Problem Definition

Our world nowadays deals with the digital systems everywhere to improve our way of living and a large segment of our modern systems mainly deal with digital images captured by modern cameras that must be accompanied by noises produced due to environmental conditions and because of the limit of the sensor capabilities that don't help in capturing the whole information which leads to the deterioration of the image quality and the noise maybe produced during compressing and transmitting the image from a place to other. Hence, further work needs to be done on the image to reverse the damage and to reduce noise without losing the image features as edges and corners as that noise will affect image processing as in video processing, and image tracking and analysis adversely. This field of image processing is called image denoising

Image denoising

Image denoising is removing the noise that affects the image quality and to restore the original image with edges that should not be blurry, smoothed flat areas, preserved textures, and without generated artifacts. The image denoising plays a historical role in many applications as image segmentation, image classification, visual tracking, …etc. Consequently, obtaining the original image content is crucial. The denoising is a challenging task as from a mathematical perspective, it is classified as an inverse operation done on an image to reverse the effect of that noise and the solution of such task is not unique.

Noise

Yet, what is noise? Noise is a variation in brightness and color information randomly and mainly is produced as a result of the technical limits of the sensor or improper environmental conditions. In real scenarios it is frequently to face such a common and an incontinent issue that is solved by an appropriate denoising algorithms. In digital imaging, we encounter various types of noise:

I. **Salt-and-pepper noise**: images have white pixels in dark are or dark pixels in white area. Mainly there are two reasons that cause this type of noise is digital-to-analog-converter and bit errors in transmission

II. **Periodic noise:** effected images have a repeated pattern on top of the image, the reason for this type of noise is electrical or electromechanical interference during the image capturing process

III. **Shot noise:** it is completely random and it came from generating a digital value from a single pixel by converting incoming photons into electrons

Salt-and-pepper noise

Periodic noise

Shot noise