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Removing Stripe Noise from Satellite Images using Convolutional Neural Networks in Frequency Domain

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Many satellite images are corrupted by stripping; this noise degrades the visual quality of the images and inevitably introduces errors in processing. Thermal and hyperspectral images often suffer from stripping. The frequency distribution characteristic of stripe noise makes it difficult to remove such noise in the spatial domain; contrariwise, this noise can be efficiently detected in the frequency domain. Numerous solutions have been proposed to eliminate such noise using Fourier transform; however, most are subjective and time-consuming approaches.

The lack of a fast and automated tool in this subject has motivated us to introduce a Convolutional Neural Network-based tool that uses the U-Net architecture in the frequency domain to suppress the anomalies caused by stripe noise. We added synthetic noise to satellite images to train the model. Then, we taught the network how to mask these anomalies in the frequency domain. The input image dataset was down-sampled to a size of 128 x128 pixels for a fast training time. However, our results suggest that the output mask can be up-scaled and applied on the original Fourier transform of the image and still achieve satisfying results; this means that the proposed algorithm is applicable on images regardless of their size.

After the training step, the U-Net architecture can confidently find the anomalies and create an acceptable bounding mask; the results show that - with enough training data- the proposed procedure can efficiently remove stripe noise from all sorts of images. At this stage, we are trying to further develop the model to detect and suppress more complex synthetic noise. Next, we will focus on removing real stripe noise on satellite images to present a robust tool.