Automatic Marine Targets Detection using Features based on Local Gabor Binary Pattern Histogram Sequence

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Abstract— In this paper, a new method for automatic ship detection using Local Gabor Binary Pattern Histogram Sequence (LGBPHS) is presented. In this approach, a ship image is modeled as a "histogram sequence" by concatenating the histograms of all the local regions of different local Gabor magnitude binary pattern maps. To detect ship targets, the input image is divided to overlapping blocks and based on the extracted features the ship area is detected. The extracted features are used to train an artificial neural network and SVM classifier for ship detection. The proposed algorithm is tested with different images containing single ship and without it and the results compared with those of using Haar-like features and cascaded classifier. The experimental results showed the proposed method is efficient. The method not only has proper result but also is robust against different imaging conditions.

Keywords- Local binary pattern; Gabor filters; Neural networks; Automatic target recognition; MLP; SVM

I. INTRODUCTION

Automatic Target Recognition (ATR) systems have many applications in different areas like industrial and military applications. The ATR systems have the advantage of removing the human role from the identification and prosecution process. ATR systems may be utilized to recognize different targets like car, ship, aircraft and so forth. The input image for the ATR system may be acquired from different imaging sensors such as millimeter wave radar, laser radar, video or infrared camera. Different applications may utilize ATR algorithms, including surveillance, industrial inspection, content-based image retrieval, robotics, medical imaging, human computer interaction and intelligent transport system to name a few. Among these applications, the face recognition is the mostly applicable ATR system [1]. From the algorithmic view, a typical ATR system is mainly composed from four major components, which are: I- pre-processing, II- segmentation, III- feature extraction, IV-classification.

Pre-processing: This part offers primary processes to improve the quality of the image and prepare it for the other stages of the algorithm. This process generally consists of noise filtering stage to eliminate or reduce the image noise and clutter, improve the contrast for better resolution, detection of edges and borders around all the existing objects in the image, and so on[2].

Segmentation: This part is used for the segmentation of different areas in the image. Thresholding and region growing algorithms are two mostly used algorithms for segmentation [3].

Feature Extraction: After the input image is segmented, the features are extracted from different areas. Different features are used for ATR systems, including geometric features, texture based features, spatial features, moment and etc.

Classification: This part is utilized to classify extracted features to the desired classes. Some classification methods that have been used for ATR algorithms are K-nearest neighbor, Linear and quadratic discriminator, tree-based classifier, multi-layer neural network, etc.

Many military and defense missions require automated surveillance and control of maritime environments. The major element of these missions is automatic detection, tracking, and recognition of targets. Different targets may be considered for detection in these missions. One of the common targets in military, industry and public transportation is ships that are common in the sea and harbors. Therefore the automatic detection of ship targets is very important.

Different algorithms have been proposed for the task of ship detection. In [4], ship detection was performed based on discrete wavelet transform (DWT) and region growing algorithm in visual images. In [5], features based on real height and length of the ship are used for ship detection and classification. Then three classification methods including nearest neighbor classifier, linear classifier and quadratic classifier were employed. In [6], a new methodology to detect and recognize object in high resolution and multi-spectral images was described. The method extracts the spectral and geometrical features in small image block of the input images. In this article, unsupervised classification based on clustering was employed to recognize different types of the ship targets.

In this paper, a new algorithm for automatic ship targets detection using digital image processing is presented. The method employs Local Gabor Binary Pattern Histogram Sequence (LGBPHS) for extraction of texture-based features. The extracted features are then classified using