

CS 663: Assignment 2

Question 2

Anwesh Mohanty, 170070009

Rohan Bansal, 170070058

Shivanshu Gupta, 170020032

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1 Code Snippets

1.1 myBilateralFiltering.m

This file contains the function to implement bilateral filtering. The input image, σ_{space} , $\sigma_{intensity}$ and window size must be provided to the function. The following code snippets do the following tasks:

- Adding iid zero-mean Gaussian noise with standard deviation set to 5% of intensity range to original image:

```
noisy_img=zeros(size(img));
frac_std=0.05;
img=im2double(img);
for i=1:p
    int_range=max(max(img(:,:,i)))-min(min(img(:,:,i)));
    noisy_img(:,:,i)=img(:,:,i)+frac_std*int_range*randn(m,n);
end
```

- Initializing the spatial gaussian kernel to use later:

```
[X,Y] = meshgrid(-w:w,-w:w);
spaceG = exp(-(X.^2+Y.^2)/(2*sa^2));
```

- Defining a window for each pixel of the noisy image and calculating the weights (product of spatial and intensity gaussians) for every pixel to finally obtain the filtered image:

```
imin=max(1,i-w);
imax=min(m,i+w);
jmin=max(1,j-w);
jmax=min(n,j+w);
winIm=noisy_img(imin:imax,jmin:jmax,k);
meanIm=winIm-noisy_img(i,j,k);
intG=exp(-(meanIm.^2/(2*sr*sr)));
weights=intG.*spaceG((imin:imax)-i+w+1,(jmin:jmax)-j+w+1);
Wp=sum(weights(:));
new_img(i,j,k)=sum(weights(:).*winIm(:))/Wp;
```

1.2 myRMSD.m

This file contains the function to calculate the the root mean squared differences between the two provided matrices.

```
function [RMSD]=myRMSD(A,B)
A=im2double(A);
B=im2double(B);
diff=A-B;
diff=diff.^2;
n=numel(diff);
diffsum=sum(sum(diff));
RMSD=sqrt(diffsum/n);
end
```

2 Parameters

The optimal values of σ_{space} (σ_s) and $\sigma_{intensity}$ (σ_i) are found to be 0.6 and 3 respectively. The window size is 11x11. The RMSD values are shown in the

below table:

Image	σ_s, σ_i	$0.9\sigma_s, \sigma_i$	$1.1\sigma_s, \sigma_i$	$\sigma_s, 0.9\sigma_i$	$\sigma_s, 1.1\sigma_i$
barbara.png	0.0385	0.0399	0.0413	0.0385	0.0386
honeyCombReal.png	0.0328	0.0335	0.0334	0.0329	0.0329
grass.png	0.0302	0.0311	0.0306	0.0303	0.0304

Table 1: RMSD values for different gaussian parameters in bilateral filtering

3 Output

3.1 barbara.png

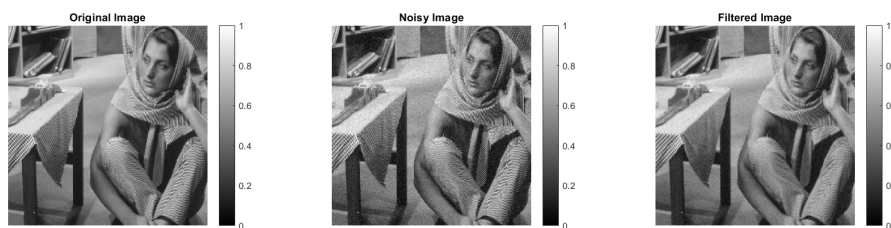


Figure 1: Output files for barbara.png

3.2 grass.png

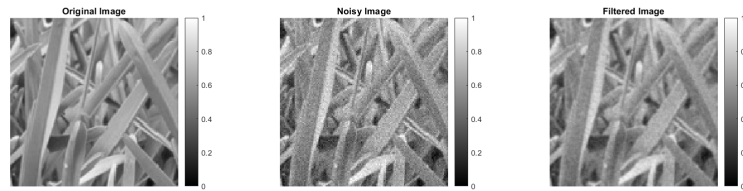


Figure 2: Output files for grass.png

3.3 honeyCombReal.png

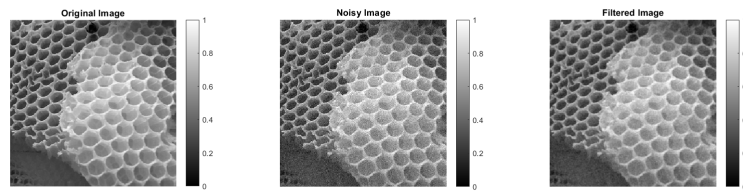


Figure 3: Output files for honeyCombReal.png

3.4 Gaussian Mask

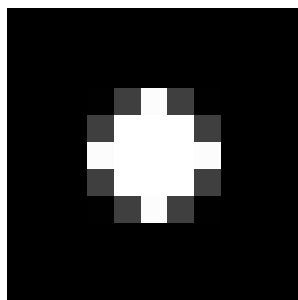


Figure 4: Gaussian Mask for window size=11