AMERICAN INTERNATIONAL UNIVERSITY–BANGLADESH (AIUB)

FACULTY OF SCIENCE & TECHNOLOGY

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Section: J, Group:6

LAB REPORT: 06

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Title: Study of Frequency Modulation and Demodulation using Simulink.

Abstract:

This experiment is designed to-

1.To understand the use of Simulink for solving communication engineering problems.
2.To develop understanding of Frequency Modulation and Demodulation using Simulink.

INTRODUCTION:

Amplitude modulation was the first modulation type to be considered in analog communication systems. Amplitude modulation has the obvious advantage of being simple and relatively bandwidth efficient .

- Since the message is embedded in the amplitude of the carrier signal, the cost, performance, and the size of the linear amplifiers are difficult to accomplish for obtaining fair performance in AM systems.
- When the message goes through a quiet period in Double Side Band (DSB) or Single Side Band (SSB) systems, very small carrier signals are transmitted. The absence of the signal tends to accentuate the noise.
- The passband bandwidth is small compared to the other modulation schemes, i.e. FM, cellular, Wi-Fi etc.

Frequency Modulation

- The angle modulated signal described in time domain:
- $s(t) = A_c \cos[2\pi f_c t + \theta(t)] = Re\{A * \exp(j\phi(t))\}$
- Where A_c is the amplitude, then
-
- The instantaneous phase is:

$$\bullet\ \phi_i = 2\pi f_c t + \theta(t)$$

- The instantaneous frequency of the modulated signal is:
- $f_i(t) = \frac{1}{2\pi}\frac{d}{dt}[2\pi f_c t + \theta(t)] = f_c + \frac{1}{2\pi}\frac{d[\theta(t)]}{dt}$

• Where $\frac{d[\theta(t)]}{dt}$ is called phase deviation.

• The phase deviation of the carrier, $\phi(t)$ is related to the baseband message $m(t)$. Then,

• $\frac{d[\theta(t)]}{dt} = K_f m(t)$

• Where K_f is frequency deviation constant

$$\bullet\ \phi(t) = K_f \int_{-\infty}^{t} m(\lambda) d\lambda$$

• Finally, the frequency modulated signal is expressed as in time domain:

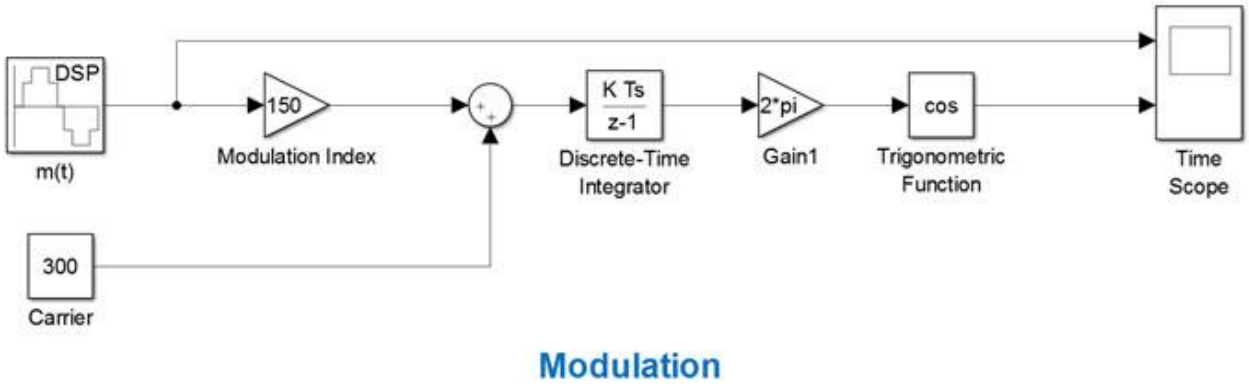
$$\bullet\ s(t) = A_c \cos[2\pi f_c t + K_f \int_{-\infty}^{t} m(\lambda) d\lambda]$$

• Carson's rule is used to determine the bandwidth of the FM wave. According to the Carson's rule, the bandwidth is given by:

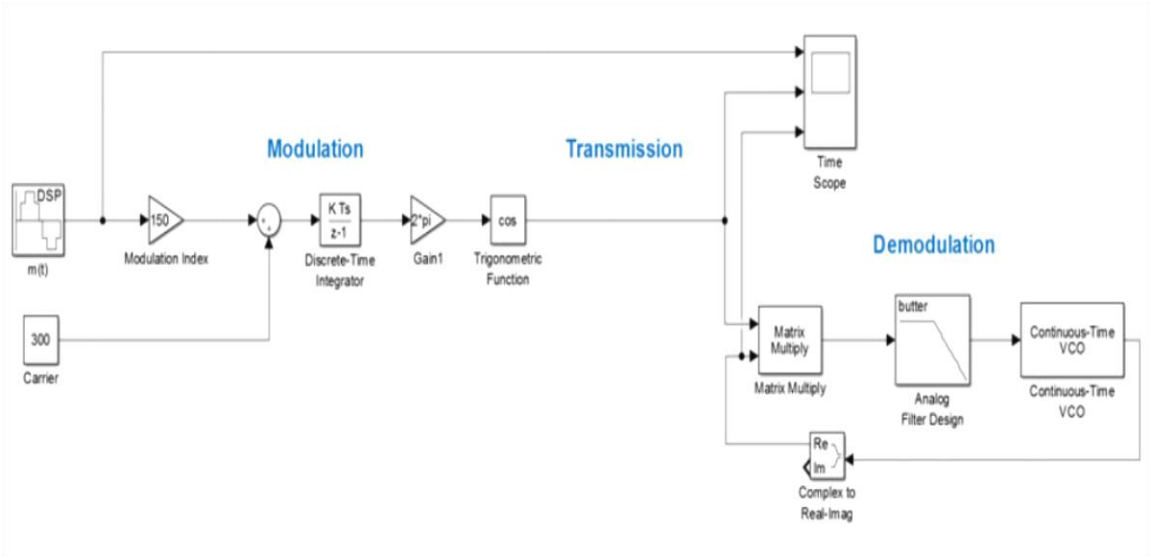
• $B_t = 2W(1 + D)$, where W is the bandwidth of the information signal, and D is the frequency deviation which is defined as for FM:

$$\bullet\ D = \frac{K_f}{2\pi W} \max |m(t)|$$

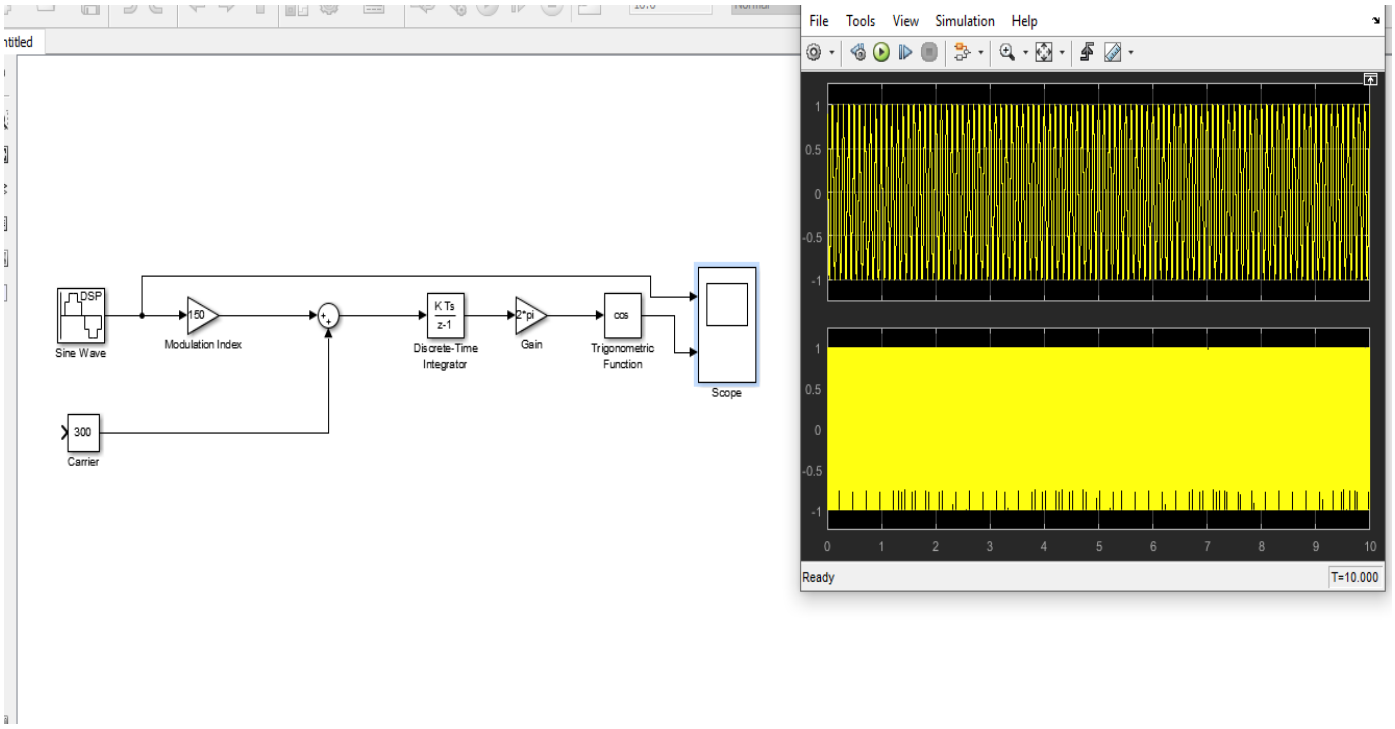
Block Diagram:

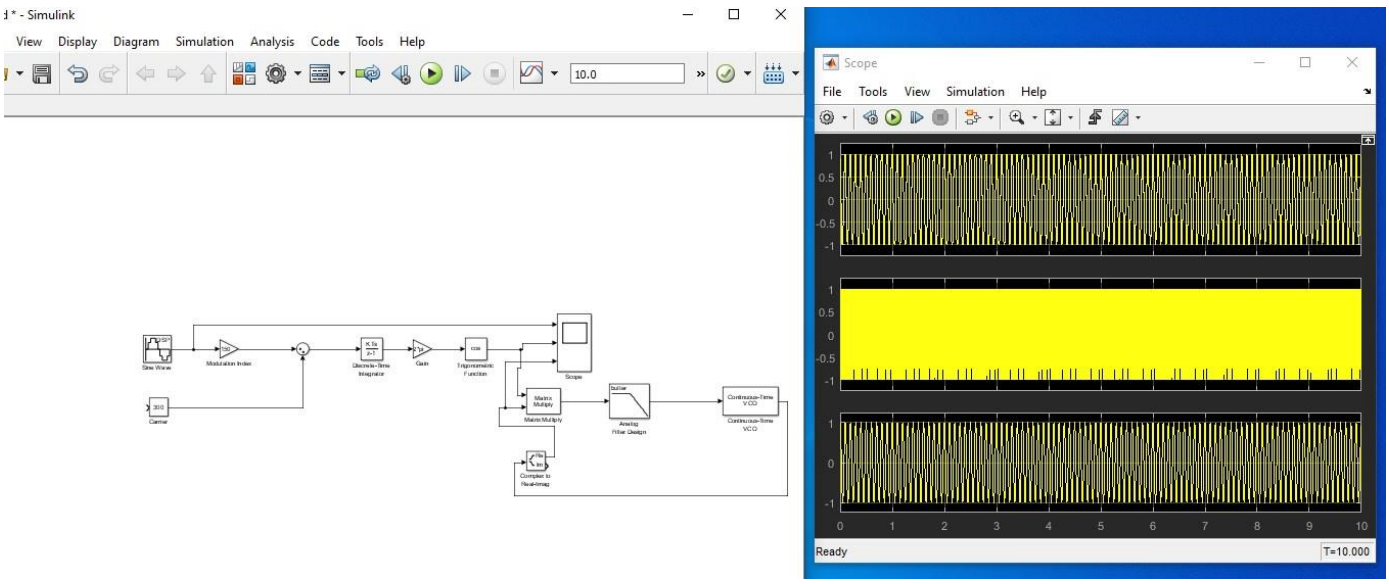


Modulation



Output Waveforms:





DISCUSSION AND CONCLUSION:

We used Simulink to model an FM transmitter and receiver and observed the demodulated audio signal. The results showed that FM is effective for transmitting audio signals, but noise and distortion reduce the signal-to-noise ratio of the demodulated signal. Techniques such as filtering and equalization can improve SNR. Simulink is a powerful tool for modeling and analyzing FM and demodulation circuits.