Experiment 1

Amplitude Modulation (AM) and Demodulation

Communications Lab

Submission date:

11th November 2020

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Contents

Introduction

In this lab experiment, Conventional AM, DSB-SC and SSB-SC modulation and demodulation schemes are demonstrated using MATLAB.

For observations in all the modulations scheme , the message signal is take to be

$$Message\ Signal = 5 * \sin(2\pi * 400 * t) + 5 * \cos\,(2\pi * 200 * t)$$

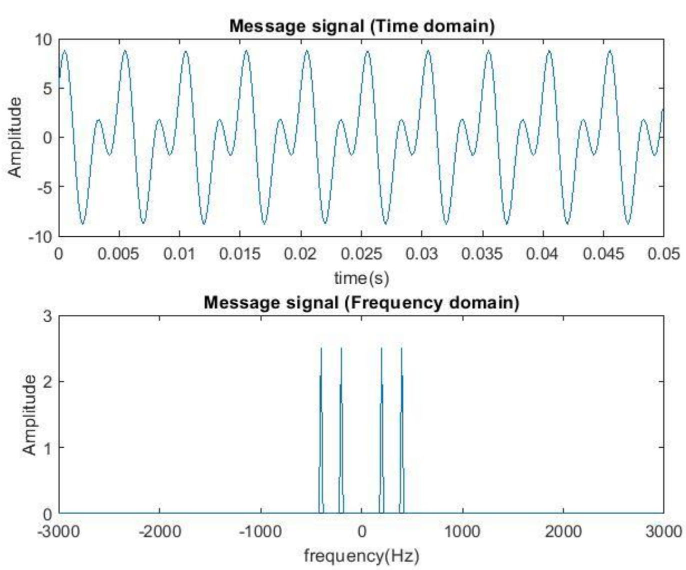
That is sum of two different sinusoids of frequencies 400 Hz and 200 Hz is as message signal.

The carrier wave frequency (f_c) for all the modulation scheme is taken to be 1000Hz.

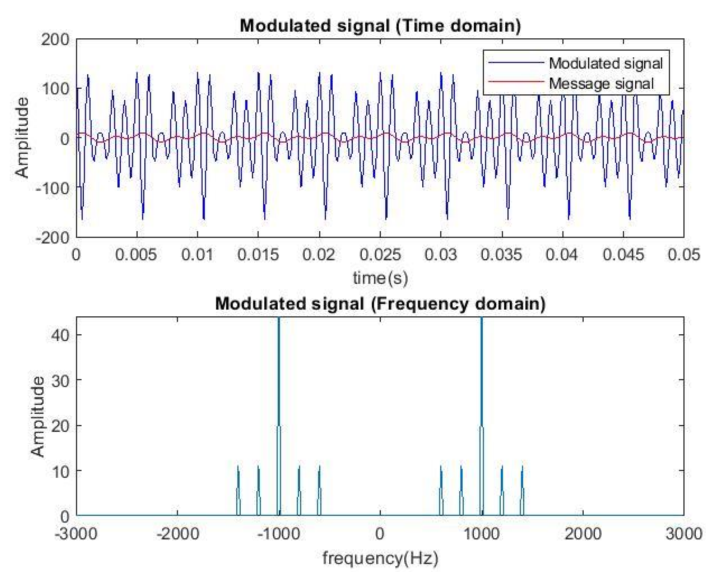
Plots

Conventional AM

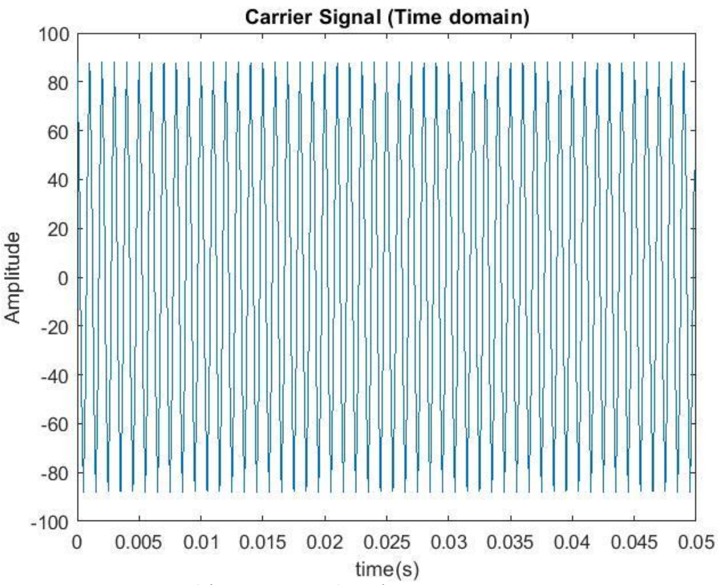
<u>The following plots are for Conventional AM:</u>



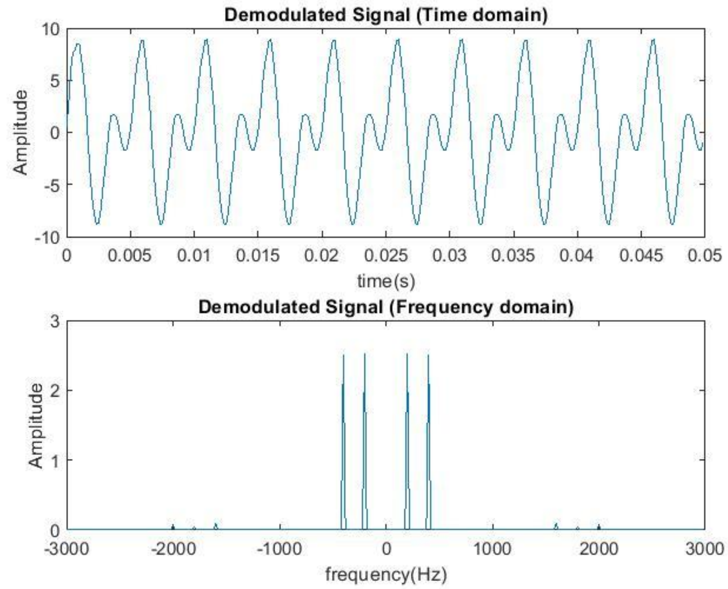
Message signal(Conventional AM)



Modulated signal (Conventional AM)



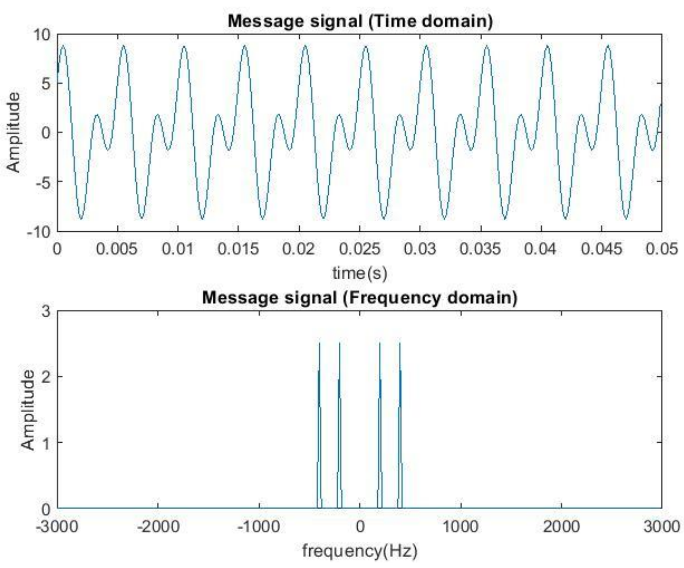
Carrier signal (Conventional AM)



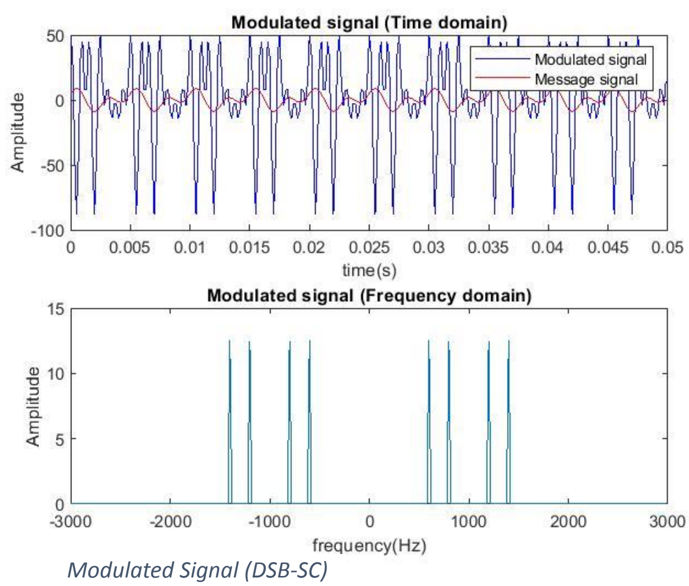
Demodulated Signal (Conventional AM)

DSB-SC

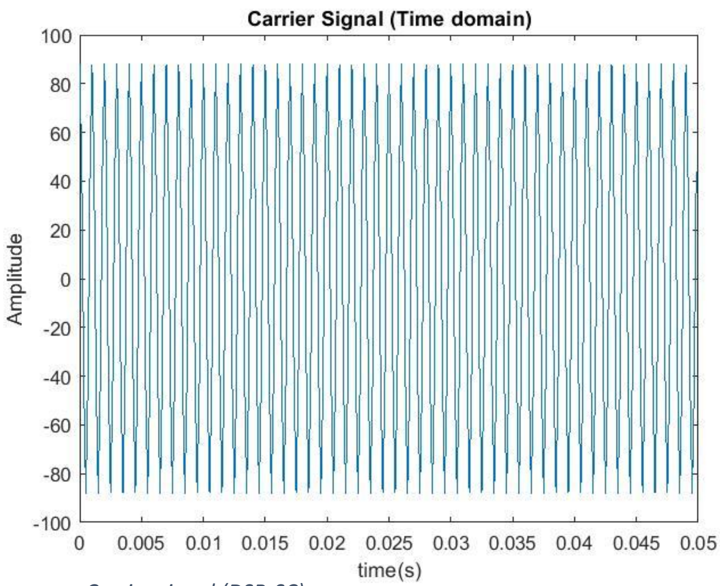
The following plots are for DSB-SC:



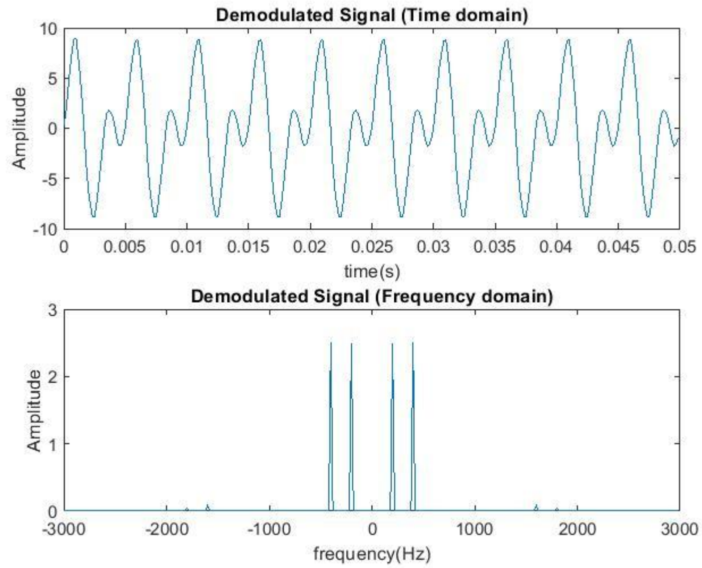
Message signal (DSB-SC)



Modulated Signal (DSB-SC)



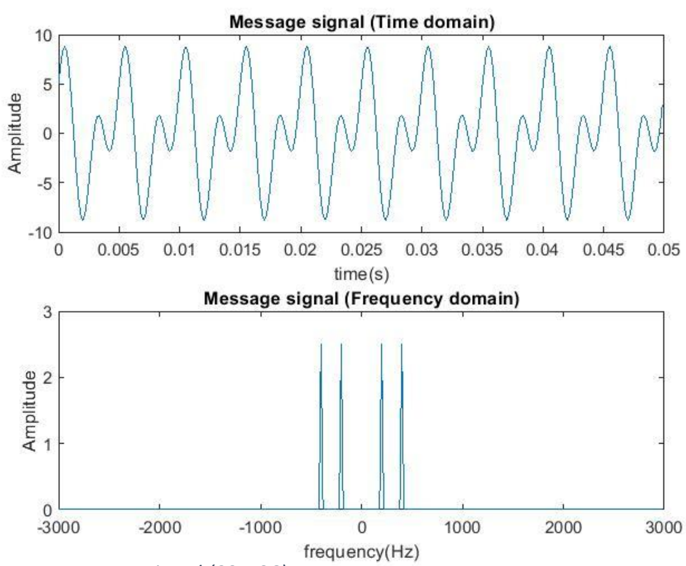
Carrier signal (DSB-SC)



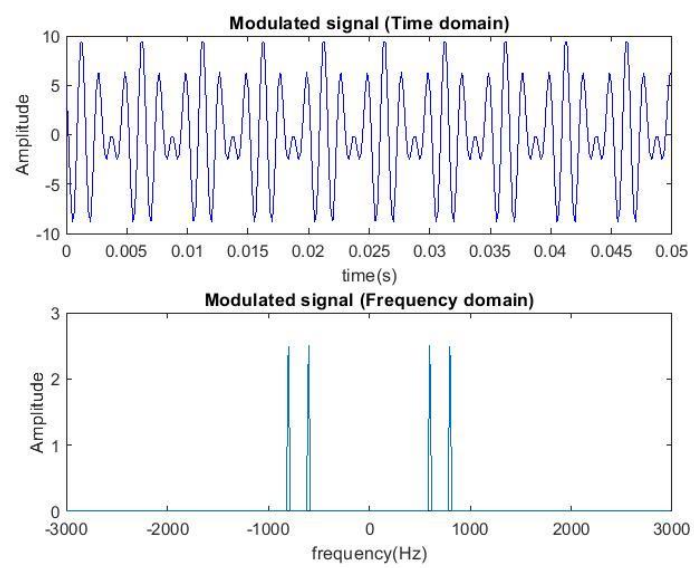
Demodulated Signal (DSB-SC)

SSB-SC

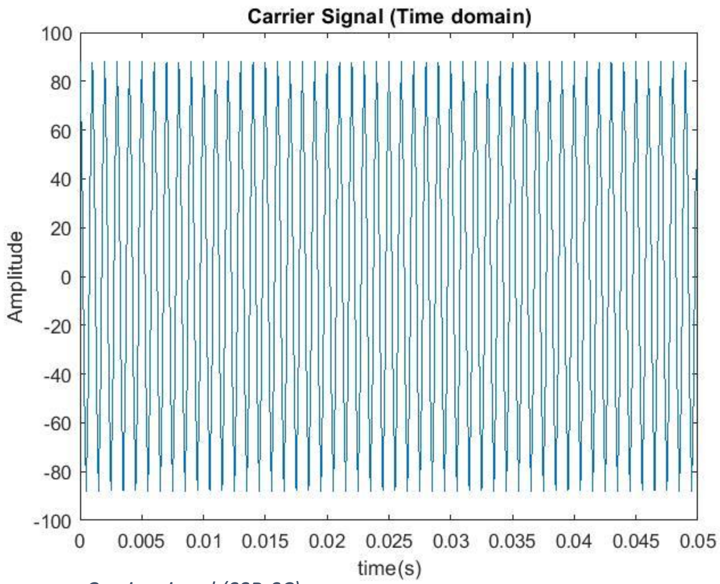
<u>The following plots are for SSB-SC:</u>



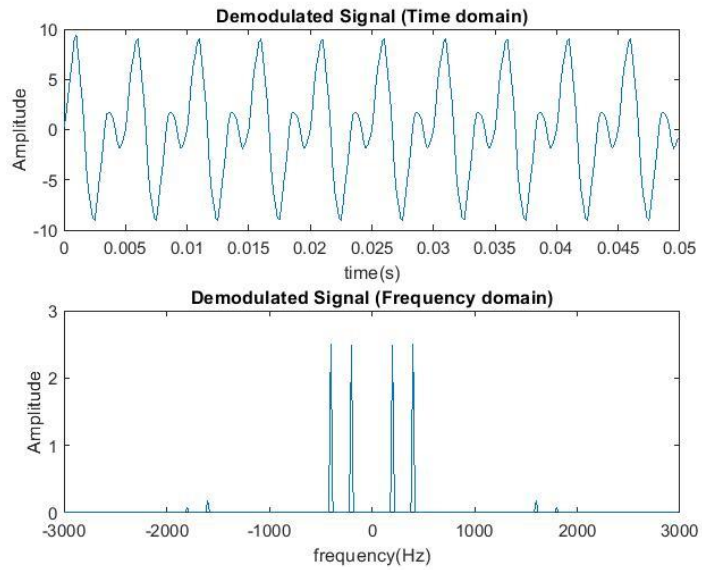
Message signal (SSB-SC)



Modulated Signal (SSB-SC)



Carrier signal (SSB-SC)



Demodulated Signal (SSB-SC)

Observations

- In all the schemes we have used a 4th order Butterworth filter for low pass filtering , since the filter is a non-ideal filter it introduces a phase shift in the final demodulated signal.
- Since we have taken a non- ideal low pass filter with cutoff frequency 1000Hz (fc), we tend to observe some small frequency components even after 1000Hz in our demodulated signal.
- Due to the transient behavior of the filter in the initial few cycles, our demodulated signal is erroneous in first few cycles.
- Coherent demodulation is highly sensitive to frequency shifts due to noise, hence it does not give appreciable results when noise is included. (Plot shown below for SSB-SC demodulated signal with SNR = 10dB). We can clearly observe that the shape of the message signal is retained in the demodulated signal but the amplitude is erroneous. This is because
  Received Signal $= m(t)\cos(2\pi f_c t + \theta_r)$
  Where θ_r is introduced due to noise.
  Performing Coherent detection:
  Demodulated signal = $m(t)\cos(2\pi f_c t + \theta_r)\cos(2\pi f_c t)$
  Where θ_r is time varying.
  Hence the final demodulated signal will be
  $$m(t)\cos\big(\theta_r(t)\big)$$
  This is the reason the amplitude of the demodulated signal is erroneous.