

Digital Image Processing

Image Noise

Image Noise

- Noise in an image is any degradation in an image signal, caused by external disturbance while an image is being sent from one place to another place via satellite, wireless and network cable.
- Noisy image can be modeled as
 - $I(x,y)$: the true pixel values
 - $n(x, y)$: the noise at pixel (x,y)

$$\hat{I}(x, y) = I(x, y) + n(x, y)$$

Source of Image Noise

- Errors occurs in image signal while an image is being sent electronically from one place to another.
- Sensor heat while clicking an image
- ISO factor indicates how quickly a camera's sensor absorbs light, higher ISO used more chances of noticeable noise
- Some other sources:
 - Light variations
 - Camera Electronics
 - Surface Reflectance
 - Lens

Matlab Functions

- Matlab command for adding noise to the image is:
 - `J = imnoise('I', 'Type')`
 - Adds noise to the intensity image I, type specifies the type of noise added (types of noise discussed in coming slides)
 - Depending upon the type of noise added, some additional parameters can also be added
 - `J= imnoise ('I', 'Type', 'Parameters')`

Types of Image Noise

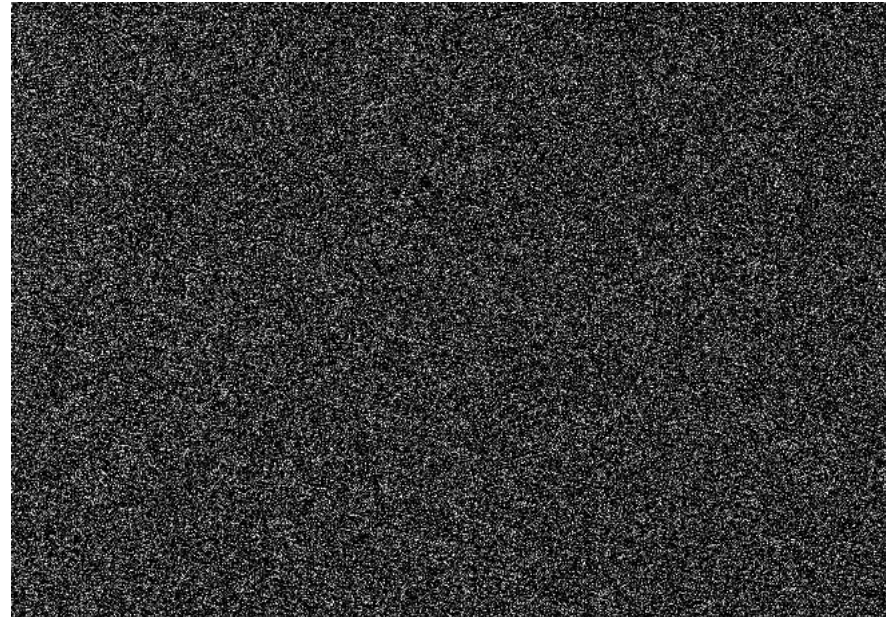
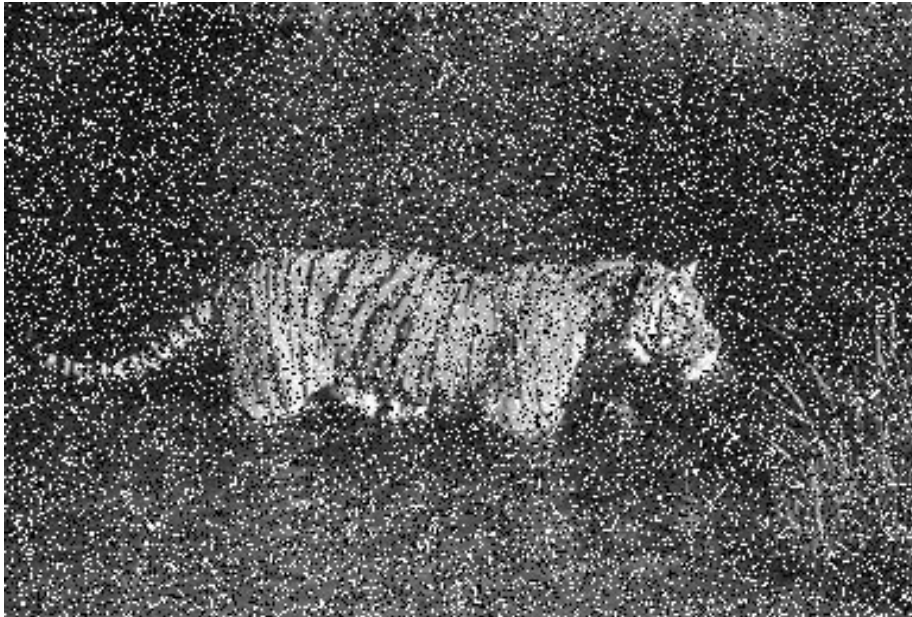
- Salt and Pepper Noise
- Gaussian Noise
- Speckle Noise
- Uniform Noise

Salt and Pepper Noise

- It is known as shot noise, impulse noise or Spike Noise
- Its appearance is randomly scattered white or black or both pixel over the image

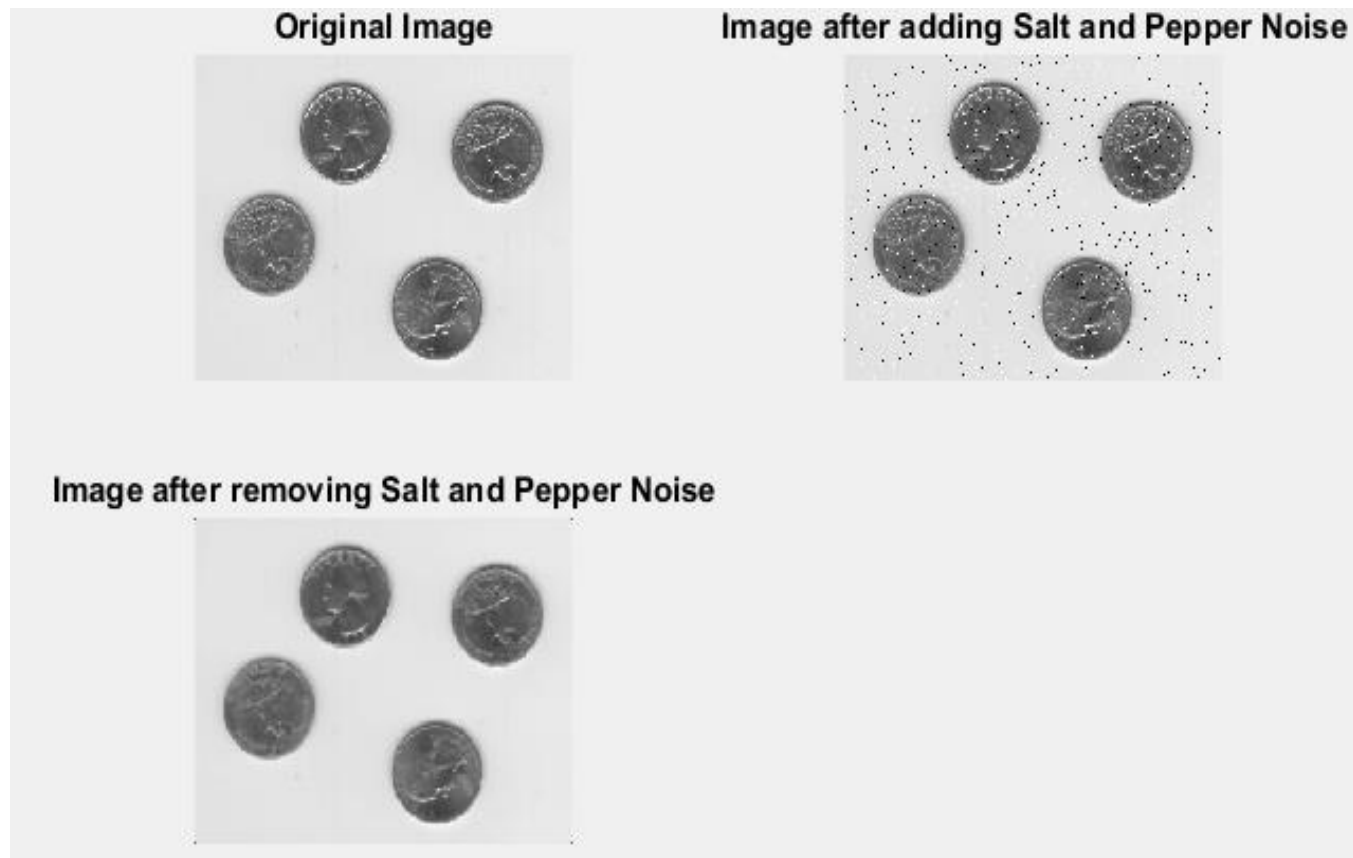
Reasons for Salt and Pepper Noise

- By malfunctioning of camera's sensor cells.
- By synchronization errors in image digitization



Adding & Removing Salt & Pepper Noise

- For adding salt and pepper noise to the image, use the command `imnoise`
- For removing salt and pepper noise, median filter serves the best purpose for this

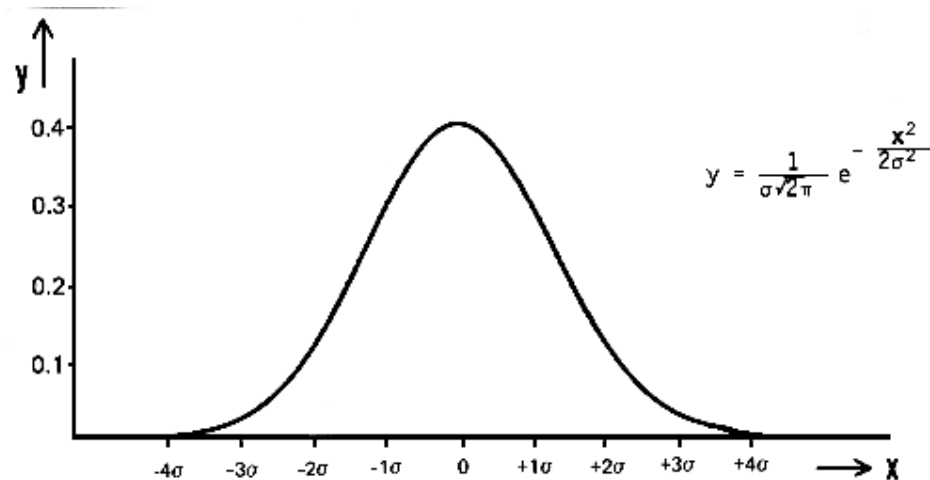


Matlab Code

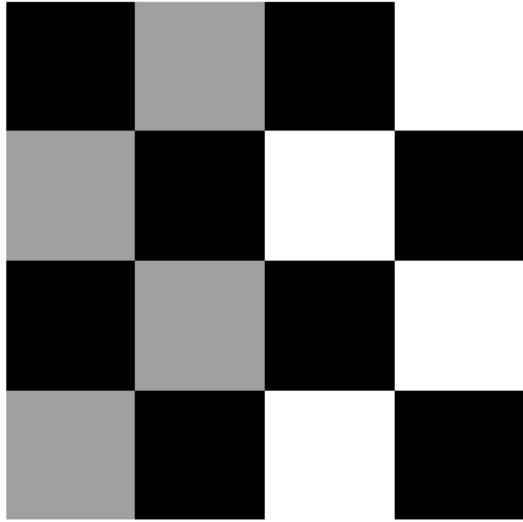
```
I = imread('eight.tif');
J = imnoise(I,'salt & pepper',0.02);
K = medfilt2(J);
% figure, imshow(I)
% imshowpair(I,J, 'montage');
subplot(2,2,1), imshow(I);
title('Original Image')
subplot(2,2,2), imshow(J);
title('Image after adding Salt and Pepper Noise')
subplot(2,2,3), imshow(K);
title('Image after removing Salt and Pepper Noise')
```

Gaussian Noise

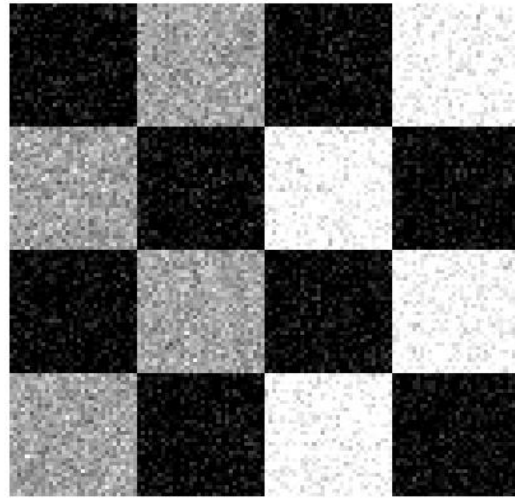
- A probability distribution describing random fluctuations in a continuous physical process; named after Karl Friedrich Gauss, an 18th century German physicist.
- The distribution describes such Stochastic Process (Any process which may be described in terms of probabilities) as the random voltage variations in a carbon resistor due to thermal motion



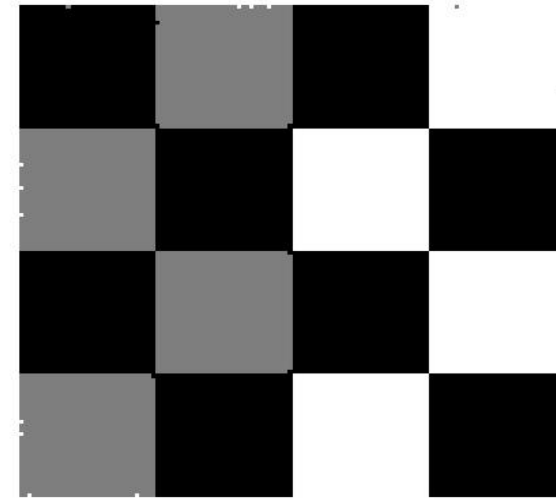
Gaussian Noise



Original
Image



Gaussian Noise
Image



Filtered
Image

Adding & Removing Gaussian Noise

Original Image



Image after adding Gaussian Noise

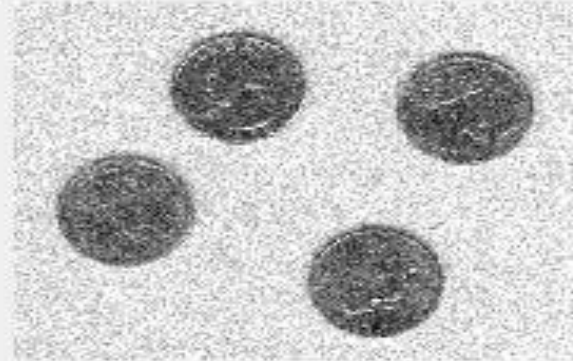
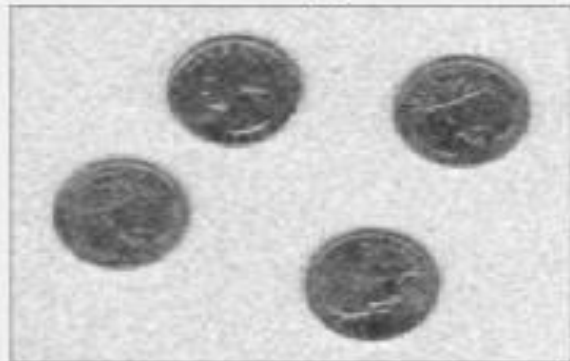


Image after removing Gaussian Noise



Matlab Code

```
I = imread('eight.tif');  
nI = imnoise(I,'gaussian');  
h = fspecial('gaussian', 7,1);  
g = imfilter(nI,h);  
subplot(2,2,1), imshow(I);  
title('Original Image')  
subplot(2,2,2), imshow(nI);  
title('Image after adding Gaussian Noise')  
subplot(2,2,3), imshow(g);  
title('Image after removing Gaussian Noise')
```

Understanding Gaussian Filters

- Next lecture