Mine Classification of Sonar Image Using K-NN Method

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Abstract
Automatic Detection And Classification (ADAC) is a system to detect and classify the underwater objects for mine hunting applications. The segmentation, feature extraction, and classification are the main steps involved in the system. Two design issues in the system, the selection of the optimal classifier and the selection of the optimal feature subset. The comparison of classification systems is based on a pre-selected feature set. A different subset might yield a different ranking. The K-NN(nearest neighbour) method that assesses the classifier performance without constraints to any specific feature subset. In the classifier system a feature selection algorithm estimates the optimal feature subset. A new extension of the Sequential Forward Selection (SFS) and the Sequential Forward Floating Selection (SFFS) methods, overcomes their main limitations, the nesting problem. Option D is used to store the best alternative at each iteration. The performance of the so-called D-SFS and D-SFFS is tested on simulated and real data. The methods are also used for designing an ADAC system for mine hunting based on synthetic aperture sonar images.The new k-nn method provide better performance than that the previous LDA method.

1. Introduction

In electrical engineering and computer science, image processing is a type of signal processing for which the image is an input, such as a photograph or video frame; the output of image processing such as set of characteristics or parameters related to the image [1]. Most image-processing techniques involve treating the image as a two-dimensional signal and applying standard signal-processing techniques to it. Image processing usually refers to digital image processing, and include optical and analog image processing also are possible. The acquisition of images (producing the input image in the first place) is referred to as imaging.

The digital image is "invisible", must be prepared for viewing on one or more o/p Devices such as laser printer, monitor etc. The digital image can be optimized for the application by enhancing for altering the appearances of structures within it. Digital image processing made digital image can be noise free. It can be made available in any desired format such as X-rays, photo negatives, improved image, etc.

Digital imaging is the ability of the operator to post-process the image .It means manipulate the pixel shades to correct image density and contrast. Images can be stored in the computer memory and easily retrieved on the same computer screen. Digital imaging allows the electronic transmission of images to third-party providers.

Feature-based ADAC systems for mine hunting consist of three steps.

- Segmentation: The image is partitioned into three regions: the highlight of the objects, their shadows, and the background. Besides man-made objects, physical features of the terrain, such as rocks and sand ripples may also be segmented.
- Feature extraction: Each object (highlight and associated shadow) is characterized by a set of features.
- Classification: Each object is classified according to the comparison of its feature vector and those of a training set. Ideally, the physical features of the terrain are classified as clutter and the man-made objects as mines. If not, they constitute false alarms and missed detections, respectively.

Real-time underwater object detection based on electrically scanned high-resolution sonar provides a good estimate of the location of the object, but strains the computer on board, because of high rate of raw data. [2]. The amount of data can be cut down by decreasing the scanned area [2],but this reduces possibility of planning an optimal path.

Synthetic aperture image reconstruction is an inverse problem where the goal is to create an image of the seafloor reflectivity from measurements of the echo signals along the synthetic aperture [2]. The hardware cost is very high to implement such a camera type. It provide a photograph as mentioned the main areas but it does not provide the mine types. It is very difficult to determine the mine type. High resolution provides good estimate but stress the hardware. A novel extension of the sequential forward selection (SFS) and the sequential forward floating selection (SFFS) methods, which mitigates their main limitations, the nesting

1.1. Segmentation

The image is partitioned into three regions: the highlight of the objects, their shadows, and the background. The man-made objects, physical features of the terrain, such as rocks and sand ripples may also be segmented [11]. Markovian method takes as input from the Region of Interest (ROI) output. Analysis the output and applies the Markovian process. The process separates the background and shadows as 0's and the object as 1's (mines).The Marko process segments the object (1's) and forward this output to the next process feature extraction. Segmentation can be done using different techniques [11].

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Thresholding: All values above some threshold are set to 1 and those below the threshold are set to 0 or vice versa. Segmentation is the process of partitioning an image into several regions. Three different regions occur: the highlights of the objects in the scene, their shadows and the seabed or background. The objects cannot only be mines, but also physical features of the terrain such as rocks or sand ripples [11]. The element that produces a shadow as being an object. The segmentation algorithm used in is a cascade of two segmentation approaches: under a Markovian image representation, but in the existing system [1] use both Markovian algorithm and active contours algorithm for segmentation process. It is very complex to run both the algorithm.

1.2. Feature Extraction

Each object (highlight and associated shadow) is characterized by a set of features. The SIFT (Scale Invariant Feature Transform) method is used in feature extraction process. The method takes as input from the segmented output. The produces output like white doted in the mine like objects. The transforms this output to the feature selection process. Each object (highlight and associated shadow) is characterized by a set of features [1]. The different features that are extracted for each segmented object are described. The selection of a meaningful feature subset, Provides the best system performance, by the feature selection methods. Traditionally, the description of sonar objects focused on the shadow shape, including, e.g., Fourier descriptors and normalized central moments [1]. The statistical properties of the image have also been considered .The set of features presented in has been extended. A combination of statistical and geometrical features for both the highlight and shadow regions is considered[1].A unified ADAC system, the segmentation algorithm is introduced and the feature set is extended, in an attempt to minimize the influence that poor segmentation has on the feature values. The selection of the optimal classifier and the selection of the optimal subset of features. Indeed, they are interdependent. The classification systems are compared; typically the same feature subset is used for all of them. A different feature subset might produce a different ranking [1]. A resampling algorithm for quality assessment of classifier performance, which is unconstrained to any specific feature subset, is proposed. The utilize it to choose the optimal classification system.

Feature Selection

The goal of feature selection is to prepare the inputs for the mine-type classification step. A novel extension of the sequential forward selection (SFS) and the sequential forward floating selection (SFFS) methods, which overcomes their main limitations, the nesting problem [1]. The best alternative at each result, a set of D options is stored.

The performance of the so-called D-SFS and D-SFFS is tested on simulated and real data, significantly outperforming the standard algorithms. The methods used for designing an ADAC system for mine hunting based on two extensive databases of synthetic aperture sonar images [1].

The output of this feature selection process is takes as small quantity from the extracted output and gives as input to the classification method. The D-SFS and D-SFFS algorithms have been employed to estimate the optimal feature subset for both databases. But in the existing system use feature selection (FS) and feature extraction (FE) [3], [4], The FS method does not attempt to produce or generate a new features, but tries to select best ones from the original set of features[3], [4]. The FE method generate a new features in which each new feature is obtained by the transformations of original feature [3], [4].

1.3. Classification

Each object is classified to the comparison of its feature vector and those of a training set. The physical features of the terrain are classified as clutter and the man-made objects as mines. They constitute false alarms and missed detections, respectively [12]. The algorithm used in the step is K-NN (nearest neighbour). It takes the input from the feature selection process as a small quantity and apply the K-NN algorithm to classify the selected mine [12]. The process of K-NN is to apply the scale values, threshold value to classify the mines. The mines obtained as like cylindrical mine, truncated mine and cone like mines and stones. The design of feature based ADAC systems, and applied to the mine hunting for two different databases of SAS images. The feature-based mine hunting fuse several simple non optimal systems, to improve the performance. The design of a single classification system, which was optimized in two fundamental aspects: the choice of the classification system and the selection of the optimal feature subset [12]. First, the segmentation process was shortly described. A collection of features was designed enforcing the insensibility of the features values to poor segmentation scenarios. Then, a resampling algorithm that provides a quantitative measure of classifier performance independently of any specific feature subset was presented.

2. Existing System

Real-time underwater object detection based on electrically scanned high-resolution sonar provides a good estimate of the location of the object, but strains the computer on board, because of high rate of raw data [2]. The amount of data can be cut down by decreasing the scanned area, but this reduces possibility of planning an optimal path [2]. Synthetic aperture image reconstruction is an inverse problem where the goal is to create an image of the seafloor reflectivity from measurements of the echo signals along the synthetic aperture [2]. The hardware cost is very high to implement such a camera type. It provides a photograph as mentioned the main areas but it does not provide the mine types. It is very difficult to determine the mine type high resolution provides good estimate but stress the hardware in the classification system the existing method used is Linear Discriminate method. It characterizes or separates two or more classes of objects or events [5]. The resulting combination may be used as a linear classifier.

3. Proposed System

In the existing system Linear Discriminant method was used in the classification stage. It characterizes or separates two or more classes of objects or events [5]. The resulting combination may be used as a linear classifier. But it won't generate more than the user defined mine type defined in the program. The proposed system overcomes this problem

by using K-NN method. The K-NN method finds out all the nearest approximate mine types as close to the user defined mine types. It is very easy to recognize the nearest mine types also.

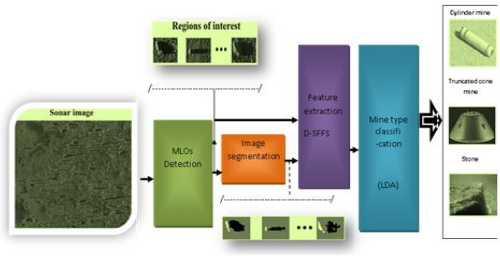

Fig: 1. Block Diagram

Synthetic-Aperture Sonar (SAS)

The principle of synthetic aperture sonar is to move a sonar along a line and illuminate the same spot on the seafloor with several pings, produces a synthetic array equal to the distance travelled. Coherent reorganization of the data from all the pings, a synthetic aperture image is produced with improved along-track resolution. SAS processing have the potential to improve the resolution by one order of magnitude compared to conventional side scan sonars. The sonar antenna comprises an axially symmetric acoustic surface having the cross-sectional form of a generally U-shaped curve of non-constant curvature. The curve is shaped to allow continuous coherent personification such that the power in the echo returned from a uniform flat sea floor is substantially constant. This equipment is used for underwater echo sounding and uses hydro acoustic transducers to personify the water and receive echoes.

Pre-Processing

The region of interest has to convert the original image or colour into gray image. The colour image consists of dimensions of (M*N*3). The long to process with this image. The gray image consists of dimensions (M*N).To reduce the difficulty to handle with this image type. For the reason have to convert the original image into gray image.

RGB Image

Another format for color images. It represents an image with three matrices of sizes matching the image format. Each matrix corresponds to one of the colors red, green or blue and gives an instruction of how much of each of these colors a certain pixel should use. The practical way of representing color images. The gray scale images but once have learned to work with a gray scale image the principle to work with color images. The first matrix has the same size as the image and one number for each pixel. The second matrix is called the color map and its size may be different to that image. The numbers in the first matrix gives instructions of what number to use in the color map matrix.

Gray Image

The process of converting RGB to GRAY the images like a black and white image, called as gray image. The gray image values ranges from 0 to 255. The objects in the image look‘s wider.

Binary Image

The gray image process we have to convert the image into binary. The value ‘1’ for objects and take value ‘0 ‘for shadows. The image format also stores an image as a matrix but can only color a pixel black or white and nothing in between. The value assigns a 0 for black and a 1 for white, apply histogram to get image as high intensity, apply thresholding to extract the object.

Region of Interest (ROI)

The MLO (Mine Like Objects) detection, which is usually realized by a template-matching technique. The scans the sonar image for the regions possibly containing MLOs. These regions are called regions of interest (ROIs). The ROIs are extracted and forwarded to the next steps, the image segmentation and the feature extraction.

Image Segmentation

The image is partitioned into three regions: the highlight of the objects, their shadows, and the background. The man-made objects, physical features of the terrain, such as rocks and sand ripples may also be segmented. Markovian method takes as input from the Region Of Interest (ROI) output. Analysis the output and applies the Markovian process. The process separates the background and shadows as 0’s and the object as 1’s (mines).The Marko process segments the object (1’s) and forward this output to the next process feature extraction. Segmentation can be done using different techniques. Here are ones of the most simple.

Thresholding: All values above some threshold are set to 1 and those below the threshold are set to 0 or vice versa.

Mine Feature Extraction and Classification

Each object highlight and associated shadow is characterized by a set of features. The both feature extraction and feature selection process are done in same stage.SIFT (Scale Invariant Feature selection) and D-SFFS (Sequential Forward Floating Selection) methods are used in in feature extraction and feature selection.

4. Conclusion

The nesting problem involved in the existing system is overcome by the D-SFFS (Sequential Forward floating selection) method. It forward the feature set by comparing it with the training set of data’s. It won’t allow all data’s from segmentation process but it forward the features which is approximate with the training set. To select the features, a new novel extension of two algorithms called D-SFS and D-SFFS. This overcomes the limitations of standard SFS and SFFS. D option is used to store the feature values approximate to the training data. The D-SFFS algorithm has improved by 10% than that of standard SFFS for real data and for simulated data. The K-NN method, which overcomes the problem of limited mine type generation. This method generates the neighbors mine characters using 4*4 or 8*8 connectivity. This ADAC system is used in application such as Mineral resource research, Mineral Exploration, Underground geographical analysis. Compared with the linear discriminant method in the existing, the features classified by the novel K-NN method provide better performances. Without the requirement of a manual setting of the number of predefined mine type, the proposed methods are also much faster than the filter methods in the literature. It exactly searches the neighbourhoods mines.

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