APPLYING AMPLITUDE MODULATION IN REAL LIFE APPLICATIONS

DATE: 21.12.2022

A MAJOR PROJECT REPORT

Submitted

CH.EN.U4AIE21014	**G CHAITHANYA**
CH.EN.U4AIE21016	**Y HEMANTH**
CH.EN.U4AIE21024	**K KOUSHIK**
CH.EN.U4AIE21034	**P HANEEF**
CH.EN.U4AIE21046	**S PRANAV REDDY**

Under the guidance of

Mr. Sudharson

In partial fulfilment for the award of the degree

Of

BACHELOR OF TECHNOLOGY

In

Introduction to communicaton systems

AMRITA SCHOOL OF ENGINEERING, CHENNAIAMRITA VISHWA VIDYAPEETHAM

CHENNAI - 601103

December -22

AMRITA VISHWA VIDYAPEETHAM

AMRITA SCHOOL OF ENGINEERING, CHENNAI-601103

BONAFIDE CERTIFICATE

This is to certify that the major project report entitled

" INTRODUCTION TO COMMUNICATION SYSTEMS"

Submitted by,

CH.EN.U4AIE21014	**G CHAITHANYA**
CH.EN.U4AIE21016	**Y HEMANTH**
CH.EN.U4AIE21024	**K KOUSHIK**
CH.EN.U4AIE21034	**P HANEEF**
CH.EN.U4AIE21046	**S PRANAV REDDY**

In partial fulfilment of the requirements for the award of the Degree of Bachelorof Technology in **INTRODUCTION TO COMMUNICATION SYSTEM** is a Bonafide record of the work carried out under my guidance and supervision at Amrita School of Engineering, Chennai.

Signature

Mr. SUDHARSON

Asst.Professor, Department of AIE.

This project was evaluated by us on …………

INTERNAL EXAMINER EXTERNAL EXAMINER

ACKNOWLEDGEMENT

We offer our sincere pranams at the lotus feet of Universal guru, MATAAMRITANANDAMAYI DEVI who blessed us with her grace to make this a successful major project.

We express our deep sense of gratitude to Dr.P.Shankar, Principal of Amrita School of Engineering, Chennai and Dr. IB.Manikantan , Director, Amrita School of Engineering, Chennai for their kind support. We are grateful to our guide Dr. Ishwariya, Assistant Professor , Department of Mathematics, ASE, Chennai for his valuable support and guidance during the major project work. We are also indebted to our guide **Dr. Prasanna Kumar** R, Chairperson of Computer Science (Artificial Intelligence),Dr.Bharathi Mohan sir, ASE, Chennai, for his guidance. Weare also thankful to all other staff members of the Department of Sciences for their valuable help, all our classmates who have always been a source of strength,for always being there and extending their valuable helps to the successful completion of this work.

APPLYING AMPLITUDE MODULATION IN REAL LIFE APPLICATIONS

G CHAITHANYA(21014), Y HEMANTH(21016), K KOUSHIK(21024), P HANEEF(21034), S PRANAV REDDY(21046)

Abstract - An amplitude modulated (AM) transmitter and receiver using double sideband suppressed carrier (DSB-SC) can be set up in GNU Radio by using a selection of blocks from the GNU Radio library. To transmit an AM signal, the audio input can be amplified and then modulated onto a carrier wave using a multiplier block. The carrier signal can be produced using a sinusoidal waveform generator block, and the resulting modulated signal can be filtered with a low pass filter to eliminate any excess bandwidth. The modulated signal can then be amplified and transmitted using an RF output block. To receive the AM signal, an RF input block can be utilized to capture the transmitted signal. The received signal can then be demodulated using a product detector block, which multiplies the received signal by a locally generated carrier signal and filters the result to produce the baseband audio signal. The baseband signal can then be amplified and passed through a low pass filter to remove any noise or interference. Overall, the transmitter and receiver can be implemented in GNU Radio using a combination of modulation, filtering, and amplification blocks, along with RF input and output blocks for transmitting and receiving the signal.

Keywords–DSBFC, AM-TRANSMITTER,

RECEIVER, GNU RADIO, LOW PASS FILTER

I. Introduction

Amplitude modulated (AM) transmission is a method of transmitting an audio signal by modulating the amplitude of a carrier wave. Double sideband suppressed carrier (DSB-SC) is a specific type of AM in which only one sideband (either the upper or lower) is transmitted, with the carrier wave suppressed. This results in a more efficient use of bandwidth compared to other forms of AM, such as double sideband (DSB) or single sideband (SSB).GNU Radio is a free and open-source software development toolkit that can be used to design, implement, and simulate wireless communication systems. It provides a wide range of digital signal processing (DSP) blocks that can be used to implement a variety of communication systems, including AM transmitters and receivers.In this project, we will implement an AM transmitter and receiver using DSB-SC in GNU Radio. The transmitter will take in an audio signal and modulate it onto a carrier wave using DSB-SC, while the receiver will demodulate the received signal to recover the original audio. We will use a combination of DSP blocks from the GNU Radio library to design and simulate the transmitter and receiver, and we will also explore the performance of the system in terms of its bandwidth and signal-to-noise ratio (SNR).

LITERATURE REVEIW

Amplitude modulation (AM) is a widely used method of transmitting information over the airwaves. It has been employed in a variety of applications, including broadcasting, military communications, and aviation. There are several different types of AM, including double sideband (DSB), single sideband (SSB), and double sideband suppressed carrier (DSB-SC). Each of these techniques has its own advantages and disadvantages in terms of bandwidth efficiency and receiver complexity.Double sideband suppressed carrier (DSB-SC) is a type of AM in which only one sideband is transmitted, with the carrier suppressed. This results in a more efficient use of bandwidth compared to DSB or SSB, as only one sideband is transmitted rather than both. However, this also makes the receiver more complex, as the carrier must be regenerated in order to demodulate the received signal.GNU Radio is a powerful tool for designing and simulating communication systems, including AM transmitters and receivers. It provides a wide range of DSP blocks that can be used to implement various types of AM, including DSB-SC. By using GNU Radio, it is possible to design and simulate an AM transmitter and receiver and explore the performance of the system in terms of its bandwidth and signal-to-noise ratio (SNR).In previous research, AM transmitters and receivers using DSB-SC have been implemented using a variety of techniques, including analog and digital approaches. For example, some studies have used analog circuits to implement the modulator and demodulator, while others have used digital signal processing (DSP) techniques to implement the transmitter and receiver in software. Using GNU Radio, it is possible to explore the performance of an AM transmitter and receiver using DSB-SC in a flexible and easy-to-use simulation environment.

AMPLITUDE MODULATION

Amplitude modulation (AM) is a type of analog communication in which the amplitude, or strength, of a carrier signal is varied in proportion to the modulating signal. The modulating signal can be a voice, data, or other type of information that is to be transmitted.

In AM, the modulating signal is superimposed on the carrier signal, resulting in two sidebands that contain the modulated information. The carrier signal is suppressed, or removed, in the process. The resulting signal is known as an AM signal.

There are two types of AM: single-sideband AM (SSB-AM) and double-sideband AM (DSB-AM). In SSB-AM, only one sideband is transmitted, while in DSB-AM, both sidebands are transmitted. DSB-AM is less spectrally efficient than SSB-AM, as it occupies more bandwidth, but it is easier to implement and has better performance under noisy conditions.

AM is used in a variety of communication systems, including radio broadcasting, telephone systems, and other forms of wireless and wired communication. It is simple to implement and has a wide dynamic range, which makes it suitable for transmitting a wide range of amplitudes. However, AM is not suitable for applications that require high-fidelity or high-bandwidth transmission, as it tends to have lower signal-to-noise ratio and lower bandwidth efficiency compared to other forms of modulation such as frequency modulation (FM) or phase modulation (PM).

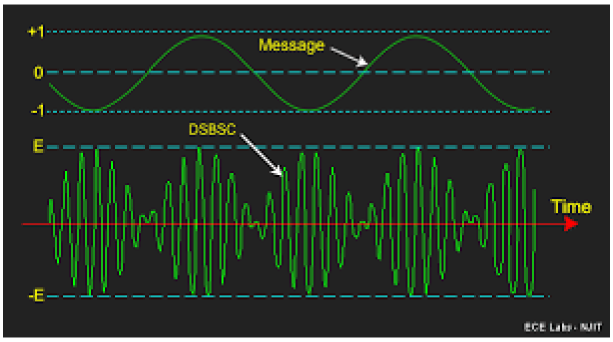
DSBSC(Double Side Band Suppressed Carrier

Double Sideband Suppressed Carrier (DSBSC) is a type of amplitude modulation (AM) in which the carrier frequency is suppressed, or removed, and only the two sidebands containing the modulated information are transmitted. The two sidebands are known as the upper sideband (USB) and lower sideband (LSB).

In DSBSC, the modulating signal is superimposed on the carrier signal, resulting in two sidebands that contain the modulated information. The carrier signal is suppressed, or removed, in the process. The resulting signal is known as a DSBSC signal.

DSBSC is less spectrally efficient than single-sideband AM (SSB-AM), as it occupies more bandwidth, but it is easier to implement and has better performance under noisy conditions. DSBSC is often used for transmitting voice and other types of audio signals over radio frequency (RF) channels.

To demodulate a DSBSC signal, a product detector or frequency demodulator can be used to multiply the received signal by a locally generated carrier signal and filter the result to produce the baseband audio signal. The baseband signal can then be amplified and passed through a low pass filter to remove any noise or interference.



FIG(1)

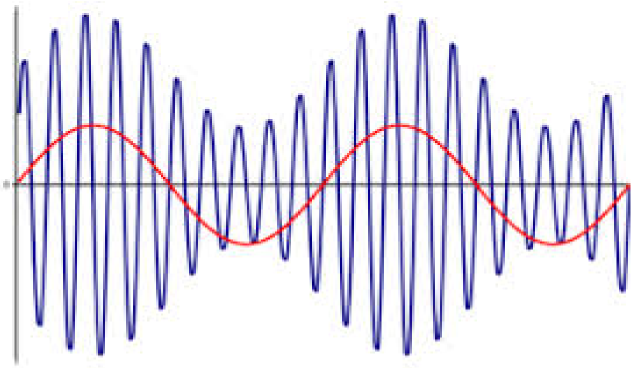
DSBFC(Double Side Band Full Carrier)

Double Sideband Full Carrier (DSBFC) is a type of amplitude modulation (AM) in which the modulating signal is superimposed on the carrier signal, resulting in two sidebands that contain the modulated information. The carrier signal is not suppressed, or removed, and is transmitted along with the sidebands. The two sidebands are known as the upper sideband (USB) and lower sideband (LSB).

In DSBFC, the modulating signal is superimposed on the carrier signal, resulting in two sidebands that contain the modulated information. The carrier signal is not suppressed, or removed, and is transmitted along with the sidebands. The resulting signal is known as a DSBFC signal.

DSBFC is less spectrally efficient than single-sideband AM (SSB-AM), as it occupies more bandwidth, but it is easier to implement and has better performance under noisy conditions. DSBFC is often used for transmitting voice and other types of audio signals over radio frequency (RF) channels.

To demodulate a DSBFC signal, a product detector or frequency demodulator can be used to multiply the received signal by a locally generated carrier signal and filter the result to produce the baseband audio signal. The baseband signal can then be amplified and passed through a low pass filter to remove any noise or interference.



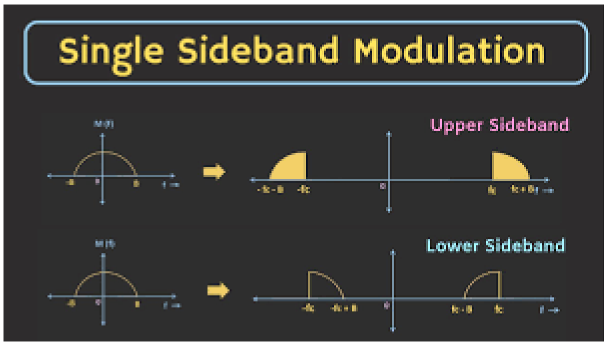
FIG(2)

SSBSC (SINGLE SIDE BAND SUPRESSED CARRIER)

Suppressed sideband (SSB) is a type of amplitude modulation (AM) in which only one of the two sidebands containing the modulated information is transmitted. The carrier signal is suppressed, or removed, in the process. The resulting signal is known as an SSB signal.

There are two types of SSB: upper sideband (USB) and lower sideband (LSB). In USB, the upper sideband is transmitted, while in LSB, the lower sideband is transmitted. SSB is more spectrally efficient than double sideband full carrier (DSBFC) AM, as it occupies less bandwidth, but it is more complex to implement and has worse performance under noisy conditions. SSB is often used for transmitting voice and other types of audio signals over radio frequency (RF) channels.

To demodulate an SSB signal, a product detector or frequency demodulator can be used to multiply the received signal by a locally generated carrier signal and filter the result to produce the baseband audio signal. The baseband signal can then be amplified and passed through a low pass filter to remove any noise or interference.



Comparison between DSBSC, DSBFC AND SSB)

comparison of the main characteristics of Double Sideband Suppressed Carrier (DSBSC), Double Sideband Full Carrier (DSBFC), and Suppressed Sideband (SSB) amplitude modulation (AM) techniques:

1.Carrier suppression: In DSBSC, the carrier frequency is suppressed, or removed, while in DSBFC, the carrier frequency is not suppressed and is transmitted along with the sidebands. In SSB, only one of the two sidebands is transmitted, and the carrier is suppressed.

2.Bandwidth efficiency: DSBSC and DSBFC are less spectrally efficient than SSB, as they occupy more bandwidth. SSB is more spectrally efficient, as it occupies less bandwidth.

3.Implementation complexity: DSBSC and DSBFC are simpler to implement than SSB, as they do not require carrier suppression. SSB is more complex to implement, as it requires carrier suppression.

4.Performance under noisy conditions: DSBSC and DSBFC tend to have better performance under noisy conditions than SSB, as they do not require carrier suppression. SSB has worse performance under noisy conditions, as it requires carrier suppression.

5.Applications: DSBSC, DSBFC, and SSB are all used for transmitting voice and other types of audio signals over radio frequency (RF) channels. However, SSB is generally more suitable for high-fidelity or high-bandwidth transmission, while DSBSC and DSBFC are more suitable for low-fidelity or low-bandwidth transmission.

REAL LIFE IMPLEMENTATION OF AMPLITUDE MODULATION IN AMPLITUDE RECEIVER AND TRANSMITTER

Amplitude modulation (AM) is widely used in a variety of communication systems, including radio broadcasting, telephone systems, and other forms of wireless and wired communication. Here are some examples of real-life implementation of AM in amplitude receivers and transmitters:

1.Radio broadcasting: AM is commonly used in radio broadcasting to transmit voice and music over the airwaves. AM radio stations use large transmitters to modulate the audio signal onto a carrier frequency and transmit it to receivers in the surrounding area. Consumers can tune in to AM radio stations using AM receivers, such as portable radios or car radios.

2.Telephone systems: AM is also used in telephone systems to transmit voice signals over telephone lines. In this application, the audio signal from the microphone is modulated onto a carrier frequency and transmitted over the telephone line. At the receiving end, the modulated signal is demodulated and the audio signal is recovered.

3.Wireless communication: AM is used in a variety of wireless communication systems, such as amateur radio, CB radio, and shortwave radio. In these systems, AM transmitters modulate the audio signal onto a carrier frequency and transmit it over the air, while AM receivers demodulate the received signal and recover the audio information.

Implementation of Amplitude Receiver and Transmitter in software GNU radio

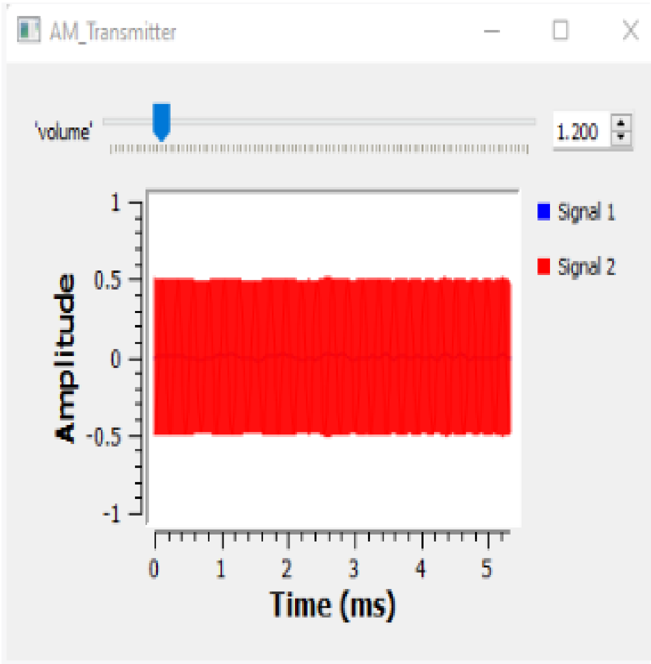
Amplitude modulation (AM) can be implemented in GNU Radio, an open-source software toolkit for building software radios, by using a few different blocks from the GNU Radio library. Here is an example of how to implement an AM transmitter and receiver in GNU Radio:

1.Transmitter: To transmit an AM signal, the input audio signal can be passed through an amplifier to increase its power, then modulated onto a carrier signal using a multiplier block. The carrier signal can be generated using a sinusoidal waveform generator block, and the resulting modulated signal can be filtered using a low pass filter to remove any excess bandwidth. The modulated signal can then be amplified and transmitted using an RF output block.

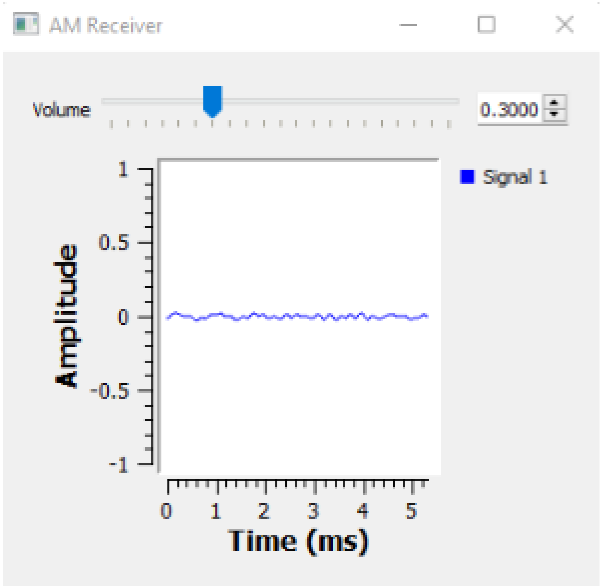
2.Receiver: To receive the AM signal, an RF input block can be used to capture the transmitted signal. The received signal can then be demodulated using a product detector block, which multiplies the received signal by a locally generated carrier signal and filters the result to produce the baseband audio signal. The baseband signal can then be amplified and passed through a low pass filter to remove any noise or interference.

Overall, the transmitter and receiver can be implemented in GNU Radio using a combination of modulation, filtering, and amplification blocks, along with RF input and output blocks for transmitting and receiving the signal.

Transmitter:-



Receiver:-



Advantages of Amplitude modualtion in Receiver and Transmitter

1.Simplicity: AM is a relatively simple form of modulation that can be easily implemented using basic electronic circuits. This makes it suitable for use in low-cost and low-power communication systems.

2.Robustness: AM signals are relatively resistant to noise and interference, which makes them suitable for use in environments with poor signal conditions.

3.Compatibility: AM is compatible with a wide range of transmission media, including radio frequency (RF) channels, telephone lines, and fiber optic cables.

4.Efficient use of bandwidth: AM signals use only a small portion of the available bandwidth, which makes them efficient for transmitting a large amount of information in a limited bandwidth.

5.Wide dynamic range: AM signals have a wide dynamic range, which allows them to transmit signals with a wide range of amplitudes.

6.Easy to demodulate: AM signals are relatively easy to demodulate, which makes them suitable for use in simple and low-cost receiver systems.

Conclusion

Amplitude modulation (AM) is a simple and effective method for transmitting and receiving voice, data, and other types of information over a wide range of transmission media. AM has several advantages, including simplicity, robustness, compatibility, efficient use of bandwidth, wide dynamic range, and easy demodulation. These advantages make AM a popular choice for a variety of communication applications, including radio broadcasting, telephone systems, and other forms of wireless and wired communication. However, AM is not suitable for applications that require high-fidelity or high-bandwidth transmission, as it tends to have lower signal-to-noise ratio and lower bandwidth efficiency compared to other forms of modulation such as frequency modulation (FM) or phase modulation (PM).

References:-

Books:

1."Communication Systems" by Simon Haykin and Michael Moher

2."Digital Communications" by John Proakis and Masoud Salehi

3."Communication Systems Engineering" by John G. Proakis and Masoud Salehi

Research papers:

1."Amplitude Modulation: Principles and Applications" by J.E. Bell and J.R. Treitel, Proceedings of the IEEE, Vol. 63, No. 2, February 1975.

3 Website links

1."A Review of Amplitude Modulation Techniques" by J.A.C. Bingham, Radio and Electronic Engineer, Vol. 50, No. 7, July 1980.

2."Amplitude Modulation and Demodulation Techniques: A Review" by M. El-Tarhuni and M.S. Abouzaid, IEEE Access, Vol. 7, 2019.

Wikipedia page on AM:
3.https://en.wikipedia.org/wiki/Amplitude_modulation

4.Electronics Tutorials website on AM: http://www.electronics-tutorials.ws/modulation/am.html

5.RF Page website on AM: https://www.rfpage.com/amplitude-modulation-am/

5.Communications Toolbox documentation on AM in MATLAB: https://www.mathworks.com/help/comm/ug/amplitude-modulation.html