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DENOISING AND SUPER-RESOLUTION OF MULTI-SOURCE REMOTE SENSING IMAGES USING DEEP LEARNING TECHNIQUES

Abstract

Artificial intelligence technology has been rapidly developing and widely used in the past decade as researchers continue to study AI theory and the growth of hardware computing power driven by Moore's Law. In the field of aerospace, AI technologies are emerging and playing an increasingly critical role in spacecraft design, manufacturing, launch, and applications. For instance, with the advantage of complex connected neural network structure and hardware parallelization data processing, AI technology has incomparable fast, convenient and accurate processing effect for Earth observation remote sensing images generated by spacecraft.

The remote sensing images produced by spacecraft for Earth observation suffer from low signal-to-noise ratio and low spatial resolution due to the limitations of long observation distance, unstable Earth environment, pronounced cosmic radiation effect, sensor manufacturing process, etc. Nevertheless, the quality of remote sensing images directly affects the effectiveness of Earth observation tasks such as object detection and identification. Meanwhile, de-noising and super-resolution images on the ground side can reduce the in-orbit processing operations of satellites, lessen the demand for satellite storage, reduce the occupation of the sky and earth links, and enhance the reliability and real-time information preservation, processing and transmission. Therefore, image denoising and super-resolution technologies have become valuable research directions in the field of Earth observation.

Traditional denoising and super-resolution algorithms have shortcomings, such as complex and challenging algorithm design, poor data quality enhancement, and extended algorithm processing time. At the same time, artificial intelligence technology can obtain powerful mapping ability and fitting ability by training neural networks to improve remote sensing image quality and enhance remote sensing image clarity more obviously. Thereby, it contributes to the development of the remote sensing field of Earth observation.

This paper reviews several traditional image-denoising and super-resolution algorithms and analyzes artificial intelligence-based image-denoising and super-resolution networks. The main innovation of this

paper is the first joint implementation of image denoising and super-resolution based on Transformer structure, redesigned Transformer network structure, added RNN-like local recursive structure, and realized the generation of denoised super-resolution remote sensing images by a single network through cyclic processing. By comparing the experimental results with other image denoising and super-resolution algorithms, the Transformer-based image denoising and super-resolution model proposed in this paper has the most effective image quality improvement, which verifies the effectiveness of the leading innovation points of this paper and the superiority of artificial intelligence technology.