Detecting changes in multitemporal multispectral Landsat images using spatial frequency-based undecimated wavelet transform fusion

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Changes in surface water are normally detected by extracting the water features from individual multispectral (MS) images. We present an approach based on pixel fusion of MS and panchromatic (PAN) bands of multitemporal Landsat images to detect the changes in surface water. Spatial frequency and the maximum amplitude selection-based fusion rule on multiresolution undecimated wavelet transform (UDWT) coefficients for extracting and injecting the spatial and spectral content from MS and PAN images is introduced. Landsat Thematic Mapper (TM) and Landsat Enhanced Thematic Mapper (ETM+) of 2010 and 2000 images acquired from the US Geological Survey were fused to investigate the potential of the proposed spatial frequency-based UDWT in highlighting the changes. Various component substitution and multiresolution analysis-based fusion algorithms were also applied. It was observed that UDWT with spatial frequency effectively extracts the spectral information from MS images and the spatial information from PAN images. The performance was evaluated based on visual interpretation and spatial and spectral quality assessment metrics. A high correlation coefficient (0.9992), high contrast similarity (0.99937), high structural similarity index measure (0.9884), less relative average spectral error (23.6426), less root mean squared error (2.2256), relatively less blind referenceless image spatial quality evaluator, natural image quality evaluator, and perception-based image quality evaluator significantly support the proposed fusion technique in yielding the pansharpened image, making it more suitable for detecting the multitemporal changes in remote sensing applications.

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