Hyperspectral Image Denoising using Superpixels of Mean Band

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Motivation

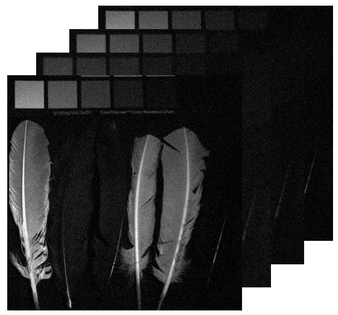
Denoising is an essential step in the hyperspectral image analysis process. Noise can interfere negatively on the accuracy of the information extracted.
The motivation for this work was to experiment with a method of simple and quick implementation that could take advantage of the spatial similarity across all frequency bands.

Related work

Explore high-correlation across spectra: dimensionality reduction with PCA
Superpixels: superpixel based non-local means, superpixel segmentation and low-rank representation,

Proposed Method

Noisy hyperspectral image

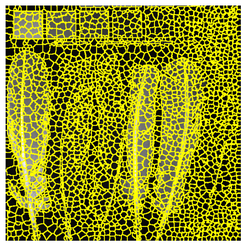


Average out noisy pixels by taking the mean of all frequency bands

Mean intensity of all bands

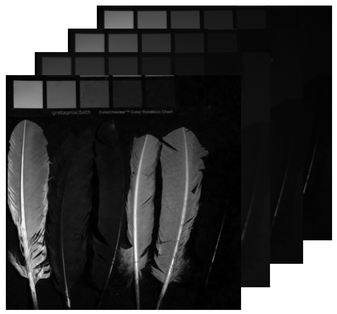
Group similar pixels into superpixels (SLIC)

Image segmented in superpixels



Scale intensity of mean image superpixel by the average intensity of the superpixel in each band

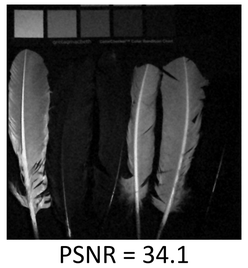
Denoised hyperspectral image



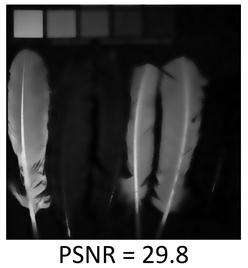
Results

RGB rendered original image

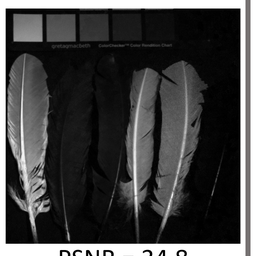
Noisy Image



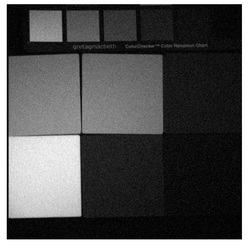
Bilateral filter PSNR = 34.1

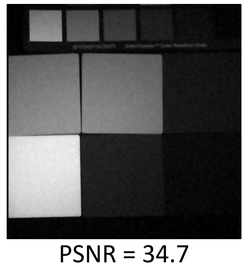


Non-local means PSNR = 29.8

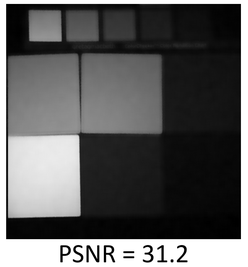


Proposed method PSNR = 34.8

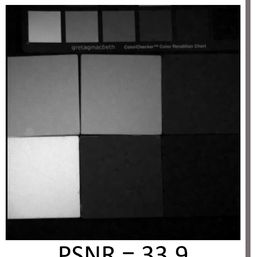




PSNR = 34.7

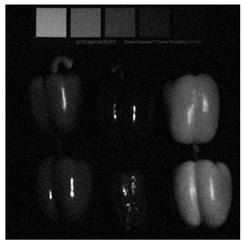


PSNR = 31.2

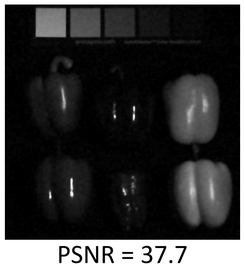


PSNR = 33.9

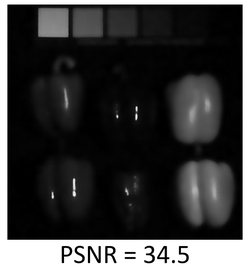
RGB rendered original image



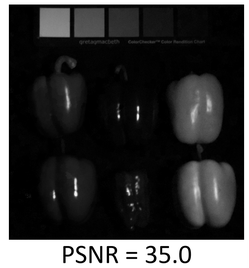
Noisy Image



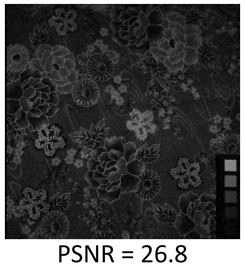
Bilateral filter PSNR = 37.7



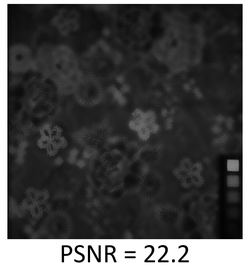
Non-local means PSNR = 34.5



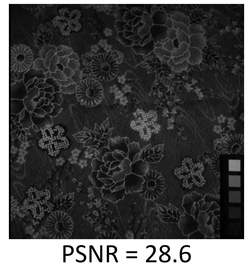
Proposed method PSNR = 35.0



PSNR = 26.8



PSNR = 22.2



PSNR = 28.6