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The optimal algorithm for Multi-source RS image fusion

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RS image fusion

A B S T R A C T

In order to solve the issue which the fusion rules cannot be self-adaptively adjusted by using available fusion methods according to the subsequent processing requirements of Remote Sensing (RS) image, this paper puts forward GSDA (genetic-iterative self-organizing data analysis algorithm) by integrating the merit of genetic arithmetic together with the advantage of iterative self-organizing data analysis algorithm for multi-source RS image fusion.

The proposed algorithm considers the wavelet transform of the translation invariance as the model operator, also regards the contrast pyramid conversion as the observed operator. The algorithm then designs the objective function by taking use of the weighted sum of evaluation indices, and optimizes the objective function by employing GSDA so as to get a higher resolution of RS image.

As discussed above, the bullet points of the text are summarized as follows.

- The contribution proposes the iterative self-organizing data analysis algorithm for multi-source RS image fusion.
- This article presents GSDA algorithm for the self-adaptively adjustment of the fusion rules.
- This text comes up with the model operator and the observed operator as the fusion scheme of RS image based on GSDA.

The proposed algorithm opens up a novel algorithmic pathway for multi-source RS image fusion by means of GSDA.

A R T I C L E I N F O

Keywords: Multi-source RS image, Genetic-iterative self-organizing data analysis algorithm (GSDA), RS image fusion, Self-adaptive fusion rules, The effect evaluation of the fused image

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Method details

Since the imaging mechanism and imaging bands of different RS sensor are diverse, so RS image of the same scene, which is generated by disparate RS sensor, there exist redundancy and mutual complementarity of information in multiple RS images. The advantages of RS image generated with disparate sensor can be integrated effectively and smoothly into one RS image, so that more precise and more comprehensive and more reliable image description of identical RS scene can be achieved, and this manipulation can be also realized by subsequent process [1]. The multiple images of the same RS scene, which is generated by unlike RS sensor or diverse imaging manner for the same RS scene, are integrated smoothly into one RS image by using a mathematical model [4].

The typical methods for RS image fusion include IHS (Intensity-Hue-Saturation) transform based on colour space conversion, YUV (YCrCb) transform, principal component analysis transform based on the statistics, Brovey transform, pyramid decomposing transform based on multi-scale analysis [5], DWT transform (Discrete Wavelet Transform), Contourlet transform [6], DAA (Data Assimilation Arithmetic), and GPSA (Genetic-Particle Swarm Algorithm), etc. In the above fusion approaches RS image fusion, the fusion image based on HIS is obviously insufficient in spectral preservation due to colour distortion [7]. Similarly, the fused image based on YUV is though conspicuous in details and characteristics, but spectral distortion of the fused image is extremely serious. Besides, along with the increase of the decomposition layers of DWT transform, the fused image based on DWT is though abundant in detailed information, but spectral retentivity of the fused image is slightly worse [9]. In addition, the image fused with DAA is although moderately obvious in spatial details, but spectral distortion of the fused image is likewise marginally serious [10]. In like manner, the image fused with GPSA though possesses better spectral retention, but texture information of the fused image is slightly ambiguous, and image clarity gradually decreases along with the increase of the iterations [11]. Similarly, although the image fused with combined DAA and GPSA retains more detail information of the image, but spectral torsion resistance of the fused image will become more and more serious along with the increase of decomposition layers of the image [12].

In spite of the fact that the above methods have achieved with some successes, but their fusion rules must be determined before the inosculation of RS image, and these fusion rules cannot be adjusted self-adaptively [3]. Moreover, it is also problematic for the fusion of RS image to synthesize the respective virtues of these methods [2]. In order to solve the above problems, the iterative optimization algorithm GSDA is presented for the integration of RS image in this article [8]. The proposed GSDA can be further used to dispel the spectral distortion of the fused image brought by DAA and GPSA, and the texture information of the fused image will become clearer. The proposed GSDA can be also used especially to eliminate the spectral torsion resistance introduced by DAA and GPSA, and the clarity of the fused image will become ever more perfect [13]. For this purpose, the observed data are efficiently combined with simulated data generated with GSDA so as to achieve the fused RS image that is more objective and closer to natural inosculation [2]. The proposed algorithm of RS image fusion can be used to self-adaptively modulate the fusion rule of RS image by combining with the merits of different fusion methods according to the subsequent requirement of RS image processing [14]. Thus, the proposed scheme of RS image fusion solves the urgent issues that the fusion rules of RS image cannot be self-adaptively modulated by using traditional fusion approaches [15]. In order to verify the effectiveness and superiority of the proposed algorithm, some of the instances of RS image fusion are presented in this experiment [18].

The optimized algorithm of GSD

The essence of GSDA is that the observed data are effectively combined with the simulation data by means of a mathematical mode, as a result, an analytical result of RS image data which is more objective and closer to the natural scene is achieved in the end [16]. The algorithmic flow chart of data optimization with GSDA is shown in Fig. 1. The algorithmic procedure of GSDA is summarized as follows.