Cosmos College of Management and Technology

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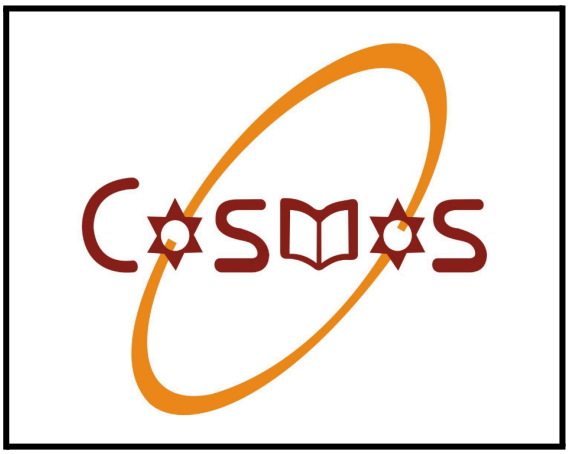
Saddobato, Lalitpur



Lab Report on: Modulate and Demodulate FM Signals in Simulink

Lab report number: 06

Submitted By

Name: Aayush Karki

Roll num: 200101

Faculty: BE IT

Semester: V

Sub: POC

Group: A

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Department of ICT

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Lab Number: 06

Lab Title: Modulate and Demodulate FM Signals in Simulink

Lab Objective

1. Understanding Frequency Modulation (FM)
2. Implementing FM Modulation and Demodulation
3. Examining Frequency Deviation
4. Observing Amplitude-to-Frequency Mapping

Theory

Modulation is the process of varying one or more properties of a high-frequency carrier signal in accordance with the information signal. This is done to effectively transmit the information over a communication channel that may have limitations in terms of distance, bandwidth, or noise. In the context of sinusoidal signals, amplitude modulation (AM), frequency modulation (FM), and phase modulation (PM) are common modulation techniques.

Demodulation is the process of extracting the original information signal from a modulated carrier signal. It is the reverse process of modulation and is essential for retrieving the transmitted information accurately.

Frequency Modulation is a type of modulation where the frequency of the carrier signal is varied in proportion to the amplitude of the information signal. In FM modulation, changes in the amplitude of the input signal result in variations in the frequency of the carrier signal. This modulation technique is commonly used in radio broadcasting due to its resilience to amplitude variations and noise.

FM demodulation is the process of recovering the original information signal from a frequency-modulated carrier signal. It involves extracting the variations in frequency caused by the information signal.

FM Modulator Baseband is a component or system that performs frequency modulation on a baseband signal. In the context of sinusoidal signals, the FM Modulator Baseband modulates the frequency of the input signal directly without the need for upconversion

to a higher frequency carrier. It is a fundamental building block in communication systems employing FM modulation.

FM Demodulator Baseband is a component or system that performs demodulation of a frequency-modulated signal at baseband. In the case of sinusoidal signals, the FM Demodulator Baseband extracts the original baseband signal from the frequency-modulated carrier signal without the need for downconversion to a lower frequency. This demodulator is designed to handle the unique characteristics of frequency-modulated signals.

Modulate and demodulate a sinusoidal signal using FM Modulator Baseband and FM Demodulator Baseband blocks.
The fm model generates a sine wave of frequency 4 Hz and amplitude 1 V. The FM Modulator Baseband block sets the frequency deviation to 50 Hz.

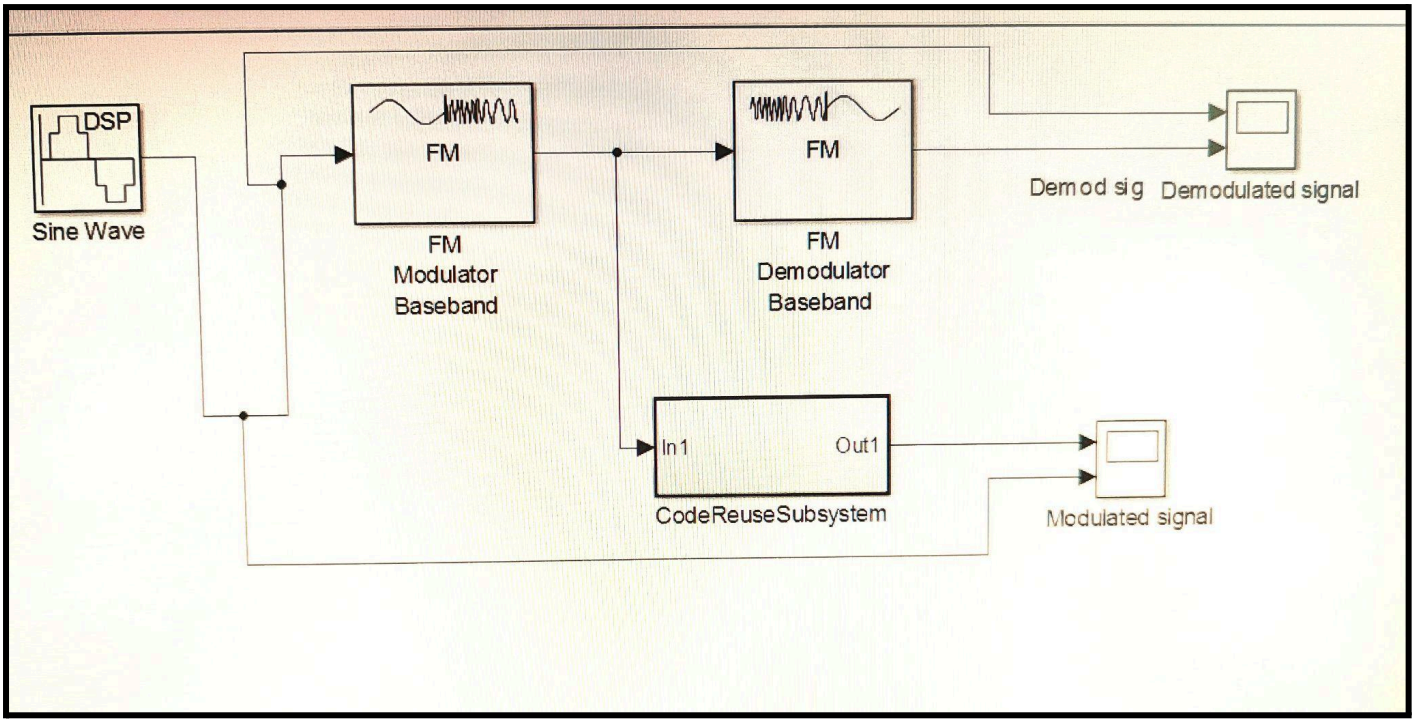
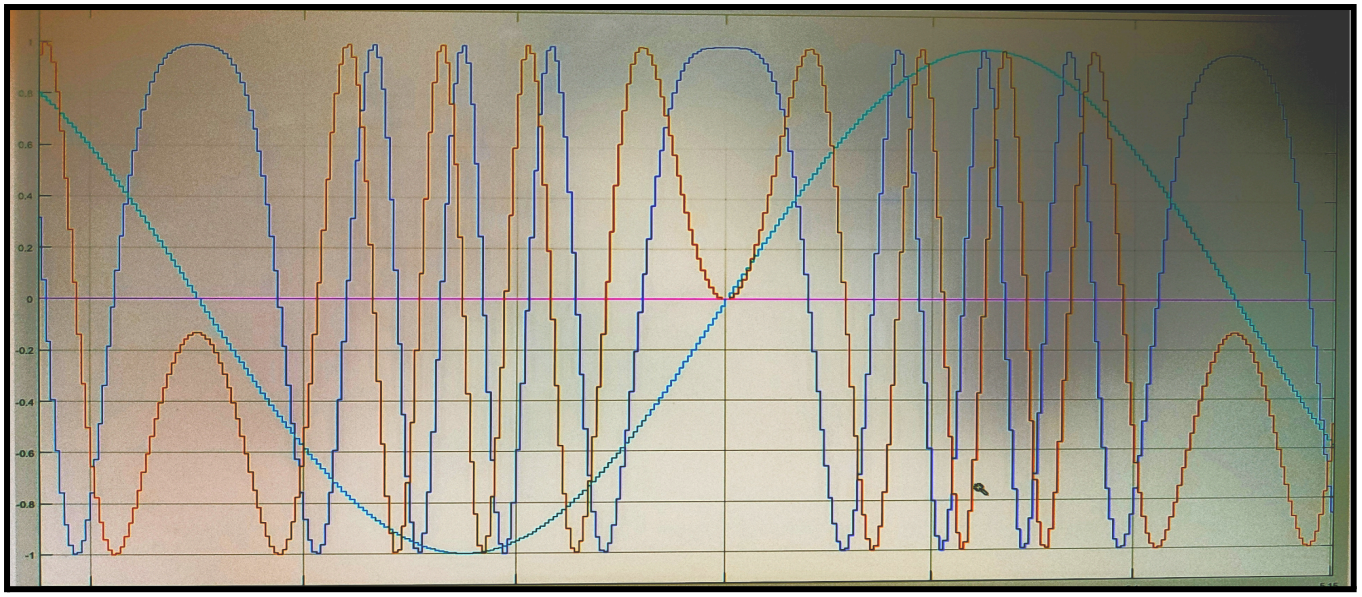


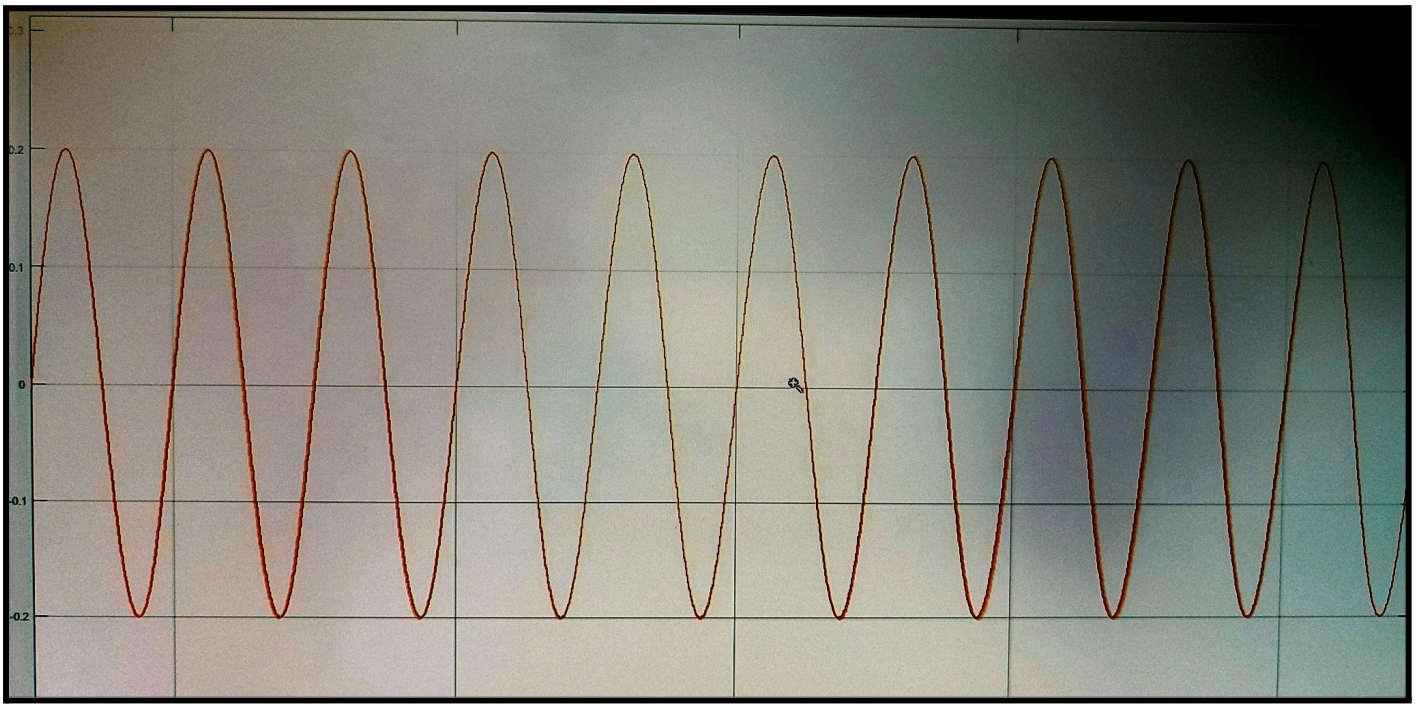
Fig: Implementation of the Circuitry for FM Modulation & Demodulation in simulink

The Modulated Signal scope shows that the frequency of the modulator output, Mod Sig, varies with the amplitude of the input data.

Outputs:



The Demodulated Signal scope demonstrates that the output of the demodulator, Demod Signal is perfectly aligned with the input data.



DISCUSSION

In this lab, we delved into the fundamental concepts of Frequency Modulation (FM) and implemented the modulation and demodulation of a sinusoidal signal using Simulink. The objective was to gain insights into the behavior of FM signals, particularly focusing on frequency deviation and amplitude-to-frequency mapping.

The Simulink model was configured to generate a sine wave signal with a frequency of 4 Hz and amplitude of 1 V. The FM Modulator Baseband block was employed to modulate

this signal, with a set frequency deviation of 50 Hz. The implemented circuitry for FM modulation showcased the dynamic variation in the frequency of the modulated signal, emphasizing the impact of amplitude changes in the input data. The Modulated Signal scope vividly illustrated the correlation between the amplitude of the input data and the resulting frequency modulation. As anticipated, higher amplitudes led to broader frequency variations in the modulated signal. This aligns with the principles of FM modulation, where changes in amplitude directly influence the carrier signal's frequency. The FM Demodulator Baseband block was employed to demodulate the frequency-modulated signal. The Demodulated Signal scope demonstrated the successful extraction of the original baseband signal from the frequency-modulated carrier. The output of the demodulator, Demod Signal, exhibited a perfect alignment with the input data, highlighting the effectiveness of the demodulation process.

CONCLUSION

This lab provided hands-on experience in modulating and demodulating sinusoidal signals using FM Modulator Baseband and FM Demodulator Baseband blocks in Simulink. The observations from the Modulated and Demodulated Signal scopes reinforced the theoretical understanding of FM modulation and demodulation.

The varying frequency deviation played a crucial role in determining the extent of frequency modulation. A higher deviation resulted in more pronounced frequency variations, emphasizing the importance of this parameter in FM. The correlation between input data amplitude and the frequency modulation of the carrier signal was clearly demonstrated. This understanding is fundamental in designing and optimizing communication systems utilizing FM modulation.

Overall, the lab successfully achieved its objectives, providing valuable insights into the behavior of FM signals and reinforcing theoretical concepts through practical implementation in Simulink. The hands-on experience with modulation and demodulation processes contributes to a deeper comprehension of communication systems utilizing Frequency Modulation.