ANALYSIS OF SHIP DETECTION TECHNIQUES IN REMOTE SENSING IMAGES

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ABSTRACT - This paper represents various ship detection techniques in remote sensing images. Inshore ship detection from high-resolution satellite images is a useful yet challenging task in remote surveillance and military reconnaissance. It is difficult to detect the inshore ships with high precision because various interferences are present in the harbor scene. Remote sensing plays a very important role in ship monitoring due to some of its virtues such as a long operating distance and a wide monitoring range. Inshore ship detection algorithms in terms of precision rate and recall rate were discussed. The target pose of the detected ship can also be obtained as a byproduct of the ship detection.

Keywords: Inshoreship detection, Precision

1. INTRODUCTION

Ship detection is one of the hottest issues in many fields, such as harbor dynamic surveillance, traffic monitoring, and maritime management. According to the complexity of background, the existing ship detection methods are divided into the offshore ship detection and the inshore ship detection. For the offshore ship detection, the gray distribution analysis [1]–[3] or the constant false alarm rate detector [4]–[6] is usually adopted due to the fact that the gray level of the ships is usually higher than that of the sea background, especially in the synthetic aperture radar images. However, due to the various interferences in the harbor scene, it is more difficult to accurately detect the inshore ships compared with the offshore ships. For example, there are many distractors with the similar color, texture, or shape of the ships, such as the docks and the storages. Moreover, the ships are usually moored adjacent to the docks in different directions and scales.

Inshore ship detection algorithms can be categorized into two types: model-based and contour-based. The model-based methods are initially proposed for target detection in natural images. To eliminate the interference of the color, texture, and the background, the model-based methods generate discrim-inative descriptors for the local features of the target from a large number of positive samples and negative samples by the training strategy. Commonly known models include the bag-of-words (BoW) model [7]–[12] and the part-based model (PBM) [13]–[16]. The BoW model applies the statistic characteristic of the visual words and trains a support vector machine [17]–[19] to classify the target words and non-target words. Due to the strong flexibility of target describing, the BoW is widely used in scene categorization [8], object classification [10], and image annotation [12]. Recently, the spatial sparse coding BoW (SSCBoW) model was introduced for target detection of remote sensing images [7]. Although some spatial information was considered, the SSCBoW model is still difficult to represent the object with complex structure, as pointed in [14]. On the other hand, the PBM divides the target into several parts and describes their spatial relations under a graph structure [15]. Since the PBM is able to solve the deformation problem, it is suitable to detect the targets in natural images, especially with various poses such as pedestrians, animals, and plants [13]. However, the PBM is limited in remote sensing detection because it does not work well for targets in different directions.

2. LITERATURE SURVEY

A.Guang Yang et al (2014)

Proposed "Ship Detection from Optical Satellite Images Based on Sea Surface Analysis "In this paper, Automatic ship detection in high-resolution optical satellite images with various sea surfaces is a challenging task. In this letter, we propose a novel detection method based on sea surface analysis to solve this problem. The proposed method first analyzes whether the sea surface is homogeneous or not by using two new features. Then, a novel linear function combining; pixel and region characteristics is employed to select ship candidates. Finally, Compactness and Length-width ratio are adopted to remove false alarms. Specifically, based on the sea surface analysis, the proposed method cannot only efficiently block out no-candidate regions to reduce computational time, but also automatically assign weights for candidate selection function to optimize the detection performance.
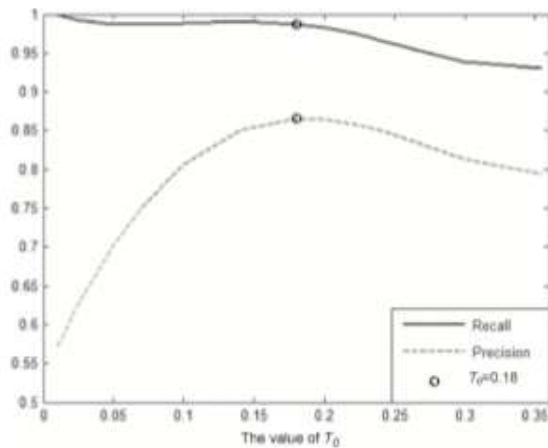
Fig1:Recall and Precision with   different values of T_o

Fig1 Shows the recall and precision with different values of T_o, the pixels above T_o are considered as ship candidate pixels. T_o will be properly set according to the training data. Experimental results on real panchromatic satellite images demonstrate the detection accuracy and computational efficiency of the proposed method. The proposed method can improve the performance of ship detection in terms of the detection accuracy and computational cost.

B. Changren Zhu et al (2010)

Introduced "A Novel Hierarchical Method of Ship Detection from Space borne Optical Image Based on Shape and Texture Features" introducing Ship detection from remote sensing imagery is very important, with a wide array of applications in areas such as fishery management, vessel traffic services, and naval warfare. This paper focuses on the issue of ship detection from space borne optical images (SDSOI) approach based on shape and texture features, which is considered a sequential coarse-to-fine elimination process of false alarms.
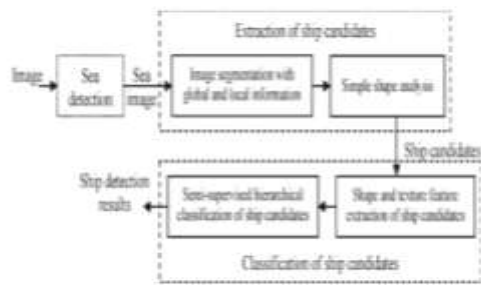

Fig2: Flow diagram of ship detection in   SDSOI

Fig 2 Shows the flow diagram for detecting ship, besides a complete and operational SDSOI approach, the other contributions of our approach include the following three

aspects: 1) it classifies ship candidates by using their class probability distributions rather than the direct extracted features;2) the relevant classes are automatically built by the samples' appearances and their feature attribute in a semi supervised mode; and 3) besides commonly used shape and texture features, a new texture operator.

Table 1:Performance of SDSOI

Method	METHOD3
Accuracy	95.42%
Missing ratio	4.58%
False ratio	3.68%
Error ratio	8.26%

Table1 Shows the performance of SDSOI ,the performance could be improved by adding typical candi- dates to the training set. Despite a small performance decrease, our approach can obtain a satisfactory performance of ship detection.

C. Nadia Proia and Vincent Pagé (2010)

Introduced "Characterization of a Bayesian Ship Detection Method in Optical Satellite Images" Our detection method is based on the Bayesian decision theory and does not need any preprocessing. Here, we describe the method precisely and the tuning of its two parameters, namely, the size of the analysis window and the threshold used to make a decision. Both are fixed from the receiver operating-characteristic curves that we draw from different sets of tests. This study focuses on the monitoring of fishing activities and on the detection of ships. The well-known advantage of radar data is that they are much less influenced by atmospherically weather conditions than optical data and can be collected night and day.

Moreover, their visual interpretation is difficult and their resolution is low in most cases (about 5 m × 25 m). For all these reasons, the detection of nonmetallic small targets is a difficult task in SAR images. High-resolution panchromatic optical satellite images are rarely used for ship detection, but their interpretation is easy for any human operator, and the current resolutions permit the detection of the very small targets, which are involved in fishing activities.

D.Wentao An et al (2014)

Presented "An Improved Iterative Censoring Scheme for CFAR Ship Detection With SAR Imagery" implemented to eliminate the influence of target returns on the estimation of local sea clutter distributions, an improved iterative censoring scheme (ICS) for constant false-alarm rate

detectors is proposed with two modifications. First, the proposed ICS censors out both target pixels and their four-connected neighborhood pixels from the estimation of local sea clutter distributions. The proposed initial detector, which only needs the probability of false alarms as an input parameter, is based on the sorting of all pixels under test. Experiments of ship detection with RADARSAT-2 Scan SAR wide mode images are presented to illustrate the effectiveness and improvements of the proposed ICS.A large number of CFAR detectors have been proposed with different local statistics of the background clutter. To estimate local statistics of the background, there is a classic problem of CFAR detectors as follows. When multiple targets exist, the clutter area of a reference window may include returns from other targets which usually are much larger than the background clutter.

E.Chao Wang et al (2014)

Introduced "Ship Detection for High-Resolution SAR Images Based on Feature Analysis" High-resolution synthetic aperture radar (SAR) data have been widely used in marine environmental protection, marine environmental monitoring, and marine traffic management. Ship detection is one of the important parts of SAR data for marine applications. This letter focuses on the feature analysis of ships in high-resolution SAR images and proposes an improved optimizing algorithm for ship detection. A fast block detector is designed to extract sea clutter in a uniform local area, and then a constant false alarm rate detector is employed.
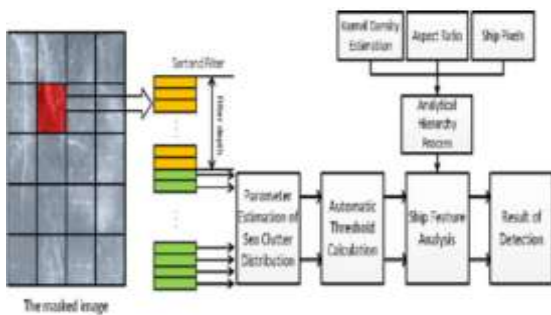

Fig3:Flow diagram of improved   optimizing algorithm

Fig3 Shows flow diagram of improved optimizing algorithm, Based on the kernel density estimation of ships, aspect ratio, and pixel points, ships are identified. Ship detection with low false alarms in high resolution SAR images faces more challenges than it does in low-resolution SAR images of ships.

Fig4:Test site for detecting ship

Fig 4 Shows the test site that is analyzed on TerraSAR-X and COSMO-SkyMed data, As no information about the ships is available, the basis for performance evaluation is through comparison with human visual interpretation of the same images. In the TerraSAR-X image, there are 64 ships in total, while in the COSMO-SkyMed the number of the ship targets is 165. Pfa is set at 0.001 and bandwidth at 5. The block size of the detector is about 2000 × 2000, and the filter depth is set the same as Pfa. FD is set at 75%.TerraSAR-X and COSMO-SkyMed images are used to test our algorithm.

Table2: Final detected results after optimization

P_{fa} (K distribution)	Performance (TerraSAR-X)						
	N_{td}	N_{fd}	N_{md}	P_d	P_{fd}	Time(s)	FoM
1E -3	61	8	3	95.31%	13%	60	0.847
1E -5	61	7	3	95.31%	10.94%	61	0.859
1E -7	60	6	4	93.75%	9.38%	62	0.857
1E -9	58	6	6	90.63%	9.38%	61	0.829
Distribution	Performance (COSMO-SkyMed, P_{fa} = 1E −3)						
	N_{td}	N_{fd}	N_{md}	P_d	P_{fd}	Time(s)	FoM
Gauss	165	67	0	100.0%	41%	328	0.711
Weibull	165	47	0	100.0%	28%	394	0.778
Gamma	163	29	2	98.79%	18%	395	0.840
G⁰	159	20	6	96.36%	12%	497	0.859
K	155	13	9	93.94%	8%	617	0.871

Table 2 shows the final detected results after optimizing of ship feature analysis. The experimental results show that this algorithm can be implemented with time-saving, high- precision ship extraction, feature analysis, and detection.

3. CONCLUSION

In this analysis a review on various ship detecting techniques is performed. Performance evaluation has been conducted on the test images collected from the Google Earth services. A detailed analysis on the effects of two important parameters to the inshore ship detection, the similarity thresh-old ε, and the weight for the "V"-shaped structure ω is also presented. From the analysis it is observed that weighted pose voting produce better performance in detecting the ship.

4. ACKNOWLEDGEMENTS

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