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# Speeded Up Robust Feature Extraction from Underwater Sonar Images

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***Abstract:*** The object recognition in underwater sonar images for the presence of submerged objects is a challenging task. In this paper we have extracted features from underwater sonar images for object recognition. The interest points that is the feature points are extracted using Speeded up robust features. The image is represented using sparse representation algorithm for retaining the minute details in the image.

***Index Terms:*** Sonar Images, Confidence map, Boundary detection, Side-Scan, Surf (Speed Up Robust Feature) method Sparse representation, Underwater acoustic image.

## 1. INTRODUCTION

The object recognition in underwater sonar images for the presence of submerged objects is a challenging task. The blurring of image makes the object detection a difficult one. Feature detection and description plays a major role in image stitching, registration, object detection etc. Underwater image usually suffers from large color variations, SURF feature extraction helps to solve this problem. The Feature points extracted from sonar images are corners, blobs, etc for recognizing the object. The feature matching algorithm helps to detect feature points identified from the target. Factors such as shadowing, environmental changes and dispersion affect the quality of light transmission which affects the quality of the image. These problems are overcome by capturing image using acoustic signal (Singh et. al.,).

The target images are captured using side scan sonar equipment which captures large areas of seabed. Side scan images may also help to identify appropriate fish living area for different type of seafloor. During the early stages of exploration, verification of side scan sonar sonographs is critical to successful identification of important habitat types (Iqbal.K et. al., 2007). Side scan sonar uses acoustic signal that is sound waves instead of electromagnetic wave. Sound waves are transmitted from the tow fish to the bottom and reflected which is received as echoes within fraction of second. Several existing techniques like saliency method which is used to recognize objects suffers from various disadvantages (Rodriguez. F et. al., .,2008). This method is limited to static images and it overlooks the spatial co-ordinates of the target. Saliency detection does not deal with complex structures (Yang. J et. al.,) The computation of saliency and hierarchical saliency is complex which limits real time applications.

## 2. RELATED WORK

Detecting the features from images in underwater conditions: The underwater acoustic image measurement technology is a technology of passive acoustic localization in near field, which can get the track of moving target by measuring the main noise sources of the target through large scale array.

A feature detective and a feature matching algorithm are necessary for object detection. A set of feature points can be extracted from an image using feature detector the target images and a set of template images are taken either out of water or in different conditions. Feature matching algorithm tries to map the feature points identified from the target image to the template image corresponding to the object. The objects present in the target and template images may have different configurations like translation, rotation, scaling. The effects of various underwater point spread functions (PSF) in detecting the image features were studied along with the impact of the function on the potential of the features while they are used for matching and detecting the object (Jiang. B. et. al., 2014)

The precision between two region descriptors are analyzed to evaluate the performance of the descriptors and detectors, an image was captured out of water and various PSF's were applied to imitate different underwater conditions following which regions are detected from each of the PSF convoluted and the original image.

## 3. PROPOSED WORK

The proposed work includes acquiring sonar image from edgetech website, preprocessing the images for removing speckle noise, enhancing the image using histogram equalisatin, extracting Speeded up robust features (SURF) for detecting target object. The Figure 1 explains the methodology used in this work.

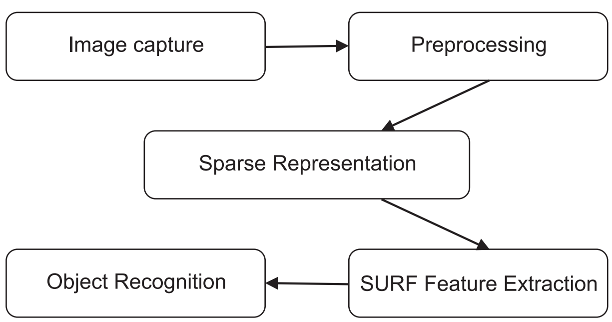


**Figure 1: Block diagram**

### *Image Acquisition*

The sonar image is captured using side scan sonar equipment which is working at a frequency of 500 kHz and covers a large sea floor. Side scan sonar images finds application in mining, archaeology investigation of fish habitat (Stefanakis et. al.,2012). The Sonar images we used are collected from Edge tech Database.

### *Preprocessing*

The sonar images acquired suffers from speckle noise. The Preprocessing is done using median filtering and histogram equalization methods in order to preserve edges.

### *Sparse Representation*

The sonar image is a high dimensional data, to process and to retain the minute information details we have exploited the regularity of sparsity of the image (Yang. J et. al., Dong W et. al., 2013; Stefanakis et. al., 2012). This huge volume of data while processing with sparsity reduces the computation time. The images are trained using K. SVD algorithm and then PCA dictionary is created. Then feature points are extracted from the sparse represented images.

### *Feature Extraction*

Feature extraction a type of dimensionality reduction that efficiently represents interesting parts of an image as a compact feature vector. The feature extraction is done with the help of *Speed up Robust Feature* (SURF) Method.

### *Surf (Speed up Robust Feature) Method*

In this SURF method we compared the neighbourhood interest points and detected the interest points. Then the interest points are represented. The interest points are selected at distinctive locations in the image, such as corners, blobs, and T-junctions. The most valuable property of an interest point detector is its repeatability. This repeatability expresses the reliability of a detector finding the same physical interest points under different viewing conditions. Next, the neighbourhood of every interest point is represented by a feature vector. This descriptor has to be distinctive and at the same time robust to noise, detection displacements and geometric and photometric deformations. Finally, the descriptor vectors are matched between different images. Here we taken the interest points are like color. In this paper processed two different sonar images. The implementation of surf process shown in the figure. The related output is displayed in Figure 7.

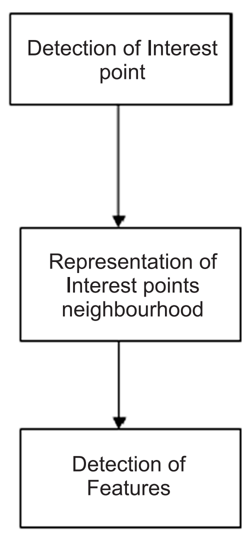


**Figure 2: Implementation of Surf Method**

## 4. RESULTS AND DISCUSSION

The proposed work reports the importance of post processing of underwater images whose quality is degraded. The simulation outputs are given below.

Figure 3 Shows the input image captured using side scan sonar.

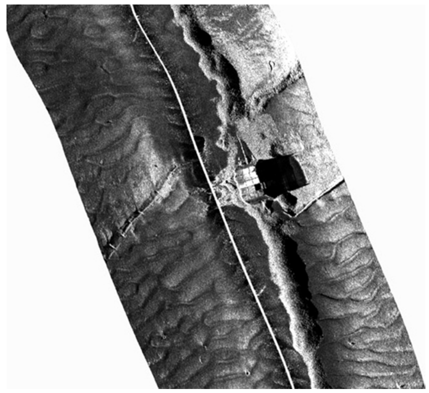

**Figure 3: Sonar image**

The Preprocessing is done using median filtering which is simple method for noise removal. This filtering is effective in removing the speckle and Gaussian noise which is mostly seen in the sonar images.

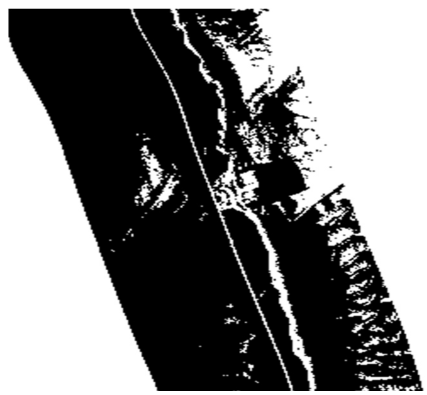

**Figure 4: Sonar image after median filtering**

Figure 5(a), (b) & (c) Sonar image after Histogram Equalization. The color features of the sonar image will be separated as Red, Green, Blue distribution for histogram.

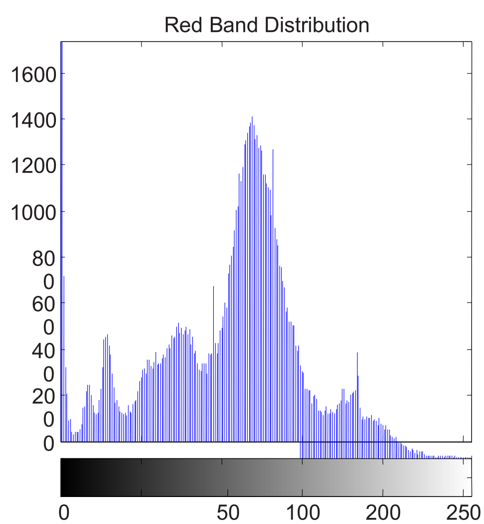


**Figure 5 (a)**

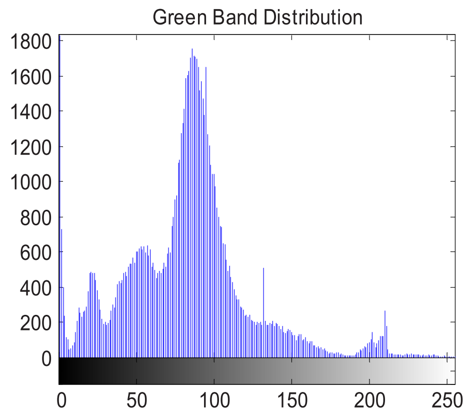


**Figure 5 (b)**

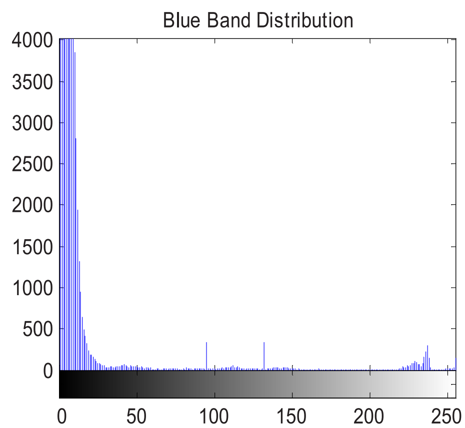


**Figure 5 (c)**

Figure 6. Shows the result for feature points detected between two sample sonar images.

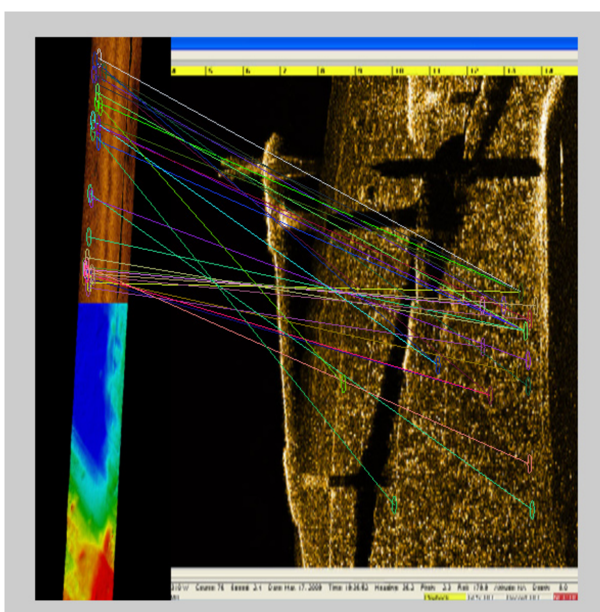

**Figure 6: Sonar image applying Surf Method**

Table 1 show the performance evaluation of SURF features for the datasets. The evaluation is done by finding the No of feature points detected, computation time, repeatability, no of matches.

**Table 1**
**Performance Evaluation of SURF features**

| | *Method* | *SURF* |
|---|---|---|
| Sonar Image 1 | No of Feature Points Detected | 843 |
| | No of Matches | 511 |
| | Repeatability | 0.7 |
| | Processing Time (Seconds) | 10.45 |
| Sonar Image 2 | No of Feature Points Detected | 736 |
| | No of Matches | 434 |
| | Repeatability | 0.68 |
| | Processing Time (Seconds) | 9.10 |
| Sonar Image 3 | No of Feature Points Detected | 847 |
| | No of Matches | 526 |
| | Repeatability | 0.6 |
| | Processing Time (Seconds) | 10.2 |

## 5. CONCLUSION

In this paper we have acquired the sonar images and represented using sparse algorithm. The sparse technique is applied to reduce the dimensionality. We extracted the SURF features for detecting the object. In future we have planned to compare with SIFT feature extracting method. We intended to evaluate the performance to find which method is suitable for real time underwater image processing.

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