

Pulse Modulation

Aya Sherif 202100642

Adham Saad 202100163

Mahmoud ElBahnsawi 202000985

TEST CASE 1: SINUSOIDAL FUNCTION

1. Pulse Position Modulation (PPM):

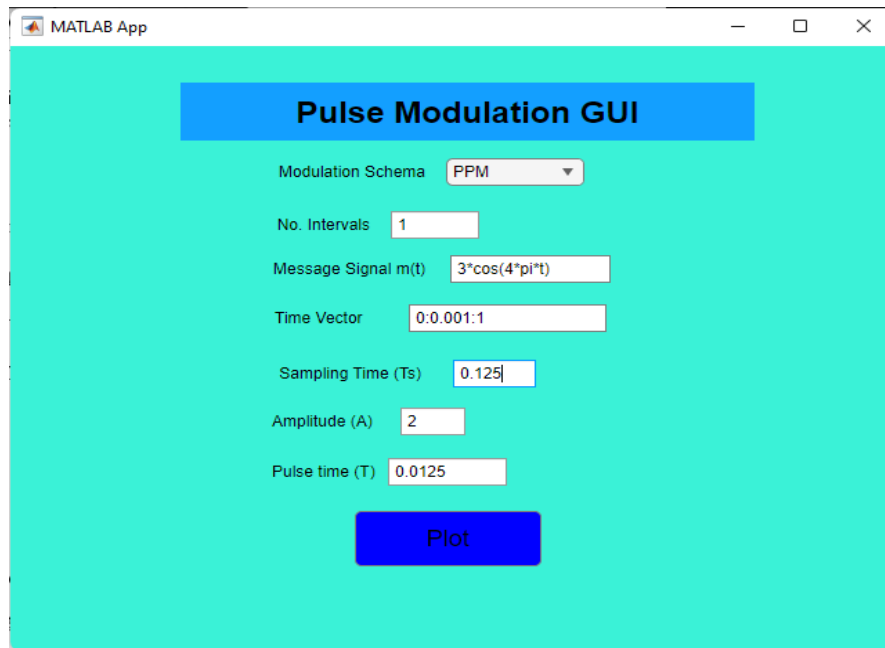


Figure 1 GUI PPM Test Case 1

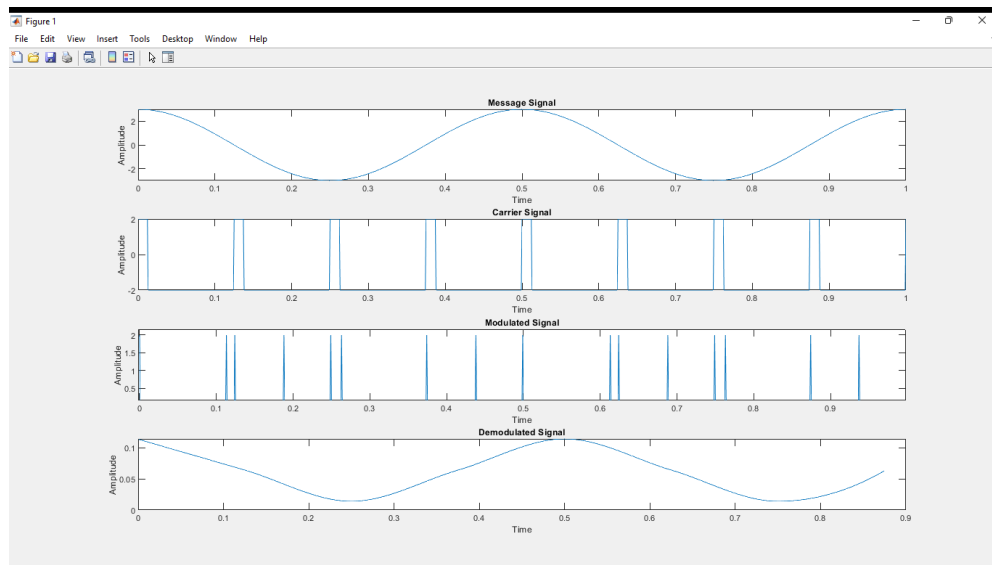


Figure 2 PPM Test Case 1

Comment:

We notice that at the first pulse we have a relatively wide pulse -half maximum width-. Additionally, the next pulse's start and end are almost on top of each other, indicating very low amplitude which is indeed consistent with our theoretical expectation. Furthermore, we see that start and end of the middle most pulse are very far apart, indicating a very wide pulse which indeed corresponds to the maximum amplitude of the message, This confirms a successful pulse position modulation of the sinusoidal signal.

2. Pulse Width Modulation (PWM):

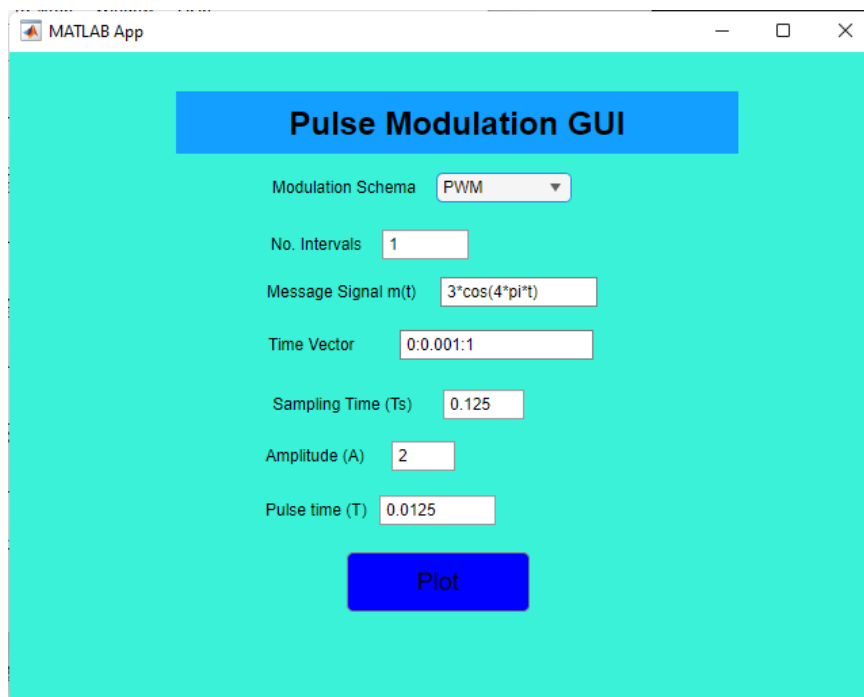


Figure 3 GUI PWM Test Case 1

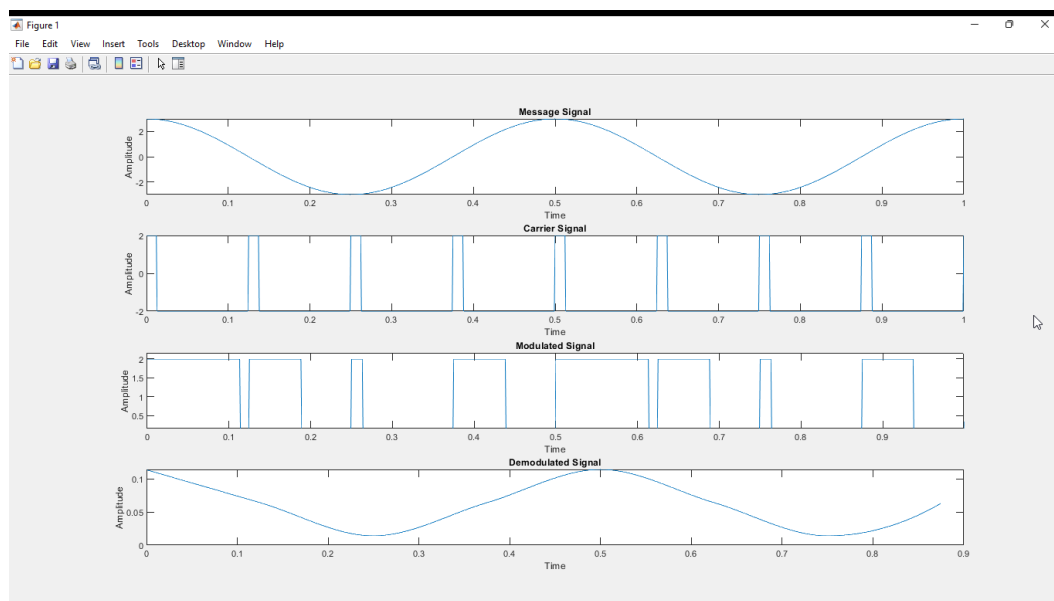


Figure 4 PWM Test Case 1

Comment:

We can clearly see that at low amplitudes of the message signal -cosine troughs-, we have small pulse widths for the modulated signal. This indeed confirms our theoretical expectations for the shape of the modulated signal. Additionally, we see the largest pulse width occurring at the peaks of the sinusoidal message. This remarks a successful pulse width modulation of the sinusoidal signal.

3. Pulse Amplitude Modulation (PAM):

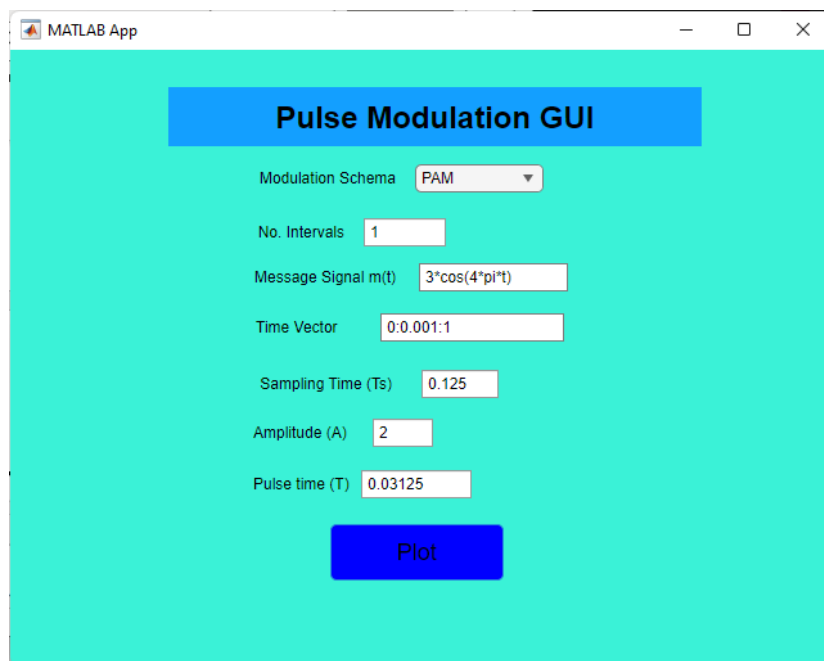


Figure 5 GUI PAM Test Case 1

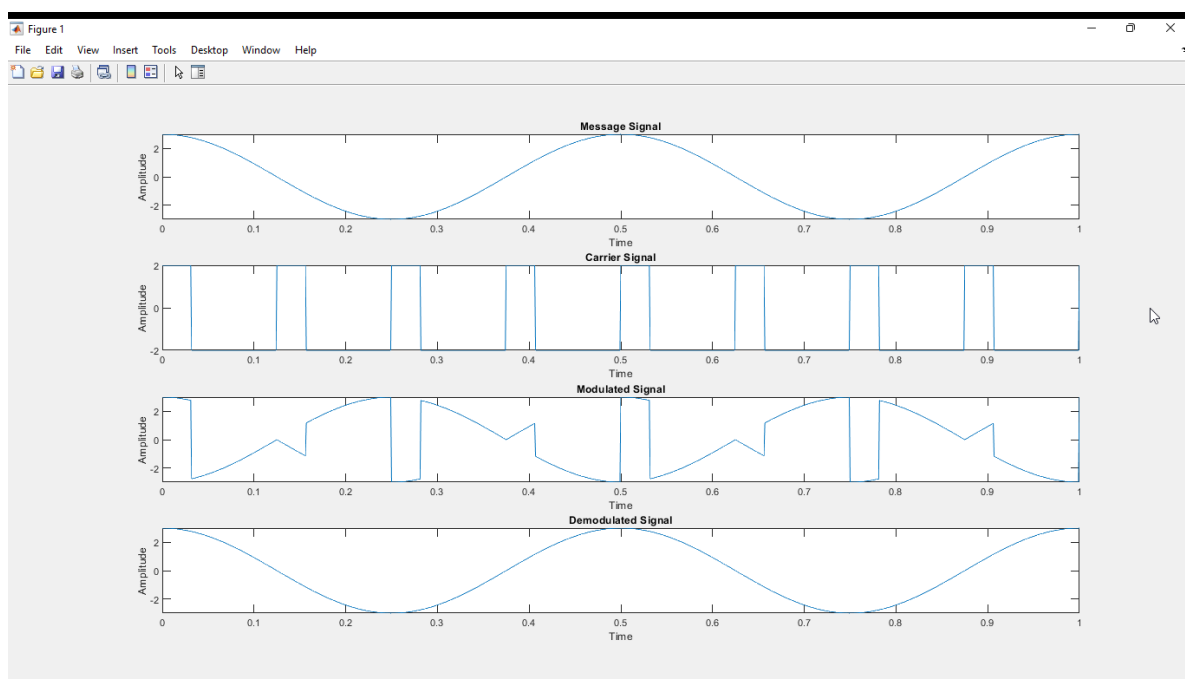


Figure 6 PAM Test Case 1

Comment:

Below are four plots illustrating the Message Signal, Carrier, Modulated, and Demodulated signals, utilizing Natural PAM. The Demodulated signal closely resembles the Message Signal, indicating a highly successful modulation despite employing a low carrier frequency.

4. Flat Top Pulse Amplitude Modulation (Flat-Top PAM):

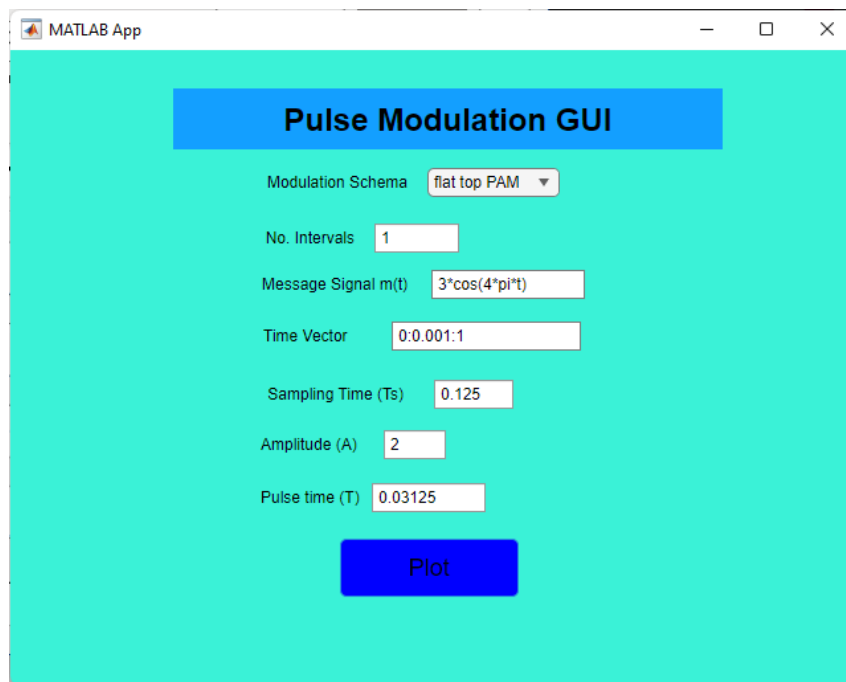


Figure 7 GUI Flat Top PAM Test Case 1

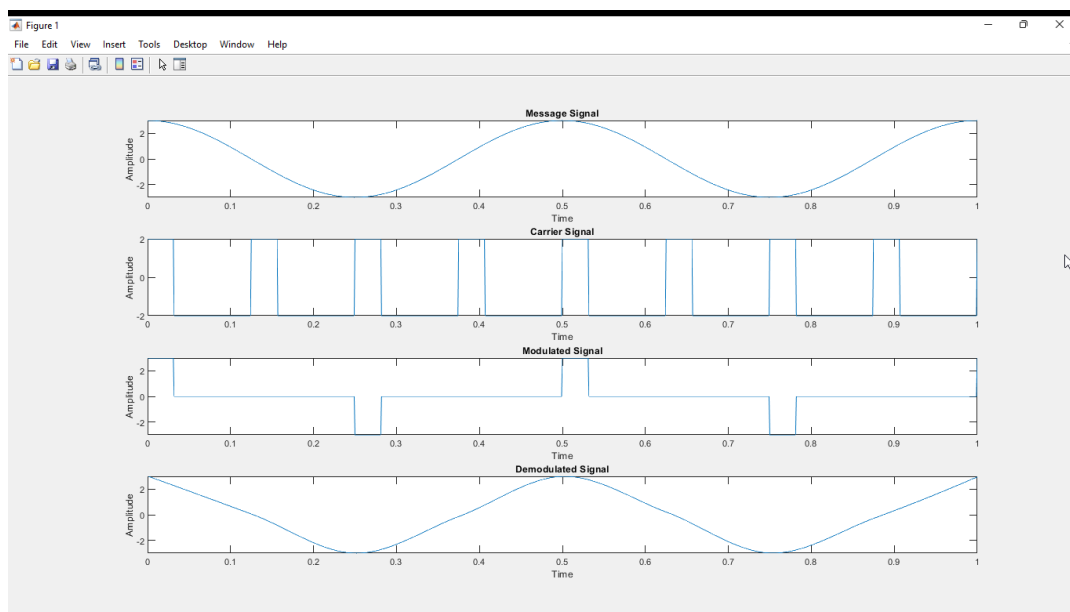


Figure 8 Flat Top PAM Test Case 1

Comment:

Here are four plots displaying the Message Signal, Carrier, Modulated, and Demodulated signals, using Flat Top PAM. The Demodulated signal exhibits minimal distortion, attributed to the constant value assigned to each pulse in flat top sampling, which results in some loss of amplitude information.

TEST CASE 2: PIECEWISE MESSAGE FUNCTION

1. Pulse Position Modulation (PPM):

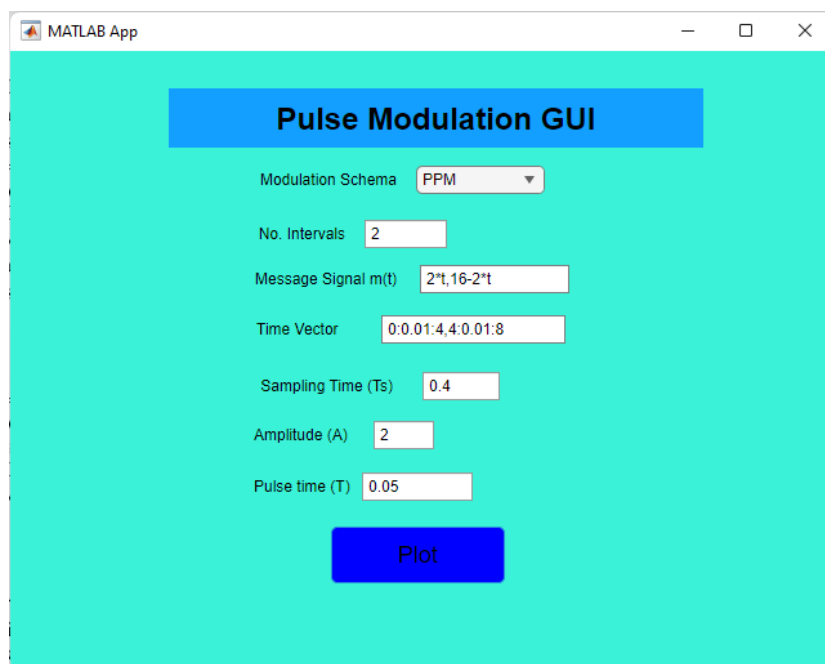


Figure 9 GUI PPM Test Case 2

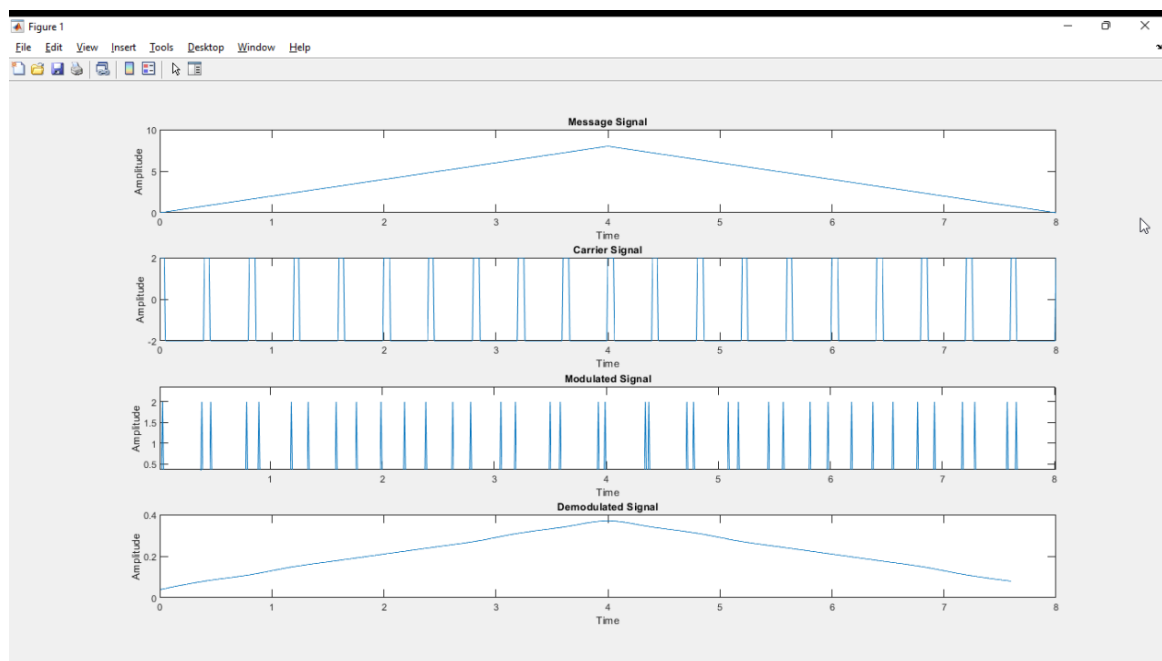


Figure 10 PPM Test Case 2

Comment:

It's clear that at the beginning of the modulated signal, the pulse starts and ends close together, reflecting a small message amplitude. As the message signal's amplitude increases, we observe a widening gap between the pulse's start and end points. In the middle, we see a significant separation between the pulse's start and end, signaling the signal's maximum amplitude. This holds true as the message signal linearly increases until the fourth second, marking the midpoint of the message duration. This indicates the effective implementation of pulse position modulation on the piecewise message signal.

2. Pulse Width Modulation (PWM):

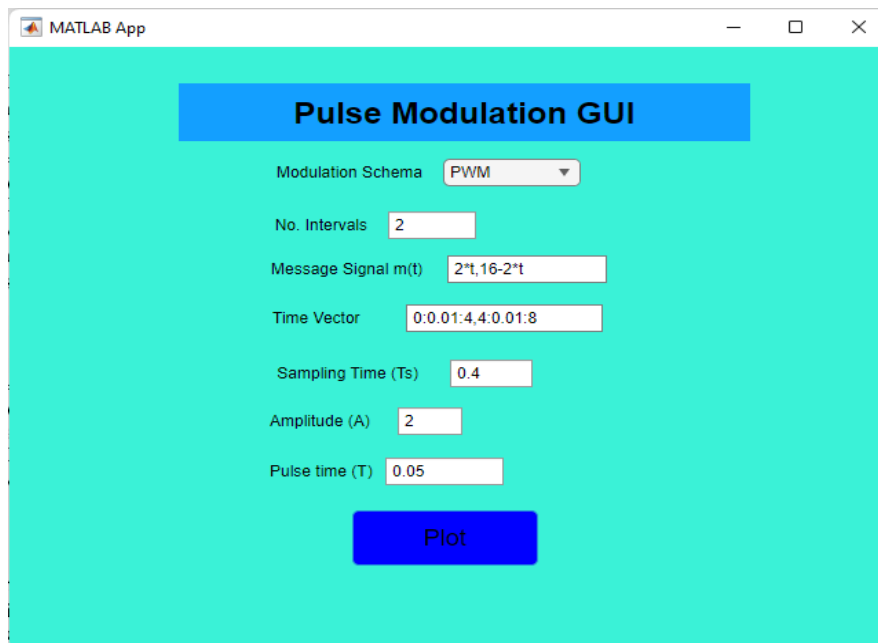


Figure 11 GUI PWM Test Case 2

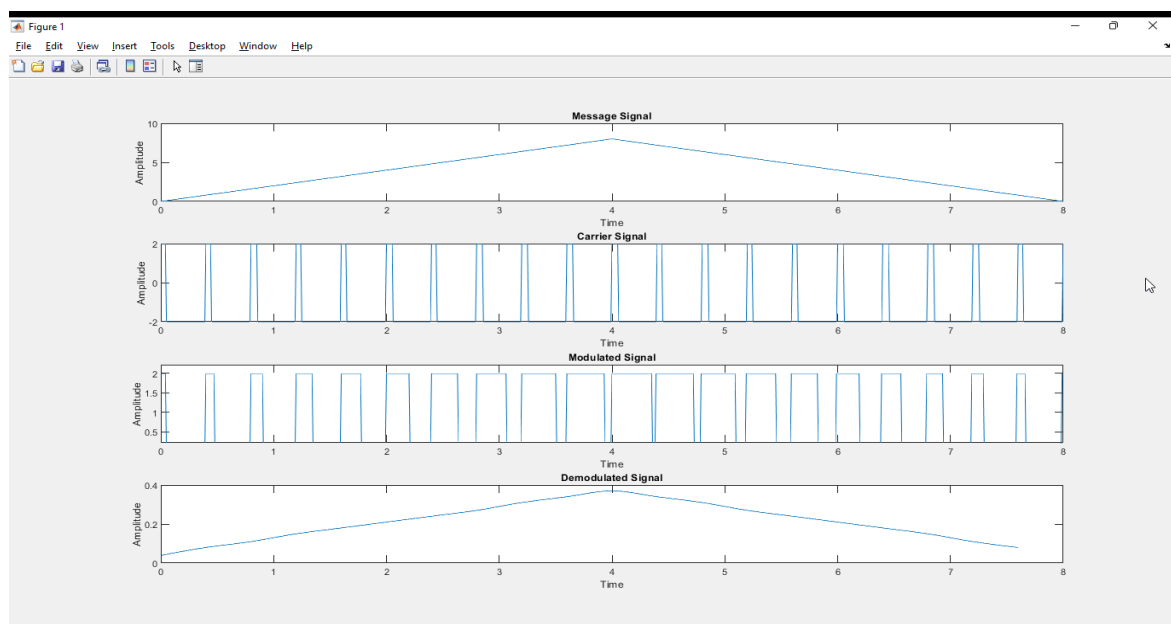


Figure 12 PWM Test Case 2

Comment:

We can clearly see that at low amplitudes of the message signal -start and end-, we have small pulse widths for the modulated signal. This indeed confirms our theoretical expectations for the shape of the modulated signal. Additionally, we see the largest pulse width occurring at the middle of the message time which corresponds to the maximum amplitude of the message signal. This confirms a successful pulse width modulation of the signal.

3. Flat Top Pulse Amplitude Modulation (Flat-Top PAM):

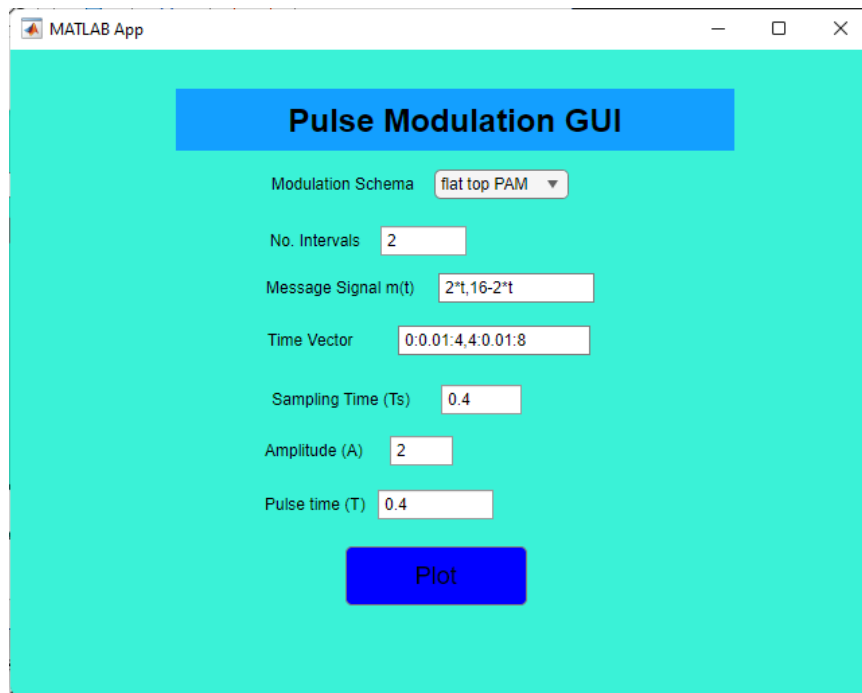


Figure 13 GUI Flat Top PAM Test Case 2

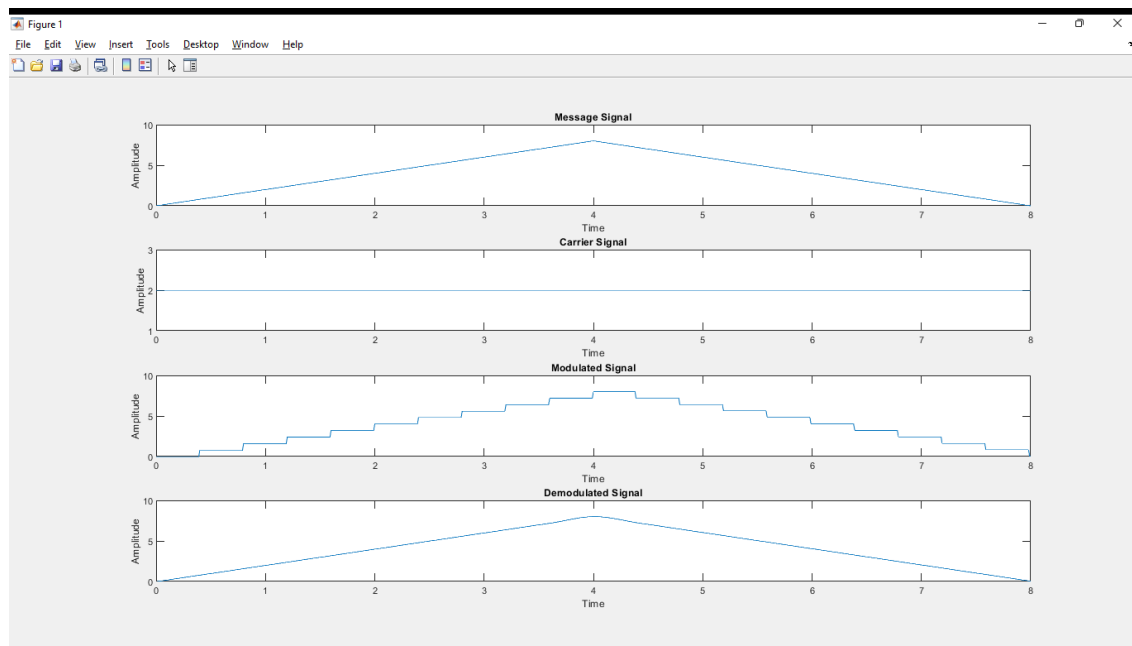


Figure 14 Flat Top PAM Test Case 2

Comment:

Below are four plots showcasing the Message Signal, Carrier, Modulated, and Demodulated signals, employing Flat Top PAM. The Demodulated signal closely resembles the message signal, owing to the message's straightforward nature. With a carrier signal duty cycle of 1, no pulse train is evident in the carrier signal.

4. Pulse Amplitude Modulation (PAM):

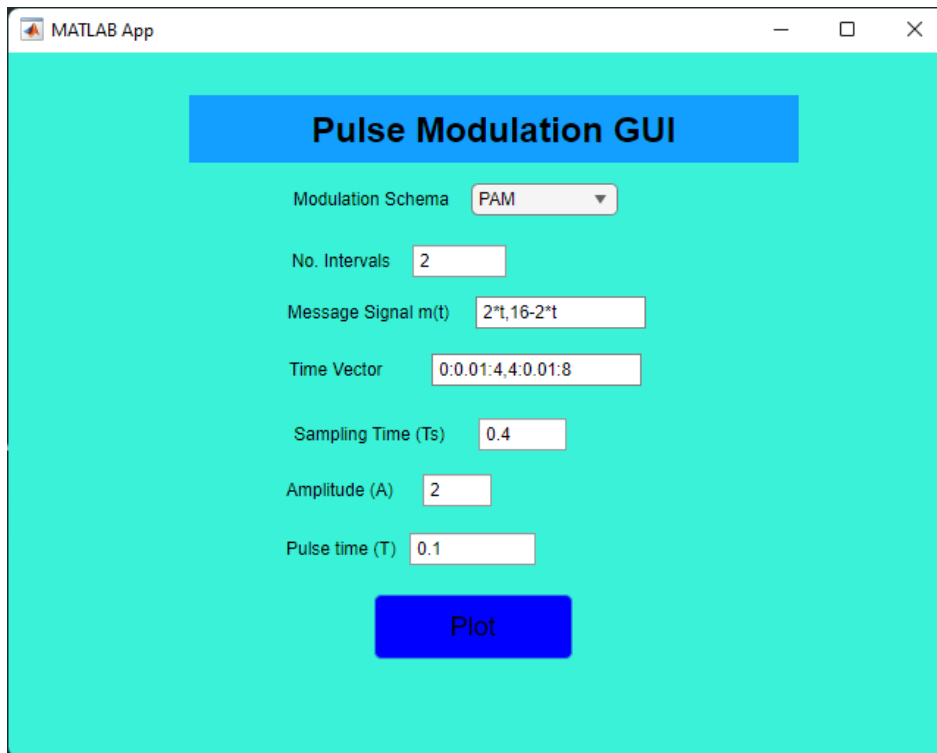


Figure 15 GUI PAM Test Case 2

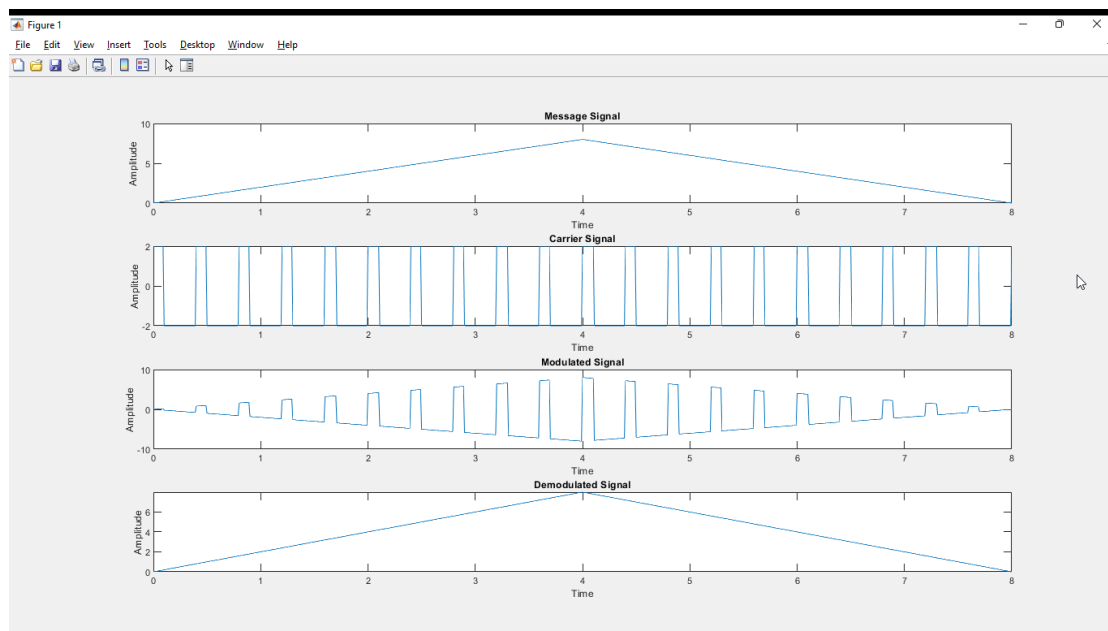


Figure 16 PAM Test Case 2

Comment:

Here are four plots demonstrating the Message Signal, Carrier, Modulated, and Demodulated signals, utilizing Natural PAM. The Demodulated signal closely resembles the Message Signal. The modulated signal exhibits downward shifts due to the carrier signal having negative values.