SAR Target Recognition based on sub-block statistical Features extracted from the Gabor filtered Image

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A method for SAR target recognition based on Gabor filter bank sub-block statistical feature extraction is presented. The proposed target recognition algorithm consists of three stages as shown in Figure 1 which are pre-processing, feature extraction and support vector machine (SVM) classification. Three types of vehicles which are BMP2, BTR70 and T72 in MSTAR public database are used for experiments.

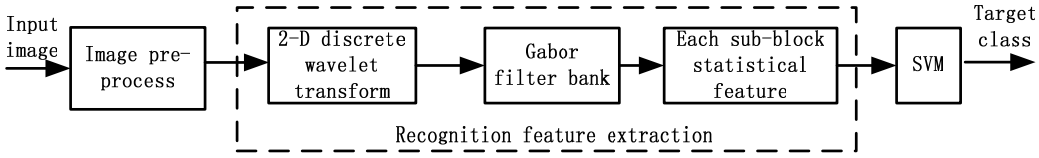
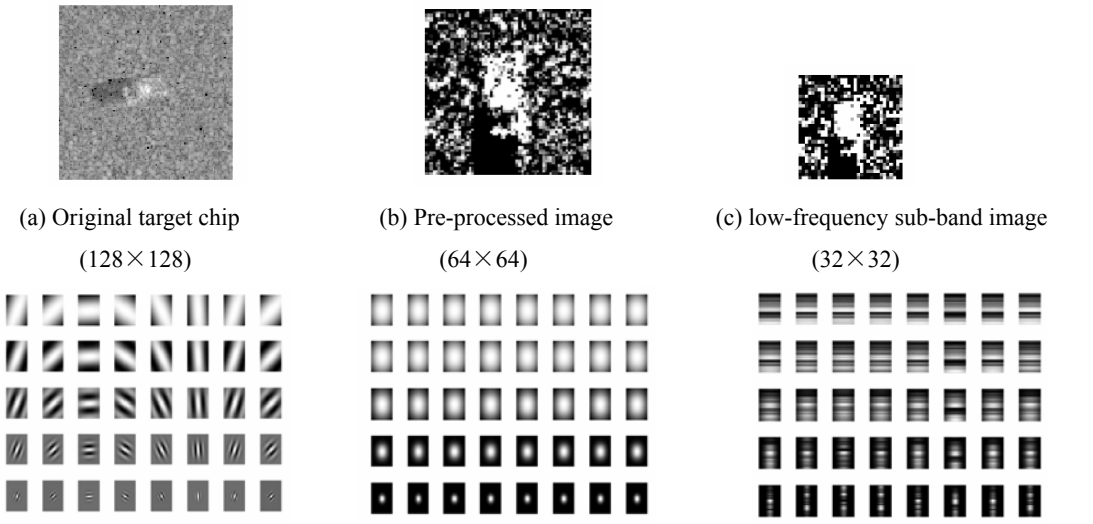


Figure1. Target recognition algorithm stages diagram

It is important to make image data pre-processed to eliminate influence made by target's rotation and asymmetric scatter before feature extraction. Feature extractions include three stages: 2-D discrete wavelet filtering, Gabor filter filtering and statistical feature extraction of each Gabor filtered sub-band image. Figure 2 shows the results of above process method, in which figure 2(f) is the result of figure 2(c) filtered by figure 2(e) that has 5 scales and 8 orientations.



(a) Original target chip (128×128)

(b) Pre-processed image (64×64)

(c) low-frequency sub-band image (32×32)

(d) the real of Gabor filter

(e) the magnitude of Gabor filter

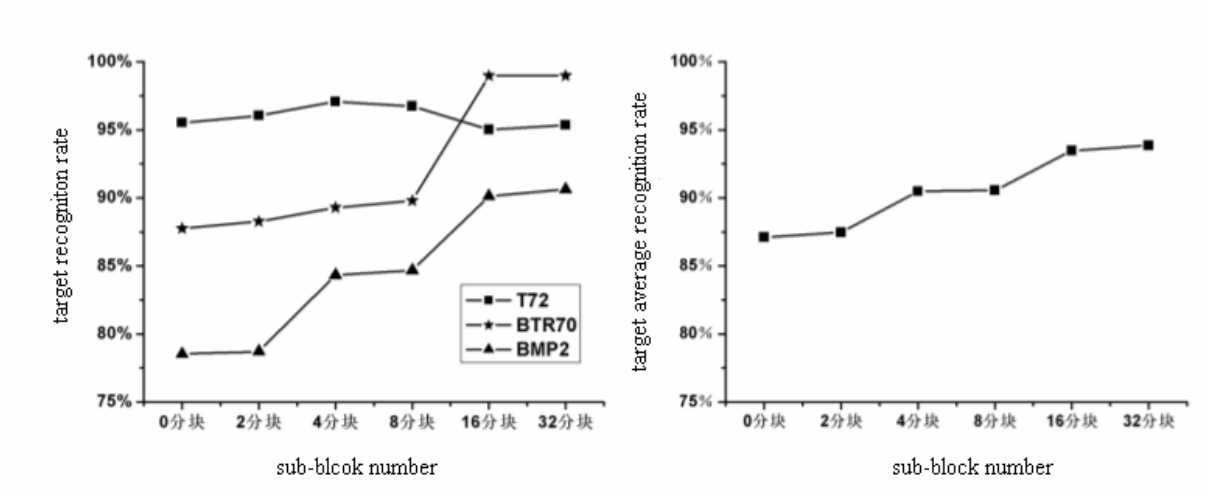
(f) the magnitude of Gabor filtered image

Figure2. The results of process methods shown in figure1

The dimension of feature vectors formed by Gabor filtered image is high (32×32×5×8). To reduce the dimension, the each Gabor filtered sub-band image is divided into different number M sub-blocks, and the statistical features derived from every sub-block of all filtered sub-band images are regarded as the target recognition feature(dimension is reduced to 5×8×M×2).

We use multi-class SVM to classify the feature vectors gained above. Different number of sub-block in Gabor filtered sub-band image results in different feature vectors which end in different Rate of Correct Recognition (RCR) of targets gained by SVM classification. Figure 3 depict the variation of each class RCR and average RCR with different sub-block number of Gabor filtered image. In figure 3(b), average RCR advances with the increase of sub-block number of Gabor filtered image. This is because the each sub-block statistical features is rapidly added with the increase of sub-block number, the feature vectors roundly consider the target difference in Gabor filtered image on different scales and orientations and expressed the target roundly. It is concluded average RCR reaches its top value 96.56 % when the sub-block number is 32. Therefore, the method proposed in this paper is a simple and effective method for SAR target recognition

The neighborhood data of Gabor filtered image exist redundant information because of the strong relativity on neighborhood scales and orientations used Gabor filter. So it should be trade off that the number of sub-block and RCR.



(a) (b)

Figure3. Each class RCR (a) and average RCR (b) with different number of sub-blocks in Gabor filtered image