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MATLAB Programming & Simulink Model for Pulse Amplitude Modulation Technique

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Abstract

The purpose of this paper is to analyze the concept of Pulse Amplitude Modulation using MATLAB Software which is the language of technical computing. It presents the MATLAB programming with emphasis on the simulink model for PAM modulation technique. The PAM waveform obtained in accordance with the variations of the continuous varying information signal along with the carrier signal is also studied. It also describes the different types of PAM signals and their applications in various systems.

Keywords: *PAM, Simulink tool*

INTRODUCTION

PAM i.e. Pulse Amplitude Modulation is that type of signal modulation technique in which the information to be transmitted such as message signal is encoded in the amplitude of order of the signal pulses. In this type of modulated signal, the amplitude of greater frequency carrier signal is varied in accordance with the information signal. While Demodulation of this signal, at every instantaneous symbol period the original signal is obtained from the amplitude level of the carrier signal.

II. DISCUSSION

Types:

There are two forms of Pulse-amplitude modulation (PAM):

A. Single Polarity PAM:

In this type of modulation technique an acceptable fixed DC bias is added to the signal to ensure that the entire pulses are positive.

B. Double Polarity PAM:

In this type of modulation technique the pulses are positive and negative or twin i.e. positive as well as negative.

PAM is such a pulse modulation system in which the modulating signal is sampled at regular intervals, and each discrete sample is made in proportion to the amplitude of the signal at every instant of sampling. The pulses are then transmitted.

The concept for generation and demodulation of PAM signal is simple in its nature.

BASIC BLOCK DIAGRAM:

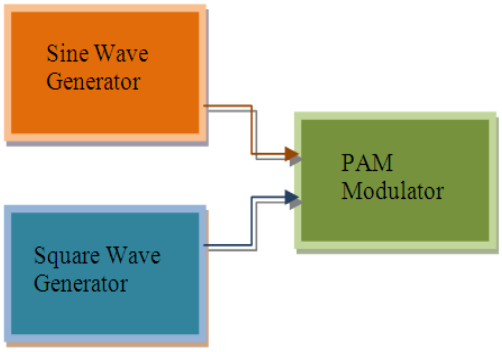


Fig1. Simple Block Diagram of PAM

Unlike the Amplitude modulation that varies the amplitude of the carrier signal in both the half cycles, the PAM modulation varies the amplitude of all the pulses only at a single half cycle. Only the upper half pulses are modulated in corresponding to the message signal.

In this paper the PAM signal is generated from a pure sine wave as modulating signal and a square wave which produces the carrier pulses and a PAM modulator circuit.

SIMULINK MODEL OF PAM:

Using the simulink tools in MATLAB, the PAM model is designed (shown above) and following are the results obtained.

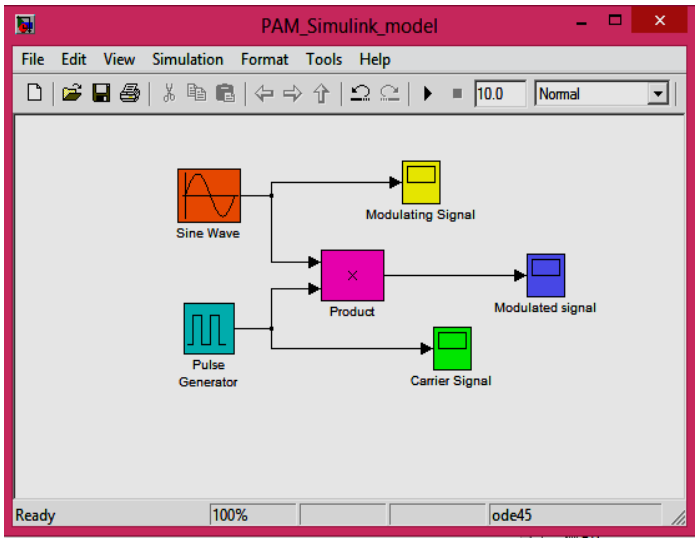


Fig 2. Simulink model of PAM in MATLAB

Generated Waveforms By Simulink Model:

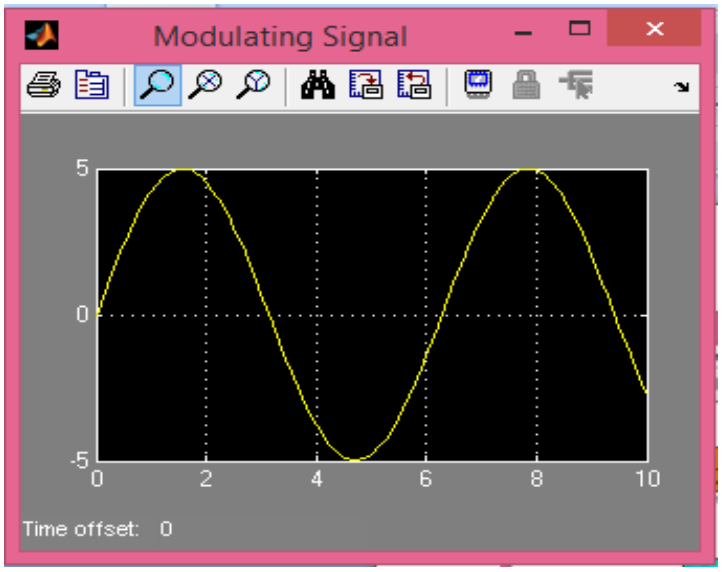


Fig 3. Modulating signal generated by simulink model

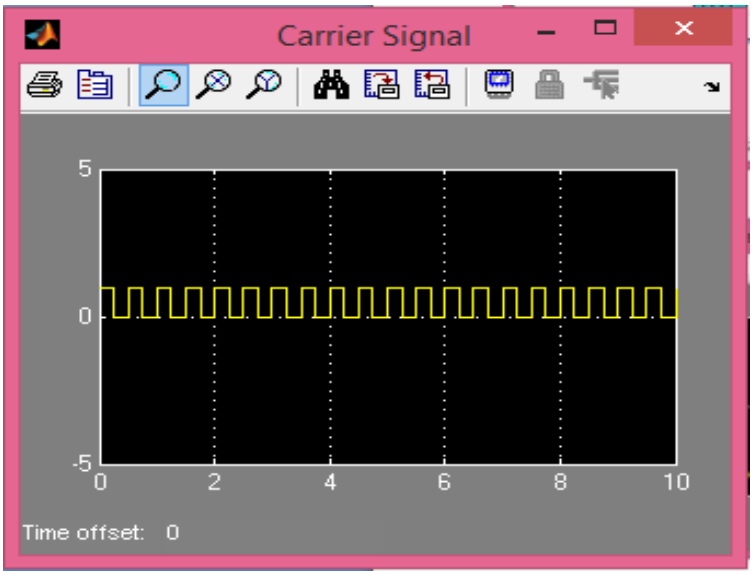


Fig 4. Carrier signal generated by simulink model

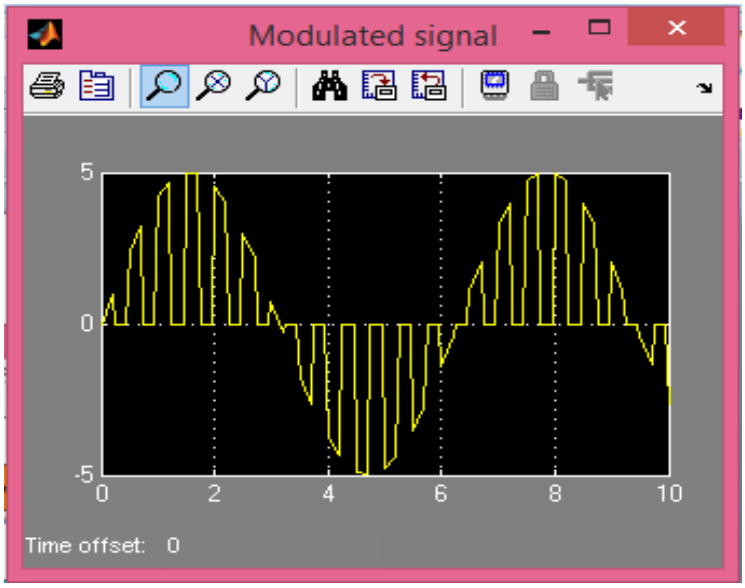
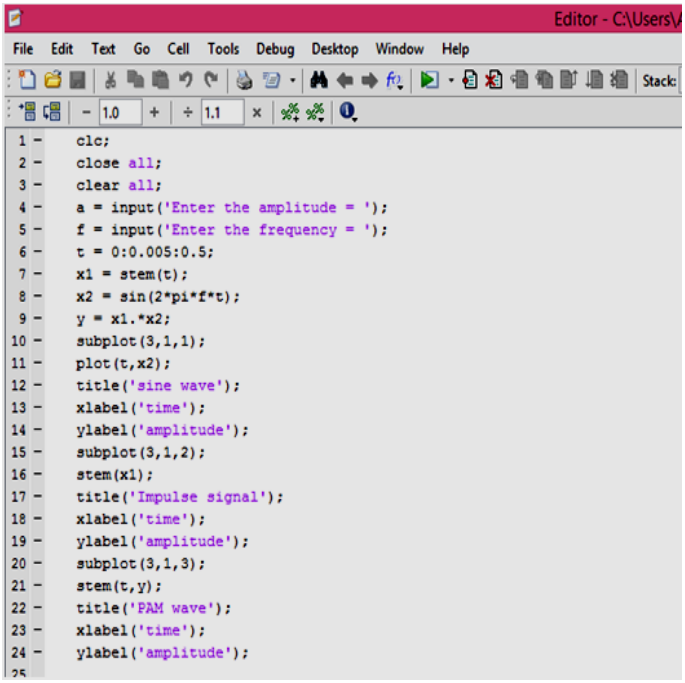


Fig 5. PAM modulated signal generated by simulink model

Matlab Programming For Pam:



Command Window:

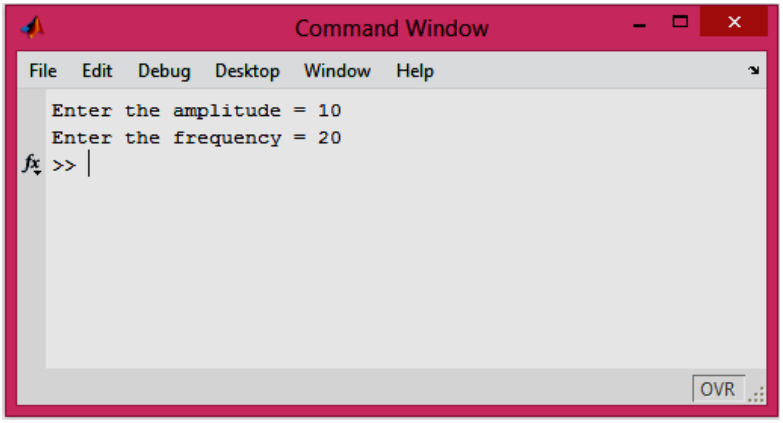


Fig 6. Command Window

Using the MATLAB functions, the PAM signals can be designed by proper coding (shown above). Command window is used for accepting different inputs from the programmer. Following are the inputs given and the results obtained.

Generated Output Of The Program:

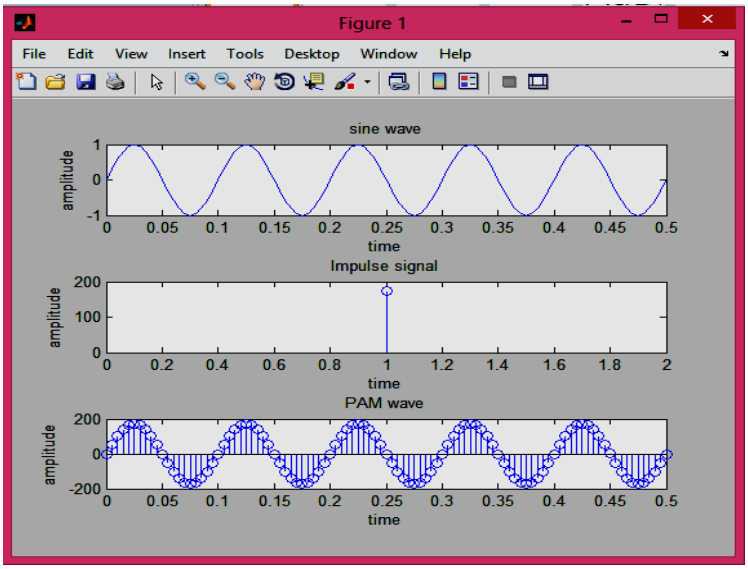


Fig 7. Output waveforms generated by MATLAB programming

III. APPLICATIONS

A. Ethernet:

Some types of the Ethernet communication standards are examples of PAM. Ethernet uses a Tomlinson-Harashima Precoded version i.e. THP of pulse-amplitude modulation with 16 discrete levels, which is encoded in two-dimensional checkerboard pattern known as DSQ128.

B. Photo biology:

PAM is also used for the study of photosynthesis using a special instrument that also has a spectrofluorometric measurement of the flurescence rise kinetics and decay in the antenna for light harvesting.

C. Electronic drivers for LED lighting:

PAM has also been designed for the control of light-emitting diodes also known as LEDs, especially for lighting applications. Drivers of LEDs based on the PAM technique offers enhanced energy efficiency over the systems which are based upon other common driver modulation techniques like PWM.

D. Digital television:

Ideally, the American Advanced Television Systems Committee standard's for television uses PAM technique to broadcast the data which generates the television signal. This system is basically on a three-level PAM, but uses some additional processing to suppress one sideband and so makes more efficient use of limited bandwidth.

CONCLUSION

The MATLAB simulink and coding makes it easy to understand all the concepts of Pulse Amplitude Modulation. We verified the principles of PAM and are able to draw the conclusion that the process of changing amplitude of pulse with respect to amplitude of low frequency modulating signal keeping width and position of pulse constant is known as pulse amplitude modulation. The modulation and demodulation of PAM is simple and reliable. Due to this factor, it is used in many small applications.

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