SIGNAL NOISE SEPARATION IN IMAGES

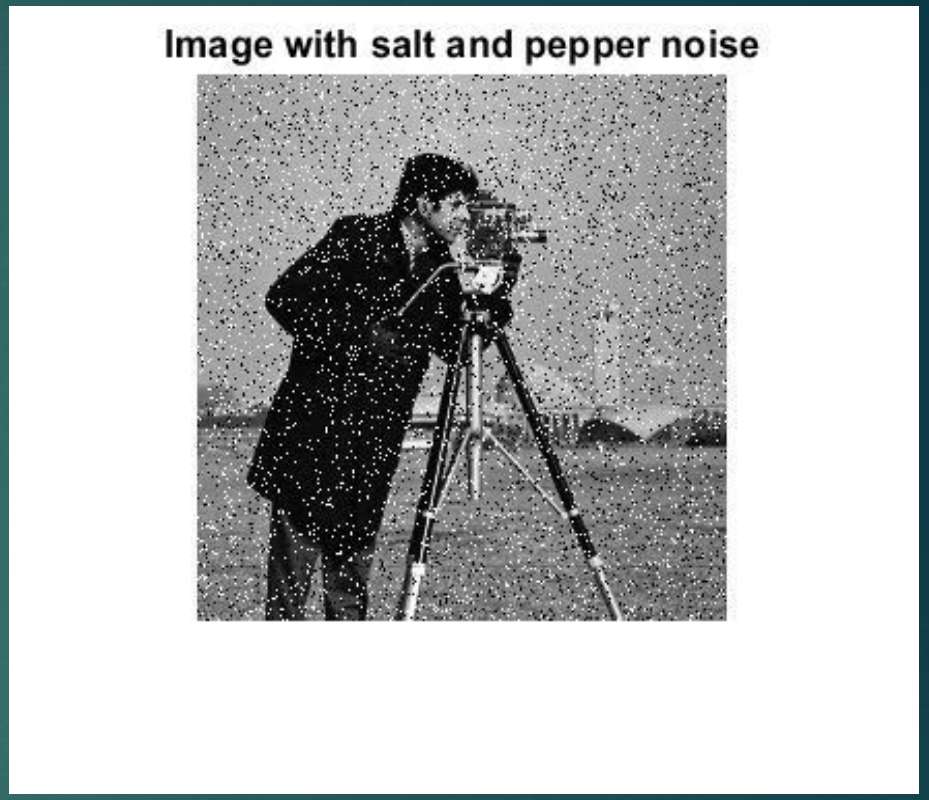
Types of noise in images

- Salt and pepper noise
- Poisson noise
- Gaussian noise
- Speckle noise

The above are the most common forms of noises and do not form an exhaustive set .

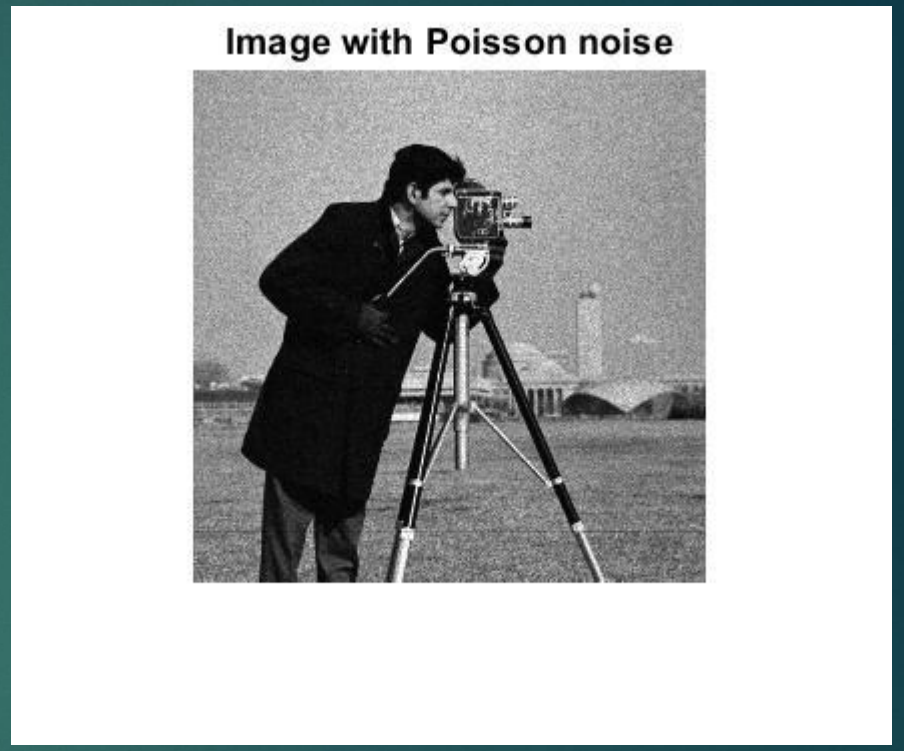
Salt and pepper noise

- Sparse disturbances in the image causing discoloration in few pixels.
- Caused during image capture with faulty charge coupled device or external factors like dust and smoke .
- Also called ‘impulse noise’.
- Causes the image to have a grainy texture .



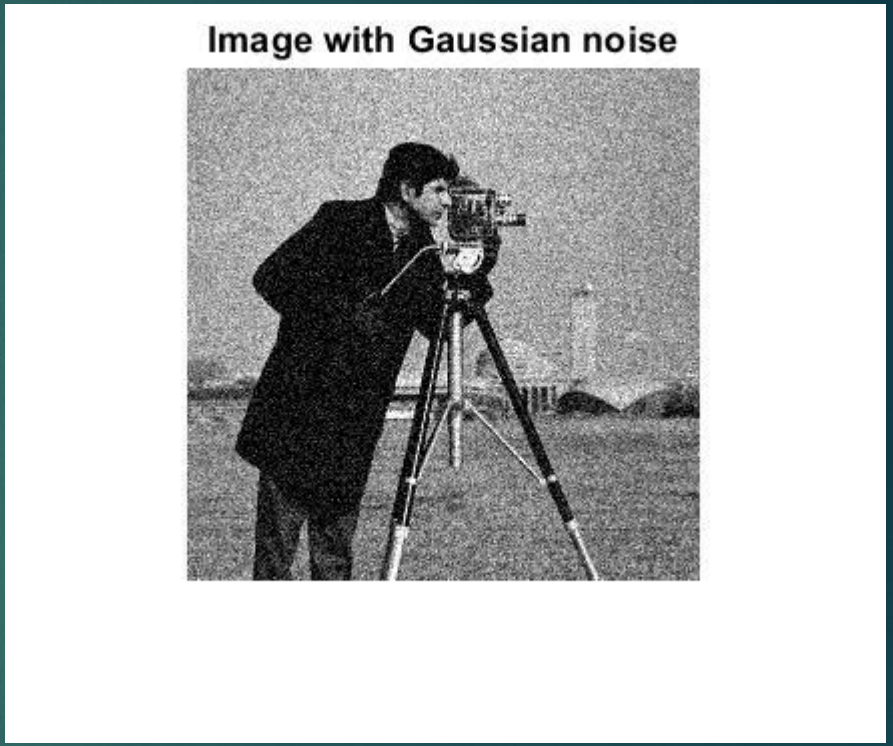
Poisson noise

- Caused due to non uniform photon distribution at an exposure level.
- Dominant in the lighter parts of an image .
- Follows something called ‘Poisson distribution’.
- Also called shot noise .



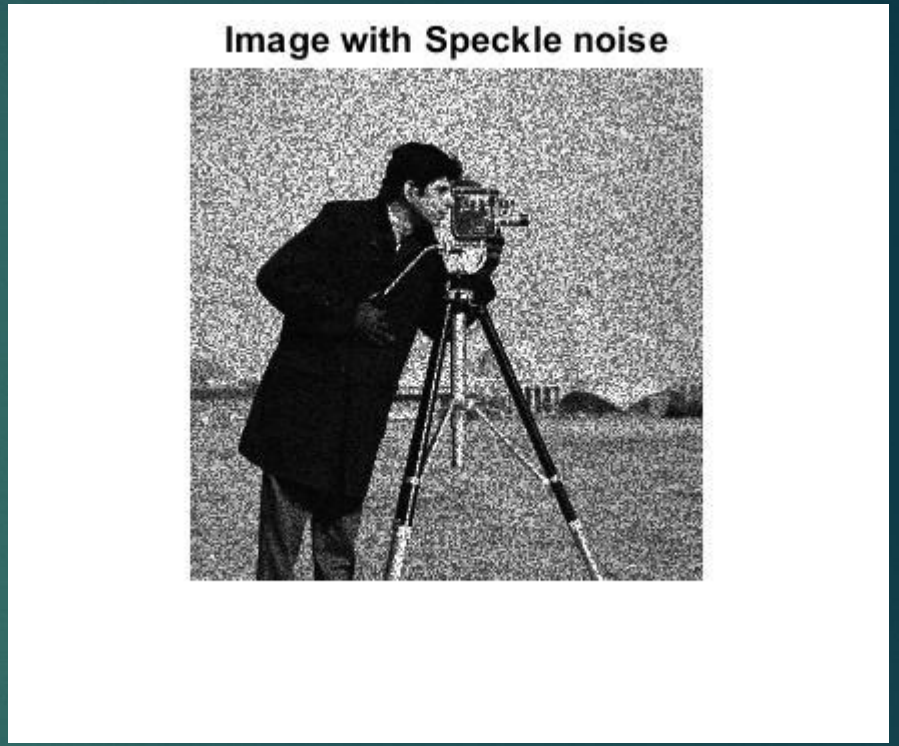
Gaussian noise

- Cause – Poor illumination during captures or high temperatures.
- Most common observed distribution is Gaussian distribution
- Also called additive noise .
- Certain distribution is added to each pixel in this kind of noise .



Speckle noise

- Causes any distribution to be multiplied by each pixel in the image.
- Corrupts images like ultrasounds, laser or sonar etc.
- It is a kind of multiplicative noise .



FILTERING TECHNIQUES

- Linear filters
- Min filter
- Max filter
- Median filter
- Wiener filter

Mean filter

- Uses average of values .
- Used for reducing random noise, sharpening edges and correcting unequal illuminations.
- It gives an output pixel which is linear combination of values of pixels in input pixel's neighborhood.
- Procedure – Filtering with correlation of appropriate filter kernel .
- Output pixel is sum of neighboring pixels .

Min filter

- Used to find darkest point in an image .
- Finds the minimum value encompassed and enhances dark areas of image .
- Reduces salt noise .

Max filter

- Used to find brightest point in an image .
- Finds the maximum value in the area encompassed and enhances bright areas of image .
- Reduces pepper noise .

Median filter

- Better for salt and pepper noise removal .
- Filters without the smoothing effects that can occur with other filters .
- Better for impulse type of noise .
- Also used as edge preserving filter at low levels of noise.

Wiener filter

- It is a type of adaptive filter .
- Performs smoothing as little or more depending on variance .
- It preserves edges and high frequency parts of images .
- More selective than a linear filter .
- Provides a statistical estimate of unknown signal; by using a relative signal as input and known signal to produce an estimate as output .

Inpainting method

- Used for restoration of particular parts of image .
- Uses the neighboring parts of image to fill in the gaps created .
- Based on geometric approach for filling in missing information.
- It approximates signals with the adjacent or neighboring pixel values.

RESULTS

Conclusions

- Min filter works well for salt noise whereas max filter works for pepper noise .
- Median filter works very well for salt and pepper and poisson noise .
- Mean filter worked well for poisson noise.
- Weiner worked very well for poisson noise .
- When region of interest is similar to neighboring parts , inpainting works very well .