EE 352 LAB REPORT

LAB 7: AM in Noise

Student Name: Harun Durmuş **Date:** 31.05.2023

Student ID: 270206025

7.1 Image Reading

Image Processing Toolbox of MATLAB contains imread(.) and imdouble(.) functions that are used for obtaining a matrix of pixels of a picture with proper size.

7.2 Modulation

Q1. What is the definition of the SNR?

A1. The Signal-to-Noise Ratio (SNR) measures the strength of a desired signal relative to the level of unwanted background noise in a communication system. It represents the difference between the signal's strength and the noise. A higher SNR indicates a stronger signal compared to the noise, resulting in better communication quality. Conversely, a lower SNR suggests a weaker signal that is more vulnerable to noise, potentially causing communication problems. SNR is typically calculated by comparing the power or amplitude of the signal to that of the noise. It is commonly expressed in decibels (dB), a logarithmic scale that simplifies the representation of a wide range of values.

Q3. Is there another way to add noise to the signal without using awgn(.)?

A3. Instead of using awgn(.), there is an alternative way to add Gaussian noise to a signal by multiplying square root of variance of the SNR value and with a normally distributed random values. This method is used in MATLAB code that is written during laboratory.

```
n0 = sqrt(var(1))*randn(1,length(m));
n10 = sqrt(var(2))*randn(1,length(m));
n30 = sqrt(var(3))*randn(1,length(m));
```

where n0,n10 and n30 stands for different SNR values [0 10 30].

7.3 Demodulation

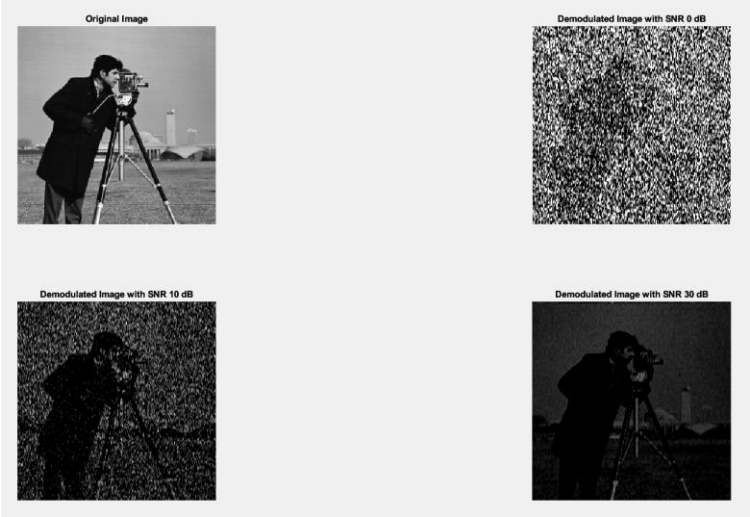

Figure 1: Original Image vs Demodulated Images with different signal-to-noise ratios

From the figure 1, it is obtained that conventional AM demodulation is not efficient in the case of additive normally distributed noise. Also it is a proof of the first answer in modulation part which indicates greater SNR means stronger signal compared to the noise, resulting better image processing quality.

Q2. What happens to the demodulated image as the SNR increases, and why?

A2. As the SNR increases in conventional AM, the quality of the demodulated image improves. This improvement occurs because the SNR represents the ratio of the power of the desired signal (modulated message signal) to the power of the noise present in the received signal.

When the SNR is high, it means that the power of the desired signal is significantly larger than the power of the noise. In this case, the demodulation process can extract the message signal more accurately from the received signal. As a result, the demodulated image closely resembles the original message signal.

Conversely, when the SNR is low, the power of the noise dominates over the power of the desired signal. This situation introduces more distortion and errors into the demodulated image.

Q4. We know that noise has the mean value and the variance value, which one represents the power of the noise?

A4. In the context of noise, the variance value represents the power of the noise. The mean value of noise indicates the average value or the DC offset of the noise signal, but it does not provide information about the power or intensity of the noise.

7.4 Mean Square Error (MSE) and Comparison

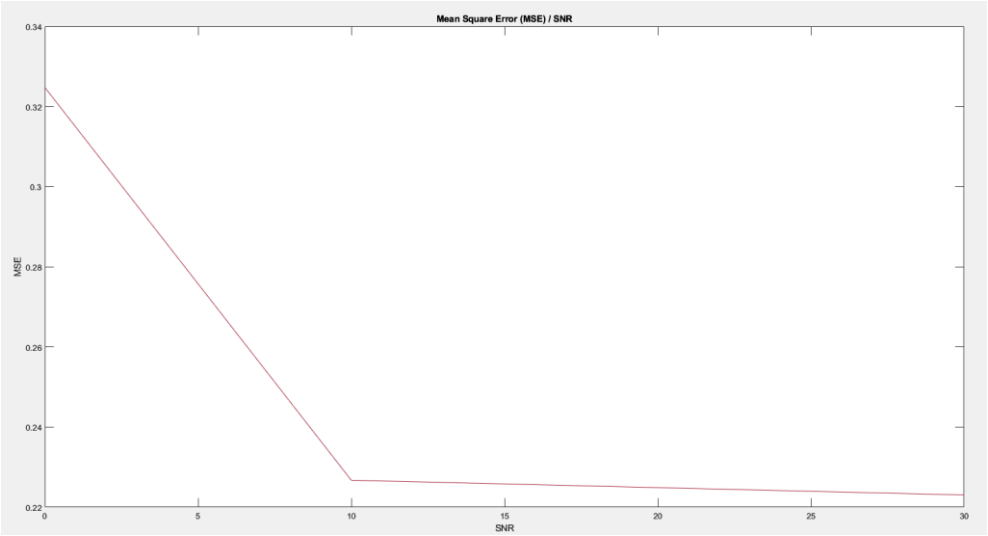

Figure 2: Mean Square Error with different SNR's

As a proof of figure 1, figure 2 shows that higher SNR value indicates better accuracy in image processing and communication.