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Multispectral Image Dehazing and Quality Enhancement using Guided Filtering and GMAN Networks

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Abstract: *Haze, brought about by atmospheric particles such as dust, smoke, and moisture, significantly compromises multispectral satellite image quality and visibility. The degradation reduces land classification, environmental monitoring, and target detection applications. This work introduces an implementation framework that unites three of the best dehazing algorithms:Before Dark Channel (DCP), Guided Filter, and the GMAN (Global and Local Prior Guided Multispectral Image Dehazing) deep model for advanced image reconstruction. To approximate this, the DCP methodology assumes that at least one of the color channels in non-sky regions is low intensity and that the atmospheric light and transmission map should be visualized. The Guided Filter is applied to reduce artifacts and retain edge details on the transmission map. The GMAN model, a residual and encoder-decoder-based convolutional neural network, is trained end-to-end with pixel-wise (MSE) and perception loss functions for producing haze-free high-quality images. The code is implemented using Python and OpenCV, TensorFlow, and Keras libraries and tested on the satellite imagery of the Smart India Hackathon (SIH) dataset. Quantitative measures like Peak Signal-to-Noise Ratio (PSNR), Mean Squared Error (MSE), and Structural Similarity Index (SSIM) are employed for assessment. Although conventional techniques like DCP and Guided Filters perform well, the GMAN algorithm performs better by generating sharper, more contrasted images with fewer hazes, particularly in intricate scenes. This paper proves the effectiveness of the hybrid method consisting of conventional and deep learning processes for substantial satellite image enhancement*

Keywords*:* Multispectral satellite image, haze removal, image dehazing, dark channel prior, guided filter, deep learning, GMAN, residual network, image reconstruction, remote sensing