

Convolutional Neural Network Based Target Recognition for Marine Search

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Abstract

The key point of marine search and rescue is to find out and recognize the distress objects. At present, the visual search method is usually adopted to detect the ships in distress, and this method can only be used at good sea condition and visibility. In this paper, a new target detection and recognition system is proposed. The parameters of radar transmitter and echo graphics and the invariant moments of radar images are extracted as the system's recognition features, and the system's target classifier is based on Convolutional Neural Networks (CNN). The developed recognition classifier has been tested using three kinds of target Images, the target's features are used as the inputs of trained CNN and the outputs of networks are target classification. Sea experimental results show that the proposed method is well-clustering and with high classified accuracy.

Keywords: Radar image, Moment invariant, Target recognition, Convolutional neural networks

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1. Introduction

It is hard to meet the needs of actual marine search and rescue work [1]. Since the poor visibility, the operation of search has to be stopped at night. Marine radar is used to detect objects in the air or at sea, it can discover the life crafts or ships in distance. To classify and recognize targets of marine search and rescue radar, it is useful to determine the scope of search and rescue and can improve the speed and efficiency.

For the purposes of this paper, recognition is defined as the identification of an individual target, whereas classification will refer to the identification of a class target. Clearly detection is required before either of those steps. There are many methods for target classification, such as statistical pattern classification, model-based recognition, multi-sensor based information fusion, neural networks recognition and fuzzy clustering method etc [2].

1.1. Marine Radar Target

The primary objective of pre-processing radar images for recognition by neural networks is one of feature extraction. The reason is that the target identification is using feature correspondence between the radar targets and the database samples to determine the target's classification.

1.2 Radar Working State Characteristics

The marine radar uses different range and pulse to detect targets, at near range, radar selects short pulse and broad band width, and at far range, uses long pulse and narrow band width. This will change the amplitude and size of the target echo.

1.3 Image Invariant Moments

In the field of pattern recognition, graphics feature of an image is a key object of feature extraction, and moment feature is another one of all widely used features. The concept of invariant moment was proposed, and applied to pattern recognition [3]. So only graphic moment is not enough to describe all the information of an image, and then many construction methods of invariant moments were introduced by some scholars and researchers in their studies [4-7].

1.4 Marine Search and Rescue Radar Recognition System

Marine search and rescue radar target recognition system proposed in this paper first got the video signals, trigger, headline and antenna azimuth signals, then through the radar data acquisition card which is based on PCI bus convert the radar echo signals into 2-D range and bearing image. The gray value of pixel is the video amplitude. The system extracted graphic features and moment invariant features from radar image, and placed them into feature database as training sample to train the CNN. The system structure is show in Figure 1.

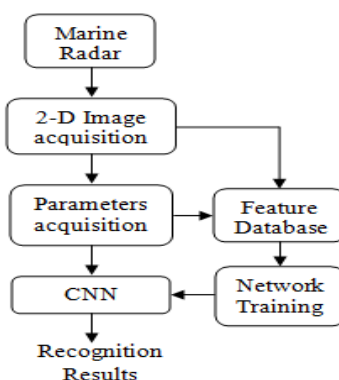


Figure 1. Block Diagram of the Proposed System

1.5 Convolutional Neural Network

Type of feed-forward artificial neural network in which the connectivity model between its neurons is stimulated by the association of the animal visual cortex is called as CNN. Entity cortical neurons respond to stimuli in a limited region of space known as the accessible field.

2. Experimental Results

In this paper, four radar working parameters, five image morphological characteristics and seven image invariant moments are extracted as recognition features for CNN. PCI-based radar data acquisition card. For three kinds of radar targets, 150 target images are acquired from marine radar and used as sample set to train the CNN.

3. Conclusion

In this paper, a new radar target recognition method for marine search and rescue is introduced. This method uses radar working parameters, radar image graphic characteristics and invariant moments as target feature and CNN as classifier. The proposed recognition algorithm has been trained and tested with real marine radar target images acquired by radar data acquisition card. The recognition results show that CNN algorithm is applied well n radar target recognition when invariant moments are used as a kind of stable target feature.

References

- [1] Yu Weihong, Jia Chuanying. Methods of Determining Search Area for SAR at Sea. *Navigation of China*. 2006; 67: 34–37.
- [2] Wang Xiaodan, Wang Jiqin. A Survey of Radar Target Recognition Technique. *Morden Radar*. 2003; 25: 22–26.
- [3] Hu M K. Visual Pattern Recognition by Moment linvariants. *IRE Transactions on Information Theory*. 1962: 179-182.
- [4] Liu Jin, Zhang Tianxu. The Generalization of Moment Invariants. *Chinese Journal of Comouters*. 2004; 27: 668-674.
- [5] Khotanzad A, Hong Y H. Invariant Image Recognition by Zernike Moments. *IEEE Transactions on Pattern Analysis and Machine Intelligence*. 1990; 12: 489-497.

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- [6] Liu Jin, Zhang Tianxu. Study on Constructing Moment Invariants. *Journal of Huazhong University of Science and Technology*. 2003; 31: 1-3.
- [7] Zhu wei, Jia Hengtian, Xu Yuru. Feature Extraction and Neural Network Training Based on Underwater Target. *System Engineering and Electronics*. 2008.