Communications Lab: Experiment 2

Frequency Modulation (FM) and Demodulation

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Introduction

In this lab experiment Frequency modulation and demodulation is implemented using MATLAB.

A message signal $m(t) = 4\cos(2\pi * 100 * t)$ is take and modulated using Frequency modulating technique, In which Carrier wave frequency to be 1000Hz (Fc).

Frequency modulation:

$$\theta(t) = \int_0^t m(t) * dt$$

$$Passband\ Signal = A_c * \cos\left(2\pi f_c t + 2\pi K_f \theta(t)\right);$$

$$where\ A_c\ is\ carrier\ wave\ amplitude, f_c\ is\ carrier\ frequency\ in\ Hz, \theta(t)\ is\ integral\ of\ the\ message\ signal,$$

$$and\ K_f\ is\ scaling\ constant.$$

Frequency demodulation:

$$Derivative\ of\ Passband\ signal\ \left(d(t)\right) = 2\pi A_c * \left(f_c + K_f m(t)\right) * \sin\left(2\pi f_c t + 2\pi K_f \theta(t)\right)$$

Hence the amplitude of the derivative of the passband signal contains the message signal. Hence by applying envelope detection on the passband signal derivative we can extract the message signal.

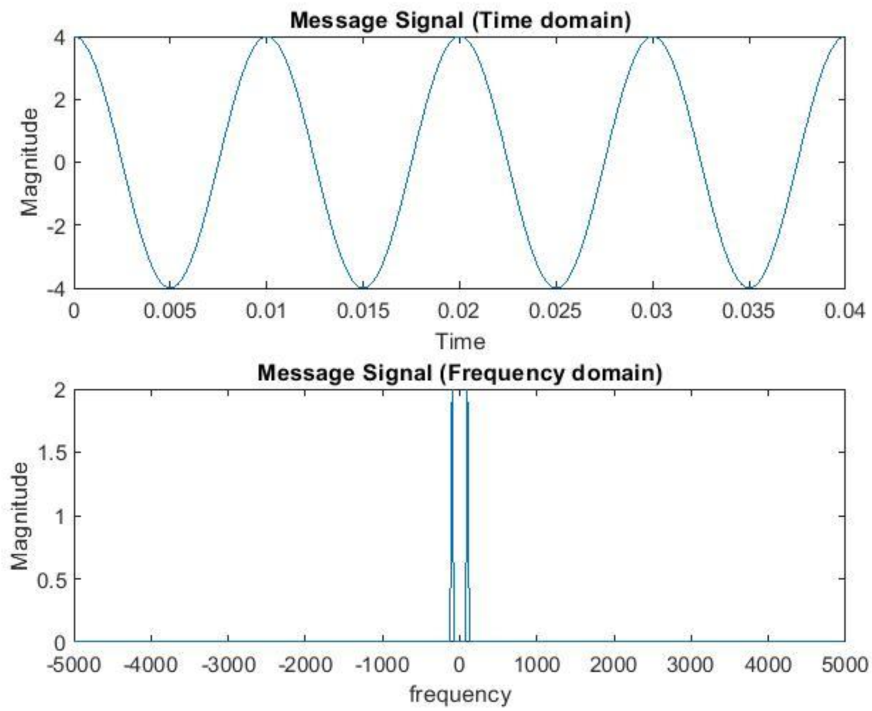
$$Envelope\ \left(env(t)\right) = hilber\ transform\ of\ d(t)$$

$$Demodulated\ Signal\ \left(\widehat{m}(t)\right) = \frac{\frac{env(t)}{2\pi A_c} - fc}{K_f}$$

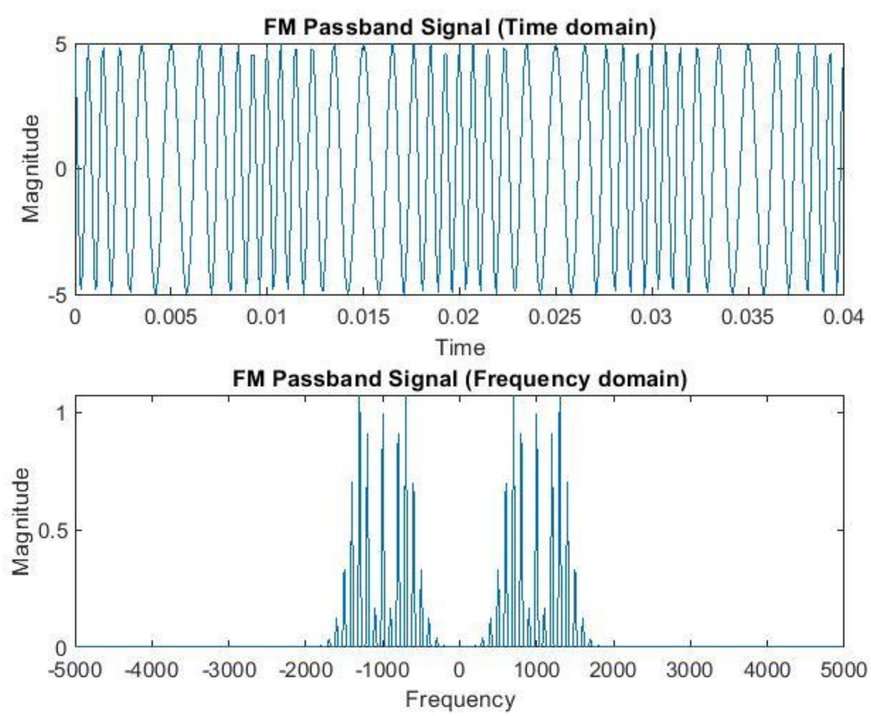
Using the above discussed methods we perform the Frequency modulation and demodulation in MATLAB and observe the following results.

Results

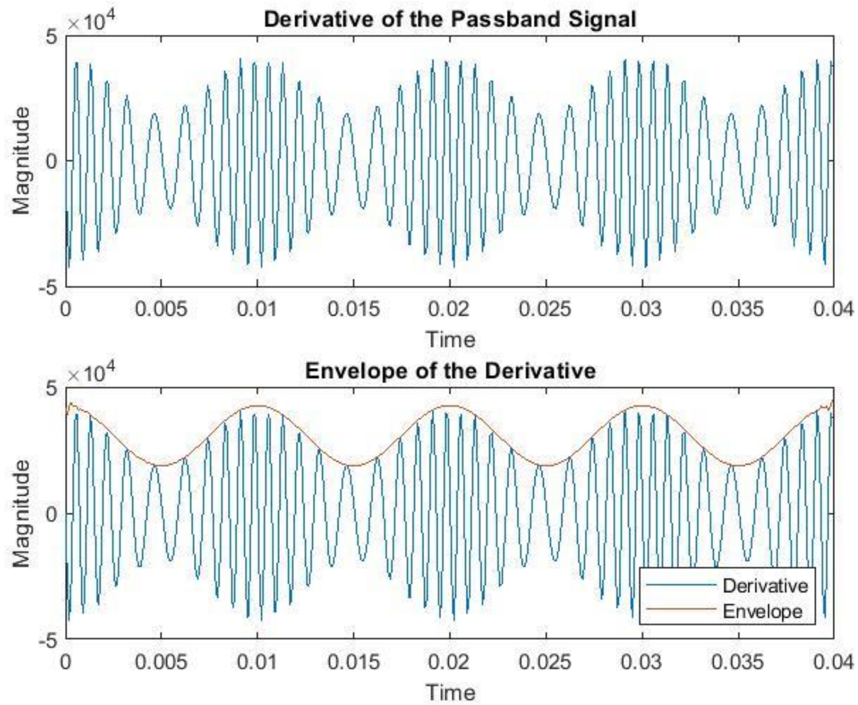
<u>Message signal:</u>



<u>Passband Signal:</u>



Derivative of the Passband signal and Envelope:



Demodulated Signal: