

Computer Vision Assignment 4 : SSIM Analysis

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Sub Task 1

Denoise the three corrupted images using any of the two order statistic filters.

Solution

I am choosing Alpha Trimmed Mean Filter and Median for denoising purpose.

Alpha Trimmed Mean Filter

Filter window size : 3 x 3 ; Alpha : 4/9 ; skipping 2 values on both ends

Median Filter

Filter window size : 3 x 3

Sub Task 2

Tabulate the SSIM scores for all nine images with reference image.

Solution

For finding SSIM , using local patch approach and finally averaging the SSIM scores over all patches. Image is divided into 256 non-overlapping patches. Patch-size depends on the image size. For example if image is 256 x 256 then patch-size will be 16 x 16. If image size is 512 x 512 then patch size will be 32 x 32. SSIM score is computed between reference image patch and patch image under test. SSIM scores are tabulated in the below table. Visual results are also shown below.

B - Blurred ; **G** - Gaussian Noise ; **L** - Laplacian Noise ;

AMTF - Alpha Trimmed Mean Filter ; **MEDFILT** - Median Filter ;

Image	B	B-AMTF	B-MEDFILT	G	G-AMTF	G-MEDFILT	L	L-AMTF	L-MEDFILT
Image 1	0.890	0.867	0.882	0.518	0.689	0.685	0.460	0.672	0.701
Image 2	0.912	0.888	0.903	0.555	0.710	0.708	0.508	0.693	0.719
Image 3	0.926	0.912	0.922	0.664	0.821	0.822	0.596	0.802	0.828



(a) Image 1



(b) Image 2



(c) Image 3

Figure 1: Three reference images

SSIM Analysis

- It can be seen that image quality is good in Blurred **B** with around 0.8 to 0.9 SSIM scores. When Median filter or AMTF is applied in both cases the image is again blurred which decreases the SSIM scores. In this case Median filter is slightly performing better than AMTF. Although the difference is negligible.
- When Gaussian noise **G** is added the quality degraded heavily with SSIM scores around 0.5 to 0.6. When Median filter or AMTF is applied the restored quality is well better with average improvement of 0.2 in SSIM scores. In this case AMTF is slightly performing better than Median filter. But it can be seen that Median filtered output is sharp and has better contrast.
- When Laplacian noise **L** is added the lowest SSIM scores is observed around 0.4 to 0.5. When Median filter or AMTF is applied the restored quality is well better with an average improved of 0.25 in SSIM scores. In this case Median filter is performing better than AMTF with noticeable difference. As we already median filter works well on spiking noise than any other filters. Better contrast and image quality is observed in median filtered output.

Visual Results



(a) 1B; SSIM=0.890



(b) 1B ATMF; SSIM=0.867



(c) 1B MEDFILT; SSIM=0.882



(d) 1G; SSIM=0.518



(e) 1G ATMF; SSIM=0.689



(f) 1G MEDFILT; SSIM=0.685



(g) 1L; SSIM=0.460



(h) 1L ATMF; SSIM=0.672



(i) 1L MEDFILT; SSIM=0.701

Figure 2: All nine images of **Image 1** with respective SSIM scores



(a) 2B; SSIM=0.912



(b) 2B ATMF; SSIM=0.888



(c) 2B MEDFILT; SSIM=0.903



(d) 2G; SSIM=0.555



(e) 2G ATMF; SSIM=0.710



(f) 2G MEDFILT; SSIM=0.708



(g) 2L; SSIM=0.508



(h) 2L ATMF; SSIM=0.693



(i) 2L MEDFILT; SSIM=0.719

Figure 3: All nine images of **Image 2** with respective SSIM scores



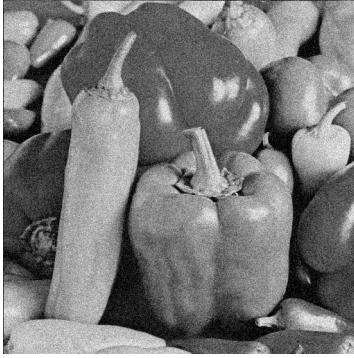
(a) 3B; SSIM=0.926



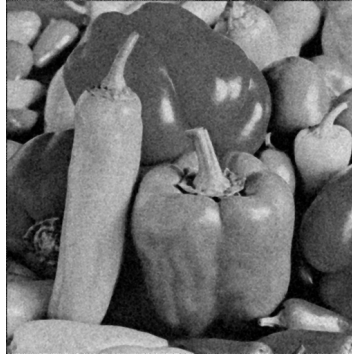
(b) 3B ATMF; SSIM=0.912



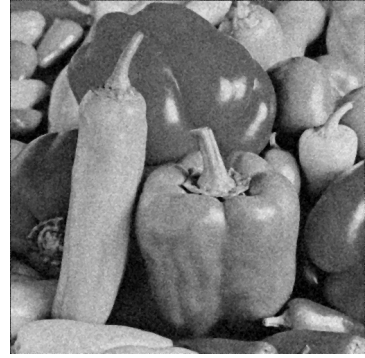
(c) 3B MEDFILT; SSIM=0.922



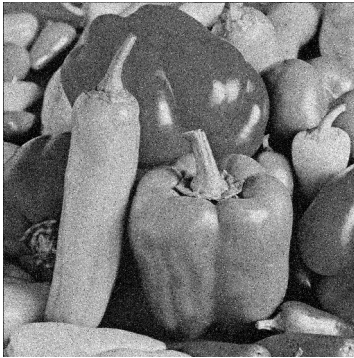
(d) 3G; SSIM=0.664



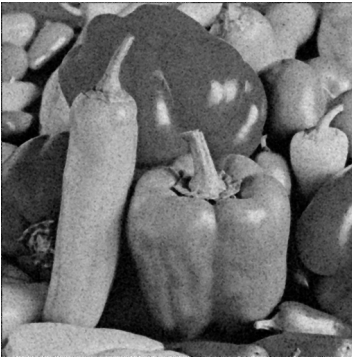
(e) 3G ATMF; SSIM=0.821



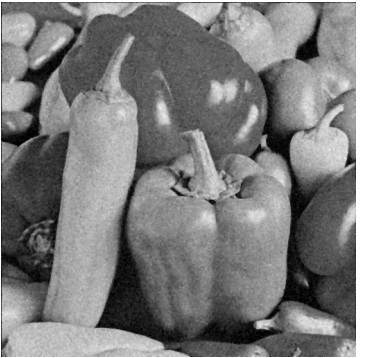
(f) 3G MEDFILT; SSIM=0.822



(g) 3L; SSIM=0.596



(h) 3L ATMF; SSIM=0.802



(i) 3L MEDFILT; SSIM=0.828

Figure 4: All nine images of **Image 3** with respective SSIM scores