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A Hybrid Image Fusion Model for Generating High Spatial-Temporal-Spectral Resolution Data Using OLI-MODIS-Hyperion Satellite Imagery

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Abstract : Spatial, Temporal, and Spectral Resolution (STSR) are three key characteristics of Earth observation satellite sensors; however, any single satellite sensor cannot provide Earth observations with high STSR simultaneously because of the hardware technology limitations of satellite sensors. On the other hand, a conflicting circumstance is that the demand for high STSR has been growing with the remote sensing application development. Although image fusion technology provides a feasible means to overcome the limitations of the current Earth observation data, the current fusion technologies cannot enhance all STSR simultaneously and provide high enough resolution improvement level. This study proposes a Hybrid Spatial-Temporal-Spectral image Fusion Model (HSTSFM) to generate synthetic satellite data with high STSR simultaneously, which blends the high spatial resolution from the panchromatic image of Landsat-8 Operational Land Imager (OLI), the high temporal resolution from the multi-spectral image of Moderate Resolution Imaging Spectroradiometer (MODIS), and the high spectral resolution from the hyper-spectral image of Hyperion to produce high STSR images. The proposed HSTSFM contains three fusion modules: (1) spatial-spectral image fusion; (2) spatial-temporal image fusion; (3) temporal-spectral image fusion. A set of test data with both phenological and land cover type changes in Beijing suburb area, China is adopted to demonstrate the performance of the proposed method. The experimental results indicate that HSTSFM can produce fused image that has good spatial and spectral fidelity to the reference image, which means it has the potential to generate synthetic data to support the studies that require high STSR satellite imagery.

Keywords : hybrid spatial-temporal-spectral fusion, high resolution synthetic imagery, least square regression, sparse representation, spectral transformation
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