Communication Systems I

HOMEWORK 3 REPORT

Student Name: Harun Durmuş **Date:** 14.05.2023

Student ID: 270206025

Results

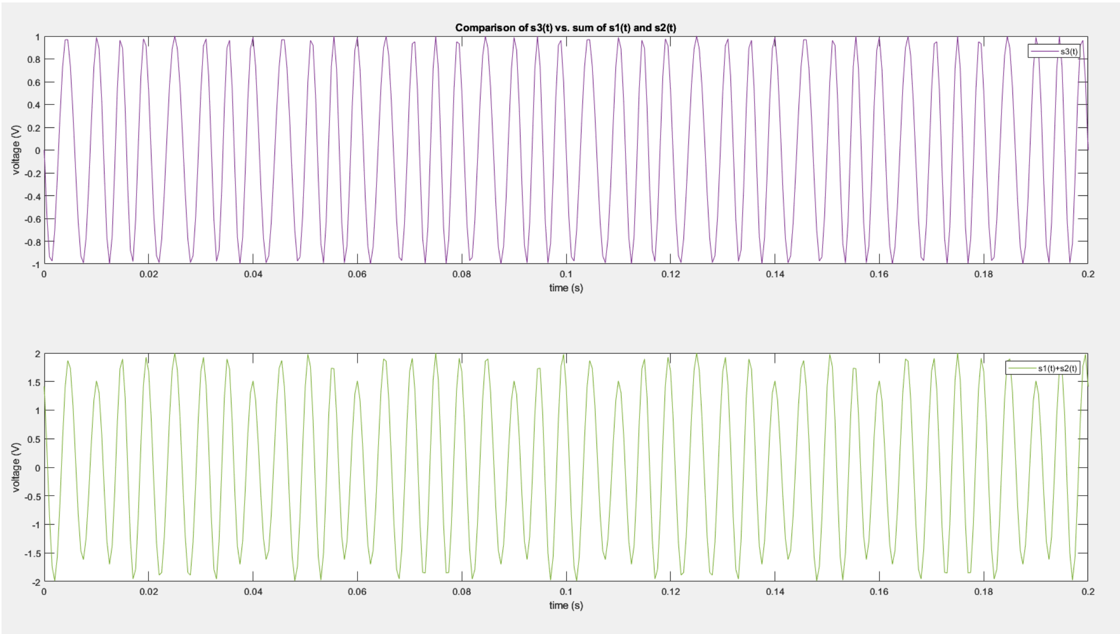

Figure 1: Comparison of $s_3(t)$ vs sum of $s_1(t)$ and $s_2(t)$

Since the phase modulation formula contains a cosine term inside of it, there occurs a difference between summing message signals before phase modulation instead of summing phase modulated signals. There is a behaviour of cosine operation in the second graph. Envelope of $s_1(t)$ and $s_2(t)$ is sinusoidal.

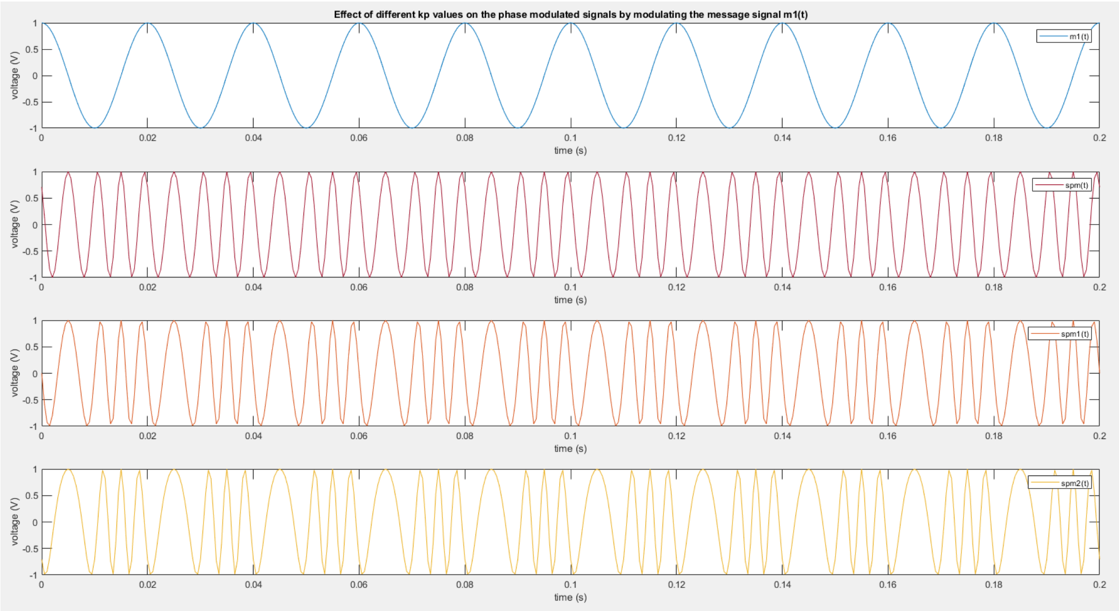

Figure 2: Effect of different k_p values on the PM signals by modulating $m_1(t)$

According to the following formula:

- (phase deviation) $\phi(t) = k_p * m\,(t)$

According to the formula given in figure 3, when the derivative of message signal is negative, period modulated signal wave becomes larger. Since phase deviation is proportional to phase deviation constant (k_p), the growth of period of the modulated signal wave increases directly proportional to phase deviation constant.

$$f_i(t) = \frac{1}{2\pi}\frac{d\theta_i(t)}{dt} = f_c + \frac{k_p}{2\pi}\frac{dm(t)}{dt}$$

Figure 3: Instantenous Frequency Formula

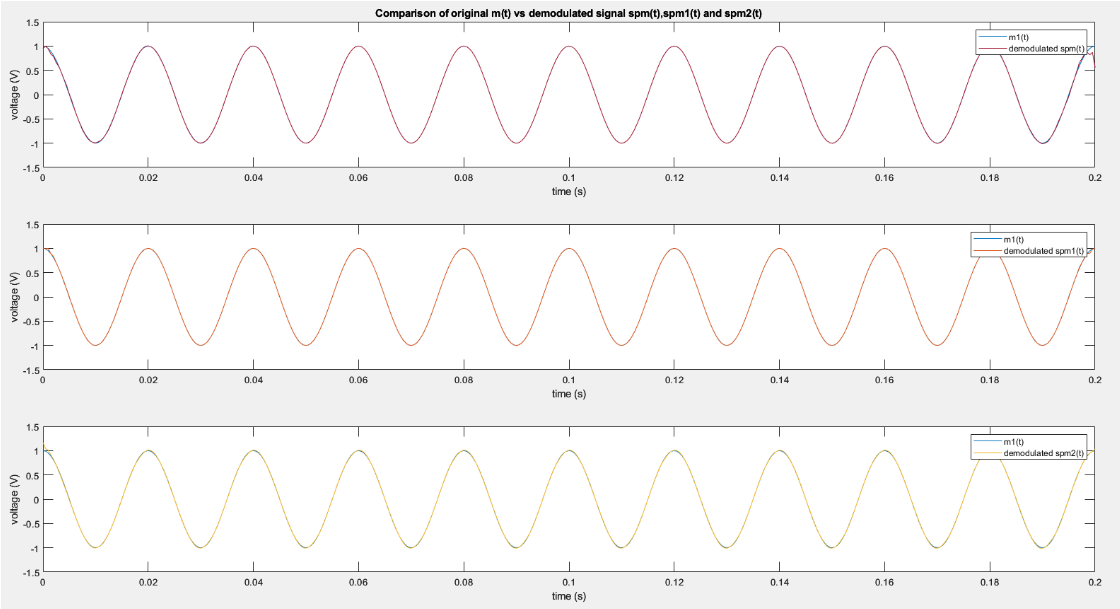

Figure 4: Comparison of original $m_1(t)$ vs. demodulated signals $s_{pm}(t)$, $s_{pm1}(t)$ and $s_{pm2}(t)$

There is no major difference between the comparisons of three demodulated signals and the original signal. Kp1, kp2 and kp3 values are not dominant over the change of the demodulation accuracy.

The unwrap() function works by detecting the phase wraps in the input signal and adding or subtracting multiples of 2π or 360 degrees to eliminate them. It performs a cumulative sum of the unwrapped phase increments, ensuring a smooth and continuous phase representation. The given figure below shows the result of the unwrapping operation.

phase_ins

1x401 double

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17
1	0.7452	1.4171	1.9977	2.5388	3.1325	-2.6219	-2.0583	-1.5270	-1.0073	-0.4817	0.0109	0.5252	1.0190	1.5292	2.0477	2.5714	3.

unwrapped

1x401 double

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17
1	0.7452	1.4171	1.9977	2.5388	3.1325	3.6613	4.2248	4.7562	5.2759	5.8015	6.2941	6.8084	7.3022	7.8124	8.3308	8.8546	9.

Figure 5: Unwrapped Phase Values