Paper ID: MT588 The 3rd International Conference on Mechatronics and Automation Technology (ICMAT 2024)

A Target Detection Method Based on Hyperspectral and SAR Decision Fusion Model

Xianming DENG[a,b,*], Fan ZHU[a], Yujuan WANG[b], Tiancai ZHANG[a], Yongfeng WANG[a] and Lin WANG[a]

[a]Southwest Institute of Technology and Engineering, Chongqing 400039, China

[b]Laboratory of Intelligent Unmanned Systems, School of Automation, Chongqing University, Chongqing 400044, China

[*]Corresponding author's email: 15198121267@163.com

Introduction

This article proposes a target detection method that combines hyperspectral and SAR decision fusion.

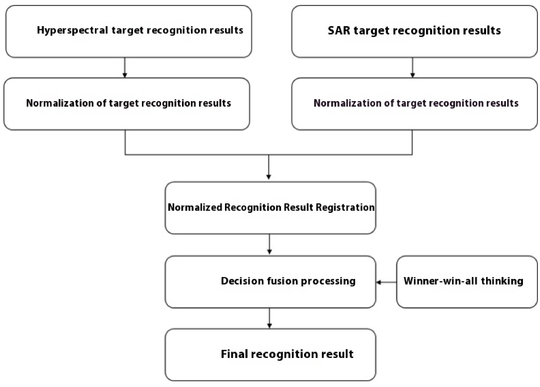

Figure 1. Roadmap for Decision Fusion Detection Technology

Research objectives

- Based on the normalized results of hyperspectral and SAR detection and recognition, Pixel level registration processing is performed to establish a pixel-by-pixel logical relationship between the output results of the two detection and recognition devices.
- Adopting the winner takes all approach, the two recognizers are subjected to decision fusion analysis and processing to obtain the final recognition result.

Methods

Target Detection Method Based on Hyperspectral and SAR Decision Fusion

Firstly, based on the normalized results of hyperspectral and SAR detection and recognition, pixel level registration processing is performed to establish a pixel-by-pixel logical relationship between the output results of the two detection and recognition devices; Then, adopting the winner takes all approach, the two recognizers are subjected to decision fusion analysis and processing to obtain the final recognition result.

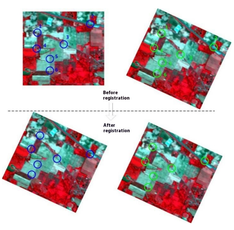

Figure 2. Pixel Registration

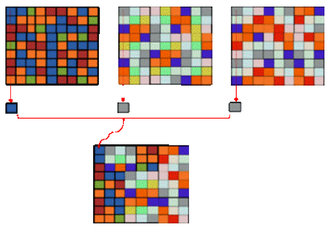

Figure 3. Implementation process of winner-take-all

Experiment

Detection and recognition experiments were conducted using SAR and hyperspectral data from the same region, where the hyperspectral data was from Hyperion satellite and the SAR was a denoised L-band polarized SAR image captured by ALOS satellite. The target to be detected is a reservoir near farmland, as shown in the following figure.

Figure 4. SAR data

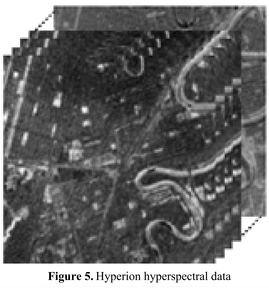

Figure 5. Hyperion hyperspectral data

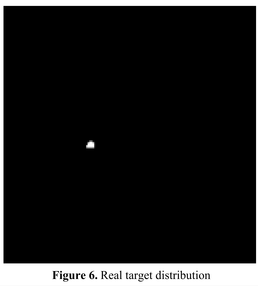

Figure 6. Real target distribution

Results

Comparative experiments were conducted using detection algorithms based on extended spatial morphology, detection algorithms based on deep fusion neural networks, and detection algorithms based on hyperspectral and SAR decision fusion.he SAR detection algorithm based on deep fusion neural network had an accuracy of 78.6%, the detection algorithm based on extended spatial morphology had an accuracy of 89.9%, and the detection algorithm based on hyperspectral and SAR decision fusion had an accuracy of 90.1%

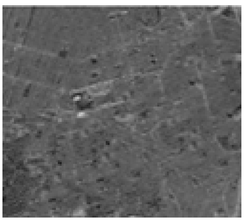

Figure 4. SAR detection results

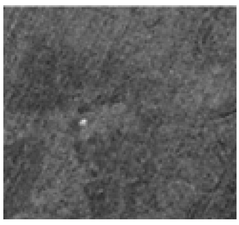

Figure 5. Hyperspectral detection results

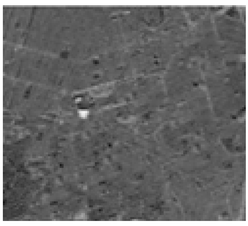

Figure 6. Decision fusion detection results

Conclusions

- This paper proposes a hyperspectral target detection method based on a hyperspectral representation model that combines extended spatial morphology and spectral information.
- Winner-take-all nonlinear fusion method is proposed, which combines the output features of hyperspectral and SAR recognizer to obtain decision fusion results.

References

[1] Ren C. L., Chih-Chen Y., Kuo L. S. Multisensor Fusion and Integration: Approaches, Applications, and Future Research Directions[J]. IEEE Sensors Journal, 2002(2): 107-119.

[2] Mercer J. B., Edwards D., Maduck J., et al. Fusion of High Resolution Radar and Low Resolution Multi-spectral Optical Imagery[A]. IEEE International Geoscience and Remote Sensing Symposium, 2005:3931-3934.

[3] Deng X. M., Miao F., Zhai Y. G., et al. Two Improved Algorithms for Hyperspectral Object Detection Based on Morphology[J]. Journal of Sun Yat-sen University (Natural Science Edition), 2017.56 (1): 151-160.