar pre-processing process.
4.1. Traditional visual interpretation

Visual interpretation is a kind of remote sensing image interpretation, also known as visual interpretation, or visual interpretation, which is the reverse process of remote sensing imaging. It refers to the process by which professionals obtain specific target feature information on remote sensing images through direct observation or with the aid of auxiliary interpretation equipment. Visual interpretation refers to extracting useful information from remote sensing images through brain analysis, reasoning, and judgment by relying on human eyes (or optical instruments), relying on the interpreter’s knowledge, experience, and relevant information. The use of traditional visual interpretation methods to vectorize the contours of islands and reefs on satellite images to compare the area of islands and reefs is one of the important methods of monitoring and is currently the most used image extraction method in China, such as land surveys, geological survey, etc. This type of method is very flexible, but requires a certain amount of experience and requires more business expertise. This method has high accuracy, but it is time-consuming and labor-intensive.

4.2. Computer automatic identification

At present, computer automation has been widely used in the field of remote sensing research. A lot of repeated work is done by computer, so as to improve the time efficiency and save the human cost. The development stage of image extraction is divided into automatic classification based on spectral computer, decision tree classification based on experts and object-oriented feature extraction. The object-oriented classification (OOC) technology integrates the adjacent pixels as objects to identify the spectral elements of interest, and makes full use of the spatial, texture and spectral information of high-resolution panchromatic and multispectral data to segment and classify. Islands and reefs area extraction is actually a single connection area calculation problem. There are many mature program algorithms in object-oriented classification extraction. Therefore, it is feasible to realize islands and reefs area automatic monitoring extraction. However, the computer automatic extraction also has its own defects. Now the three classification methods are compared as follows:

| Type                                          | Basic principles                                                      | The smallest unit of image | Applicable data sources                                      | Defect                                           |
|-----------------------------------------------|-----------------------------------------------------------------------|---------------------------|----------------------------------------------------------------|-------------------------------------------------|
| Traditional spectrum based analysis methods   | Spectral information characteristics of ground objects                | Single image pixel        | Low and medium resolution multispectral and hyper spectral images | The utilization rate of abundant spatial information is almost zero |
| Decision tree based on expert knowledge       | Pixels are classified according to spectral characteristics, spatial relations and other up-down relations | Single image pixel        | Multi source data                                              | Knowledge acquisition is complex                  |
| Object oriented classification method         | Geometric information, structural information and spectral information | An image object           | Medium and high resolution multispectral and panchromatic images | The speed is slow                                 |

4.3. Index monitoring

Each remote sensing satellite has different bands, and the unique index of remote sensing satellite data
can be formed by algebraic operation and combination between bands. The commonly used remote sensing indexes are NDVI, TVDI and so on. These changes are caused by human activities or changes in natural conditions. After a lot of data accumulation, researchers have established the normal index range. For example, according to the algorithm, the NDVI value range should be between -1 ~ 1, and the NDVI value response of normal vegetation should be between 0.2 ~ 0.7. If the NDVI is higher or lower than this range, it indicates that there is abnormal vegetation growth, so as to achieve the purpose of monitoring vegetation growth. The change of islands and reefs area can be indirectly monitored by monitoring the vegetation area index of the island, such as reclamation and other human activities. At present, the index of islands and reefs area is relatively small. Through long-term data accumulation and analysis, if we can form a vegetation index for monitoring the islands and reefs area, set a threshold value for early warning, when the area of islands and reefs is abnormal, it can be used to monitor the islands and reefs area. Theoretically, it is feasible to achieve the purpose by monitoring the index.

5. Conclusion
With the development of remote sensing technology, it is widely used in surveying and mapping. Through this study, it is feasible to extract the islands and reefs area based on satellite remote sensing. However, the traditional visual interpretation method has a lot of work, high cost, low information utilization rate of computer identification method, and the accuracy needs to be improved. The index monitoring method is not mature, which brings some difficulties to the extraction work. How to make up for each other's defects through their respective advantages is the direction of future work.

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