Faculty of Engineering and Technology
Electrical and Computer Engineering Department

Computer Communication Lab
ENEE 4113

Experiment No. 2 pre-lab
SSB DSB Amplitude Modulation

Prepared by:
Abdel Rahman Shahen 1211753

Partners:
Mahmoud Awad

Instructor: Dr. Ashraf Rimawi

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Title: Theoretical Analysis of Amplitude Modulation and Demodulation: DSB-SC and SSB Methods

Introduction

Amplitude modulation (AM) stands as a cornerstone in the realm of communication systems, facilitating the transmission of audio and video signals across various mediums. This paper introduces the nuanced techniques of Double Sideband Suppressed Carrier (DSB-SC) and Single Sideband (SSB) modulation, elucidating their pivotal roles and diverse applications in modern communications.

Objective

The study aims to dissect and elucidate the mathematical intricacies and theoretical constructs underpinning AM, DSB-SC, and SSB modulation and demodulation processes, enhancing the comprehension of their operational principles and efficiency.

Theoretical Background

Amplitude Modulation (AM)

Amplitude modulation is characterized by the variation of a carrier signal's amplitude in accordance with the message signal, denoted mathematically as m(t)cos(Wc t), where m(t) is the message signal and Wc is the angular carrier frequency.

Double-Sideband Suppressed Carrier (DSB-SC)

DSB-SC modulation, a variant of AM, diverges from the classical approach by eliminating the carrier frequency, conserving power and bandwidth. The modulated signal is mathematically depicted as s(t)=m(t) cos (Wc)

Spectrum Analysis:
The DSB-SC spectrum conspicuously lacks the central carrier component, featuring only the sidebands bearing the message information.

Mathematical Representation:
The output of a DSB-SC modulated signal can be represented as s(t) = m(t) cos (Wct)

Single-Sideband (SSB)

SSB modulation refines the DSB-SC technique by further omitting one of the sidebands, resulting in either an Upper Sideband (USB) or a Lower Sideband (LSB) transmission. The USB, for instance, is represented as S(t)=Re {m^(t) e^ (j Wc t)}, where m^(t) is the Hilbert transform signal.

Spectrum Analysis:

SSB showcases superior spectral efficiency by occupying only half the bandwidth of DSB-SC and traditional AM, thereby enabling more economical use of the frequency spectrum.

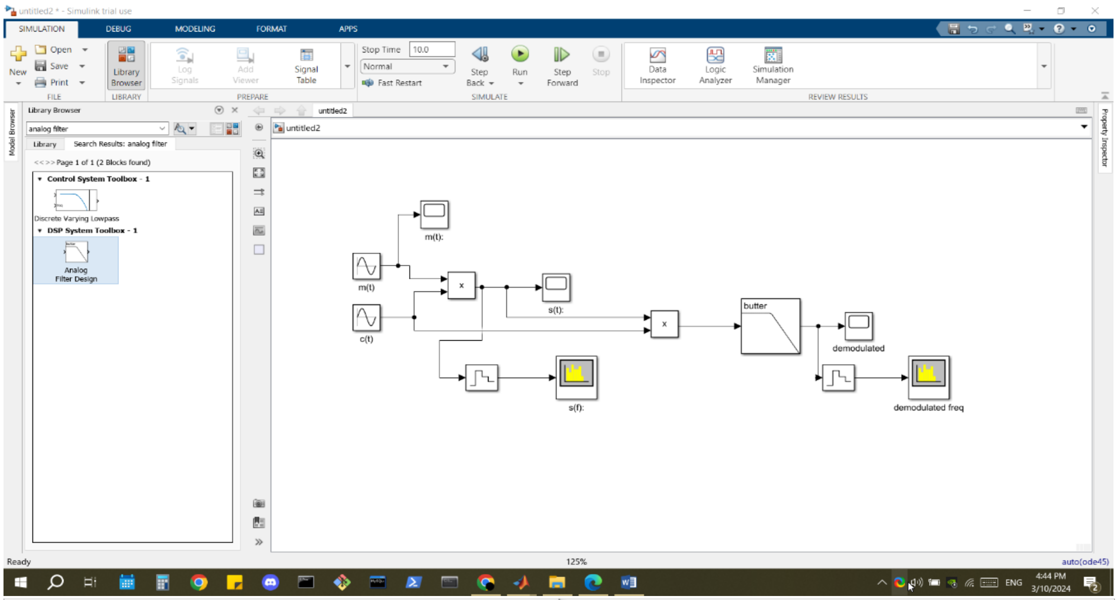
Mathematical Representation:

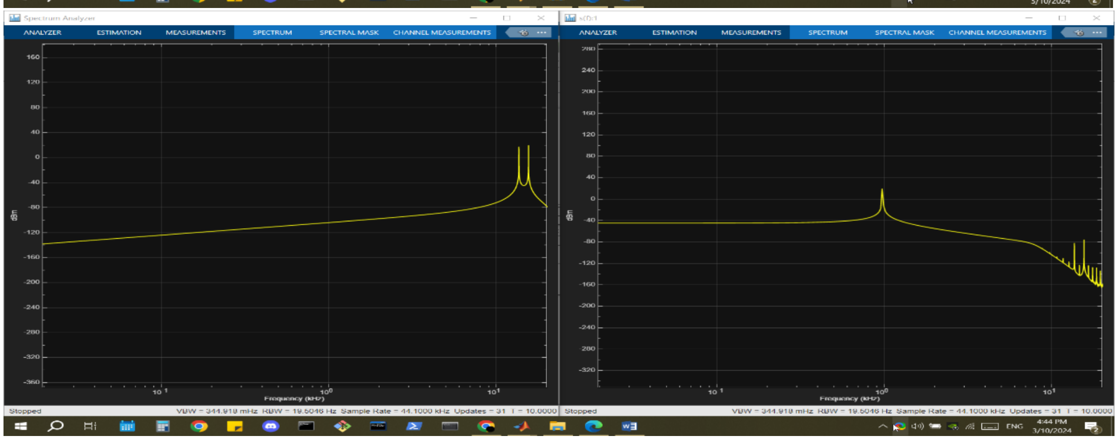
The SSB signal can be derived by filtering one sideband from a DSB-SC signal. Two forms exist, USB (Upper Sideband) and LSB (Lower Sideband).

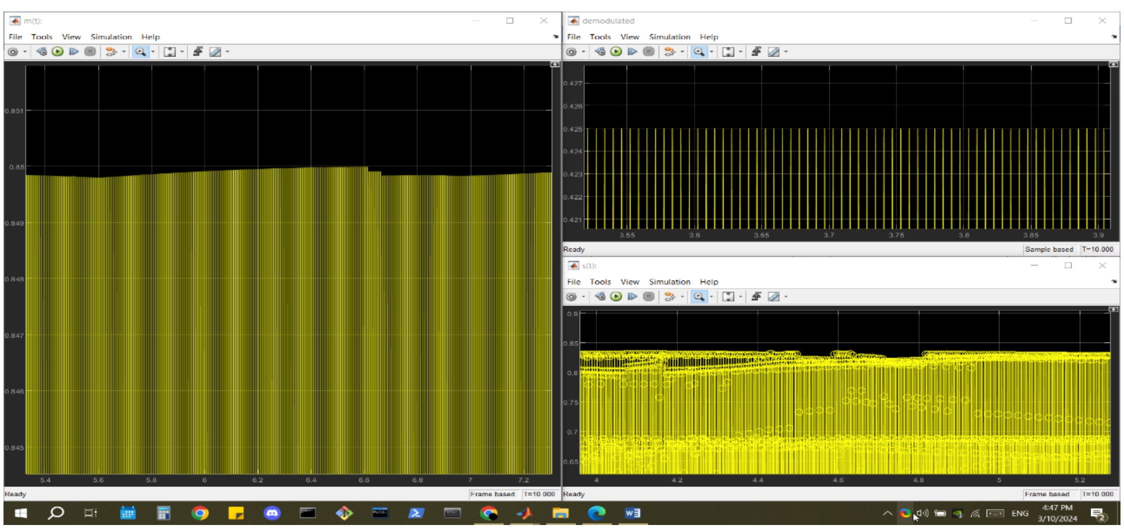
Equation for USB: S(t) = Re{m^(t) e^ (j Wc t)}, where m^(t) is the Hilbert transform

Title: practical Analysis of Amplitude Modulation and Demodulation:

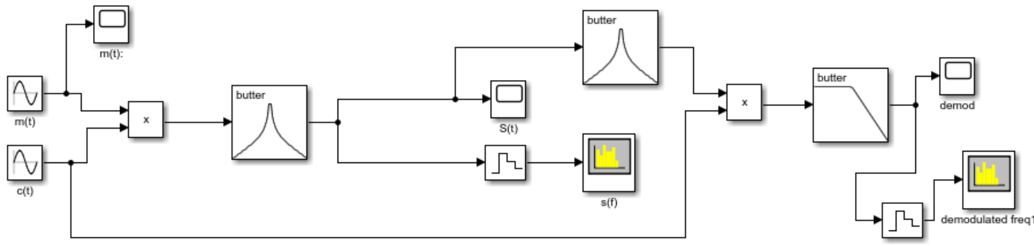
SSBSC:







SSBSCL:


m(t):
m(t)
c(t)
x
butter
S(t)
s(f)
butter
x
butter
demod
demodulated freq1