What is Image Restoration?

Image restoration attempts to restore images that have been degraded

- Identify the degradation process and attempt to reverse it
- Similar to image enhancement, but more objective
Noise and Images

The sources of noise in digital images arise during image acquisition (digitization) and transmission.

- Imaging sensors can be affected by ambient conditions.
- Interference can be added to an image during transmission.

Types:
- Gaussian Noise
- Salt and Pepper Noise
What is Noise?

- Wiki definition: **noise** means any **unwanted** signal
- One person’s signal is another one’s noise
- Noise is not always random and **randomness** is an artificial term
- Noise is not always bad (see stochastic resonance example in the next slide)
Numerical Example of Noise

Noise level p=0.1 means that approximately 10% of pixels are contaminated by salt or pepper noise (highlighted by red color)
MATLAB Command

\[ Y = \text{IMNOISE}(X,'\text{salt \\& pepper}',p) \]
Example

Noisy image

Denoised Image

$P = 0.1$
MATLAB Command

>Y = IMNOISE(X, 'gaussian', m, v)
Noise Removal Examples

Original Image

Image Corrupted By Gaussian Noise

After passing through A Median Pass Filter
Experimental Results

noisy

result

(Gaussian filtering)
Low Pass and High Pass Filters

- **Low Pass Filter**: (used for smoothening)
- **High Pass Filter**: (used for edge detection)
Lowpass Filtering Application

A low pass filter is used to connect broken text

Historically, certain computer programs were written using only two digits rather than four to define the applicable year. Accordingly, the company's software may recognize a date using "00" as 1900 rather than the year 2000.
Lowpass Filtering Application

Lowpass filters used to remove blemishes in a photograph
Highpass Filtering Example

Original image

Result
Another Highpass Filter Example

Original

Result
Thresholding

- To convert gray images to Black and White
- Find a **Threshold** value, $T$, that separates the two peaks. This process is called **THRESHOLDING**

- Algorithm:
  - If $f(x,y) > T$ then $g(x,y) = 1$, else $g(x,y) = 0$

- Result: a binary image