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Sparse Representation Based Spatiotemporal Fusion Employing Additional Image Pairs to Improve Dictionary Training

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Abstract : Remotely sensed imagery with the high spatial and temporal characteristics, which it is hard to acquire under the current land observation satellites, has been considered as a key factor for monitoring environmental changes over both global and local scales. On a basis of the limited high spatial-resolution observations, challenged studies called spatiotemporal fusion have been developed for generating high spatiotemporal images through employing other auxiliary low spatial-resolution data while with high-frequency observations. However, a majority of spatiotemporal fusion approaches yield to satisfactory assumption, empirical but unstable parameters, low accuracy or inefficient performance. Although the spatiotemporal fusion methodology via sparse representation theory has advantage in capturing reflectance changes, stability and execution efficiency (even more efficient when overcomplete dictionaries have been pre-trained), the retrieval of high-accuracy dictionary and its response to fusion results are still pending issues. In this paper, we employ additional image pairs (here each image-pair includes a Landsat Operational Land Imager and a Moderate Resolution Imaging Spectroradiometer acquisitions covering the partial area of Baotou, China) only into the coupled dictionary training process based on K-SVD (K-means Singular Value Decomposition) algorithm, and attempt to improve the fusion results of two existing sparse representation based fusion models (respectively utilizing one and two available image-pair). The results show that more eligible image pairs are probably related to a more accurate overcomplete dictionary, which generally indicates a better image representation, and is then contribute to an effective fusion performance in case that the added image-pair has similar seasonal aspects and image spatial structure features to the original image-pair. It is, therefore, reasonable to construct multi-dictionary training pattern for generating a series of high spatial resolution images based on limited acquisitions.

Keywords : spatiotemporal fusion, sparse representation, K-SVD algorithm, dictionary learning
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