A ONE-CHANNEL TRANSFORMER-BASED NETWORK FOR HIGH-RESOLUTION MULTISPECTRAL SATELLITE IMAGE SUPER-RESOLUTION

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ABSTRACT:

Super-resolution (SR) techniques driven by advances in deep learning are essential for enhancing high-resolution (HR) satellite images, such as Kompsat-3, as they often have limited spatial and spectral information due to sensor limitations. While convolutional neural networks (CNNs) have been pivotal in this area, Transformers, e.g., shifted windows for image restoration (SwinIR) have emerged as more robust alternatives for capturing broader context and distant dependencies. However, most deep learning research including SwinIR predominantly focused on processing natural-colored images, with little attention to multispectral (MS) imagery. HR satellite imagery typically consists of a panchromatic band with higher resolution and MS bands with low-resolution (LR). Generation of LR-HR pairs from panchromatic and MS data poses challenges due to their channel differences, ranging from one-band to four-band (RGBN - Red, Green, Blue, and Near-Infrared). Therefore, we proposed a one-channel transformer-based network designed for feature extraction and high-quality image reconstruction. Firstly, we modified and reconfigured the model (in this case, SwinIR, but any SR model can be applied) as a one-channel network, tailored to handle one-channel LR and HR pairs dataset. The dataset was divided into patches and HR images were four times higher in resolution compared to LR images. The one-band LR image is generated as a grayscale image by calculating the average pixel value from RGBN bands and assigning this average value to each pixel in the grayscale image. The model is then trained on HR – LR averaged MS pairs to produce a one-channel super-resolved MS image. Finally, individual LR bands are applied to create the HR ones and are stacked together to generate an HR MS image. The evaluation metrics utilized in this study are peak signal-to-noise ratio (PSNR) and structural similarity index measure (SSIM). The findings of this study highlight the dearth of research specifically aimed at enhancing the spatial resolution of Kompsat-3 imagery. Our proposed method contributes to the adaptation of the SwinIR model into a one-channel SR network for MS imagery applications.

Keywords: Multispectral Images, SwinIR, Super-resolution, High-resolution Satellite Imagery, Kompsat-3