

Matlab Assignment

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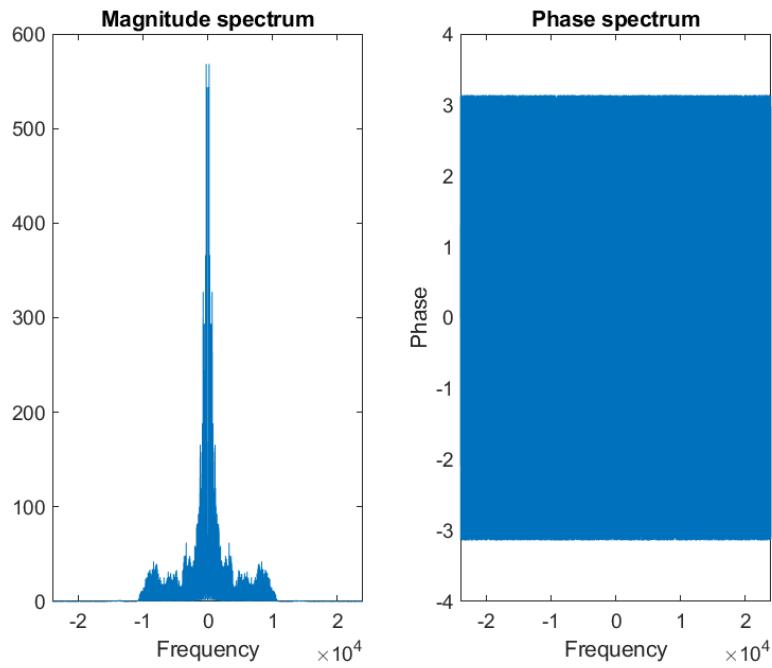
Mohamed Ashraf Elsayed Mahmoud - 20011488

October 2023



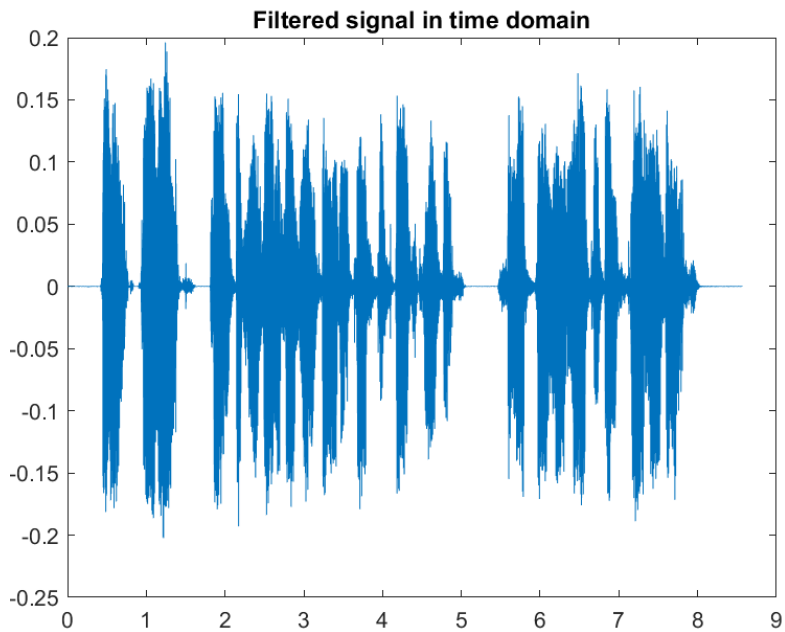
Experiment 1: Double Sided Band Modulation

- Spectrum of attached audio file

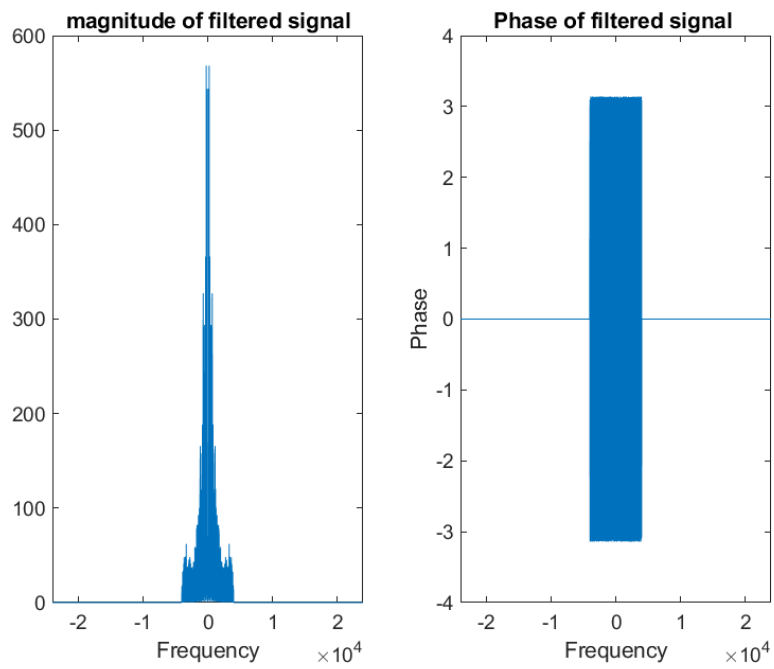


- Ideal low pass filter ($BW = 4000Hz$)

Time Domain

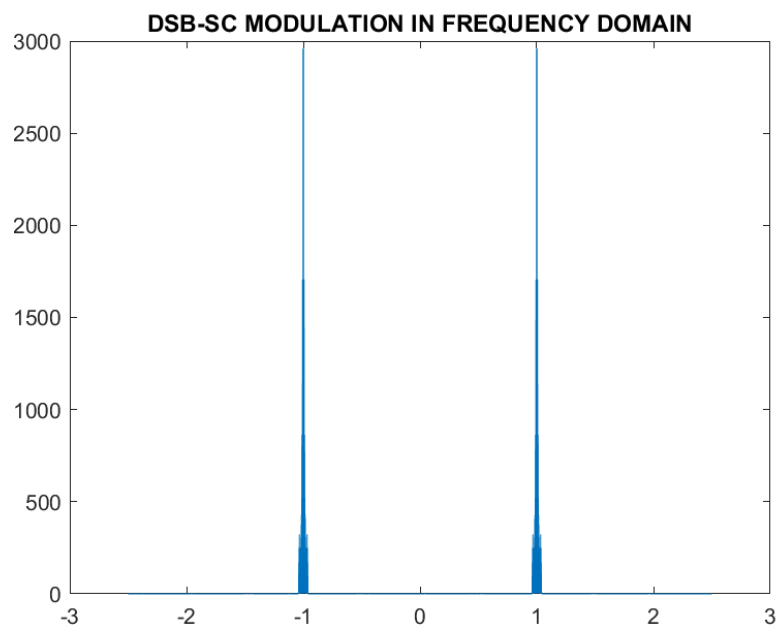


Frequency Domain

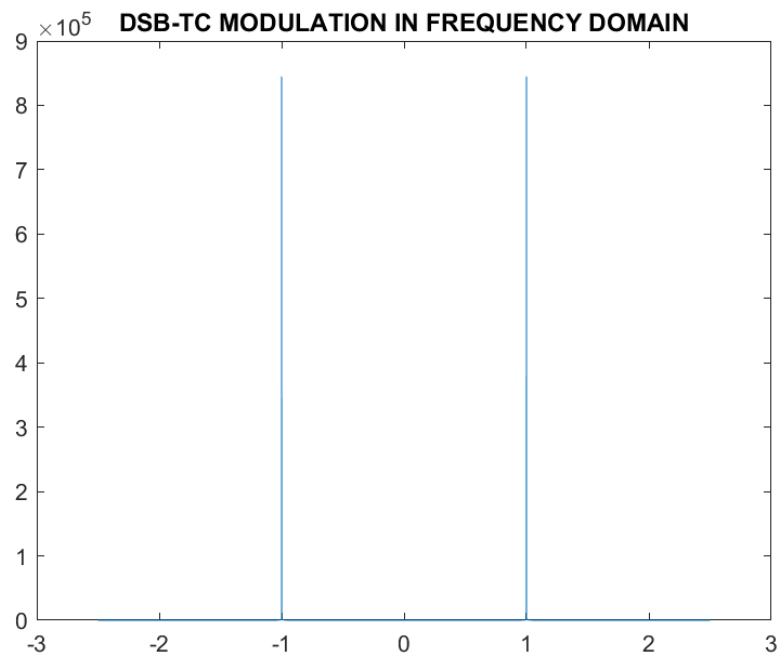


- Modulation plot in frequency domain ($f_c = 100KHz$)

DSB-SC

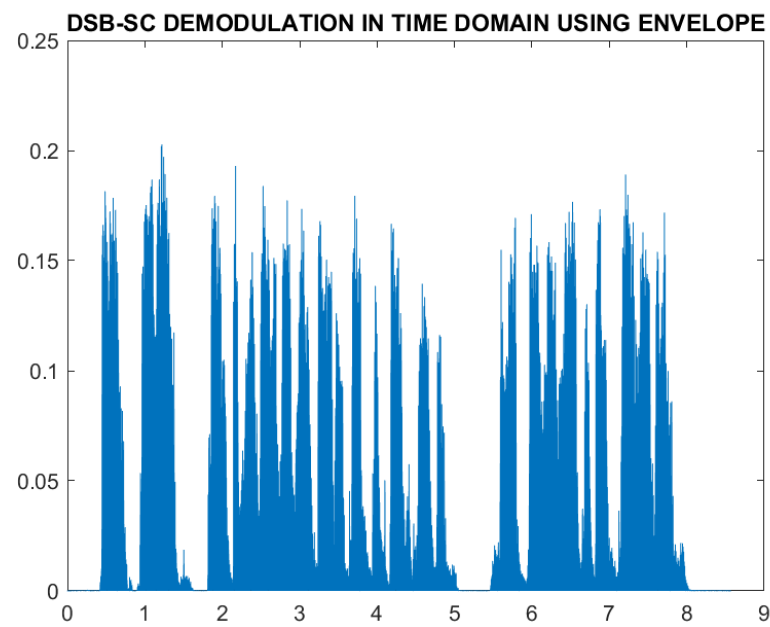


DSB-TC



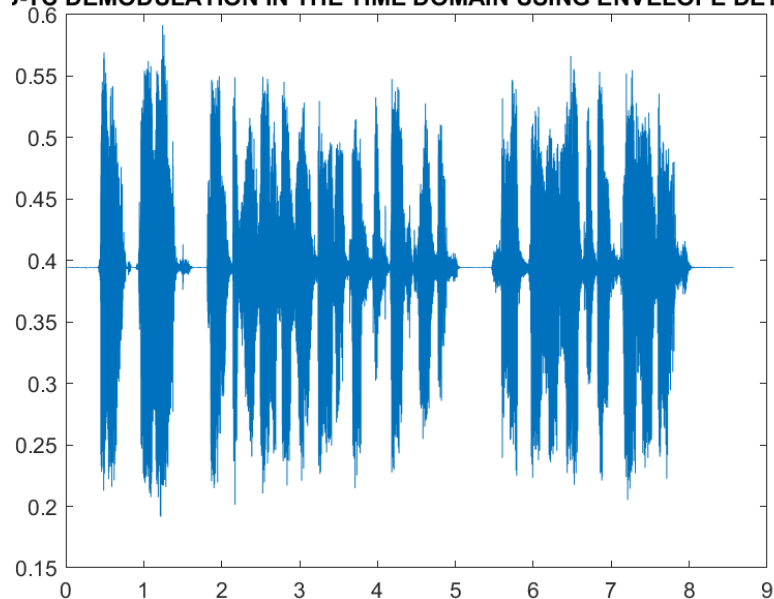
- Envelop detector in time domain

DSB-SC



DSB-TC

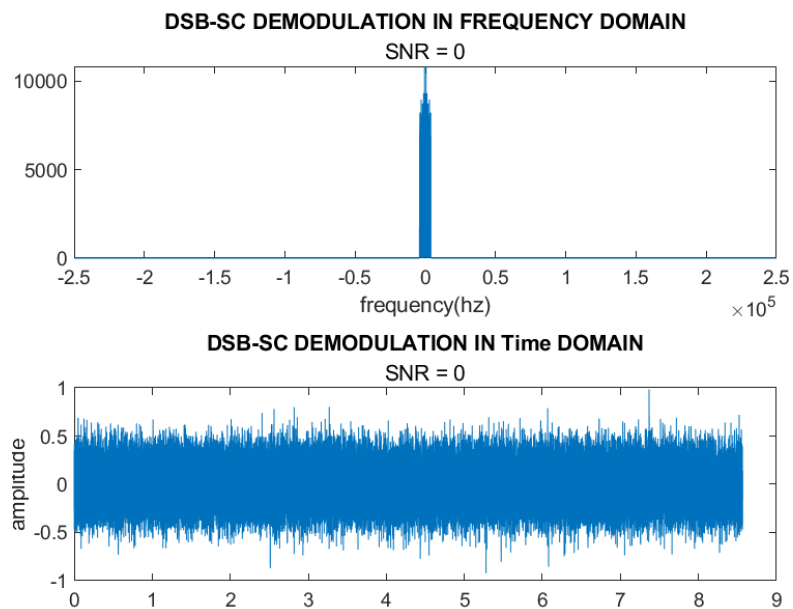
DSB-TC DEMODULATION IN THE TIME DOMAIN USING ENVELOPE DETECTION



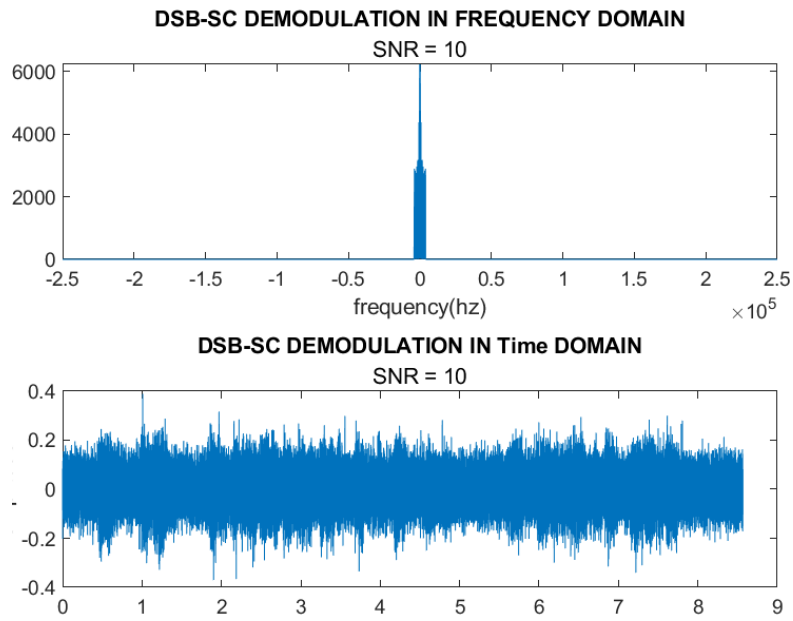
We can recognize that in DSB-SC the signal is distorted while, in DSB-TC is much better. DSB-SC has no DC bias ($A = 0$) then, the modulation index (m) tends to infinity since, $m = \frac{a}{A}$. We can conclude that envelop detection can only be used with DSB-TC.

- Coherent Detection for DSB-SC**

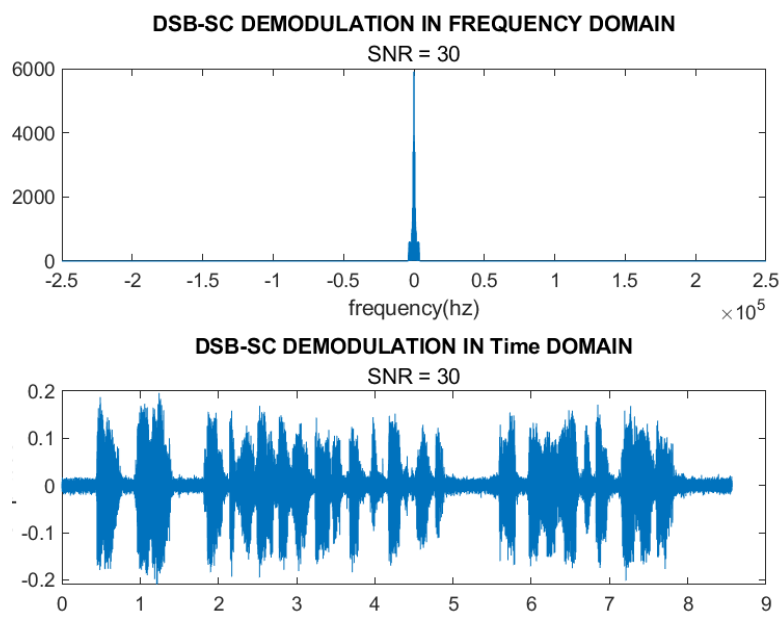
Signal to noise ratio ($SNR = 0$)



Signal to noise ratio ($SNR = 10$)

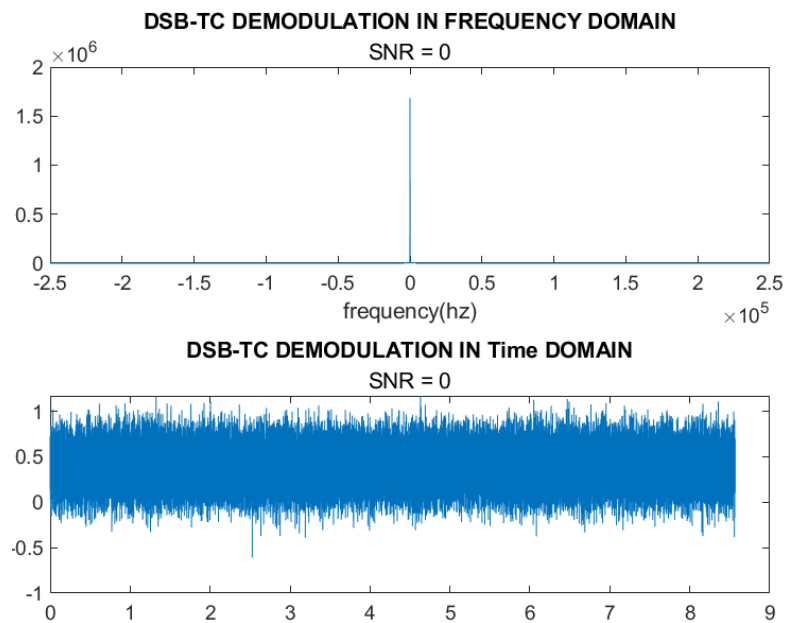


Signal to noise ratio ($SNR = 30$)

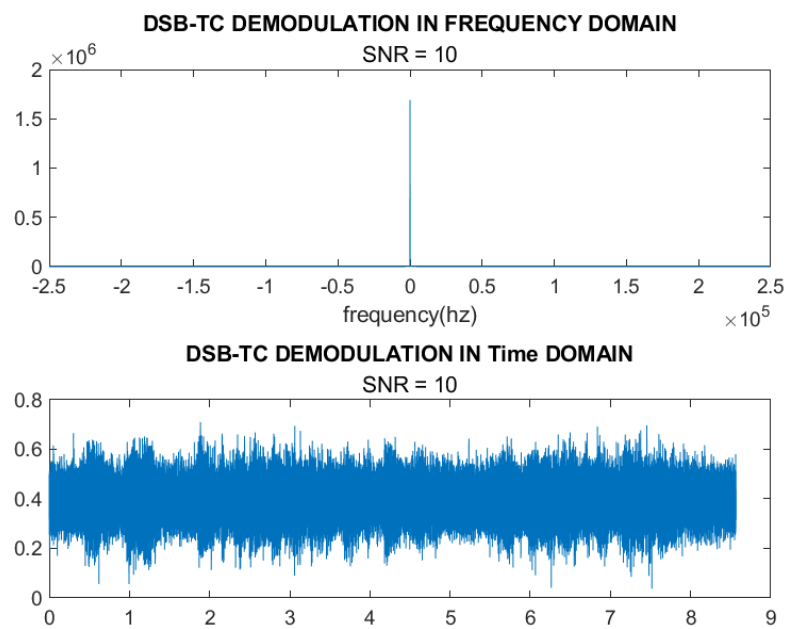


- Coherent Detection for DSB-TC

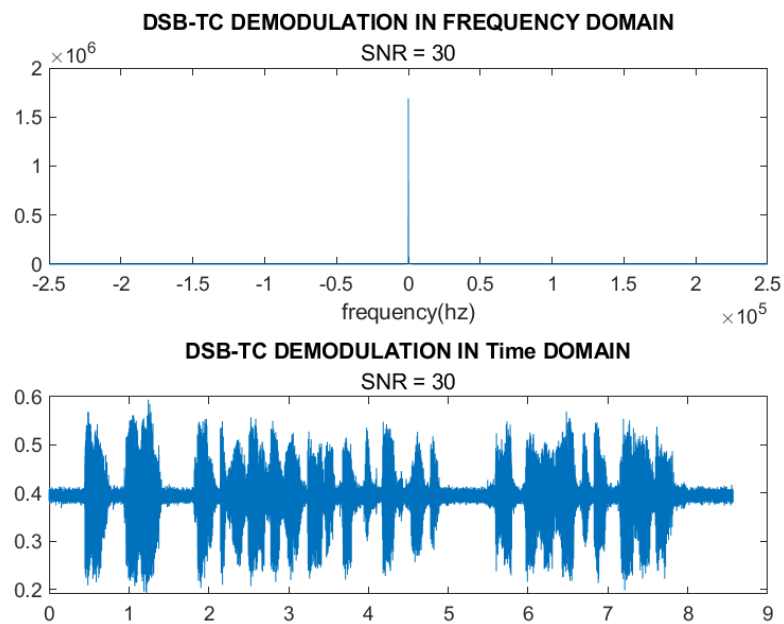
Signal to noise ratio ($SNR = 0$)



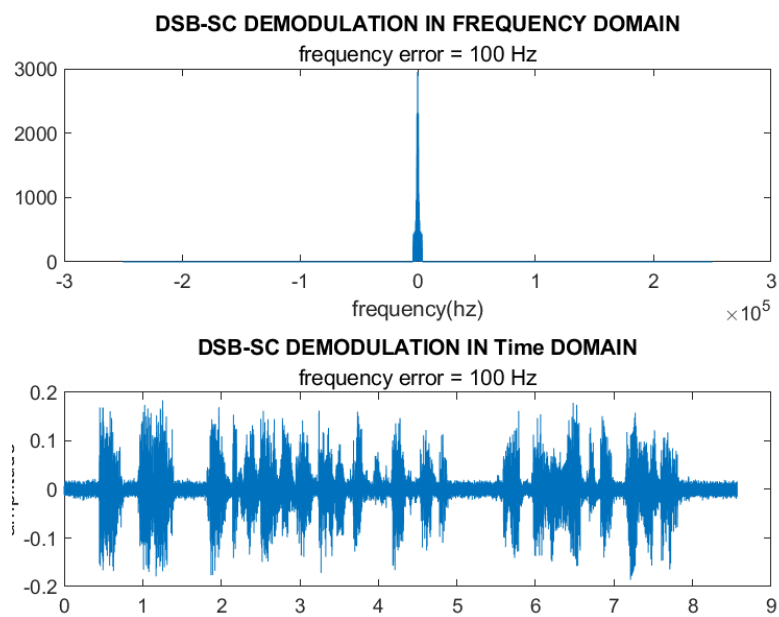
Signal to noise ratio ($SNR = 10$)



Signal to noise ratio ($SNR = 30$)

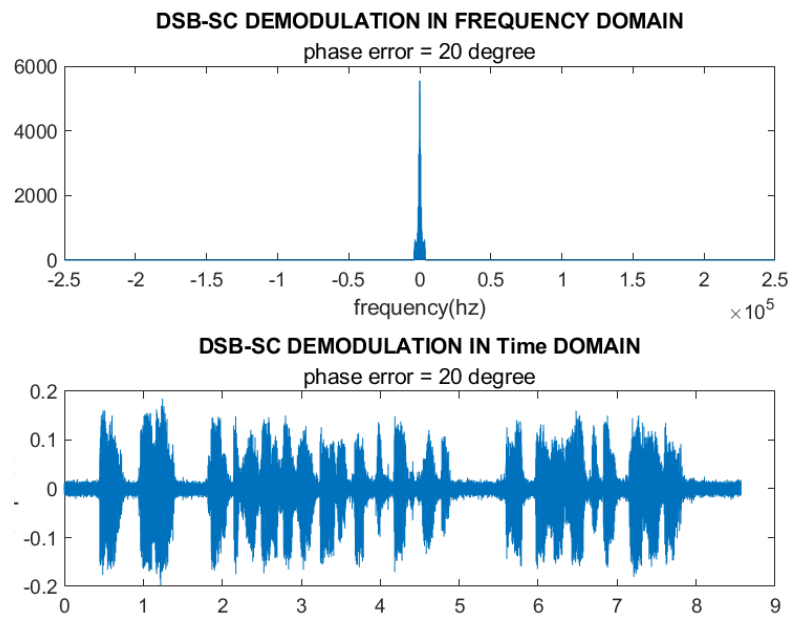


- Coherent Detection for DSB-SC with frequency error



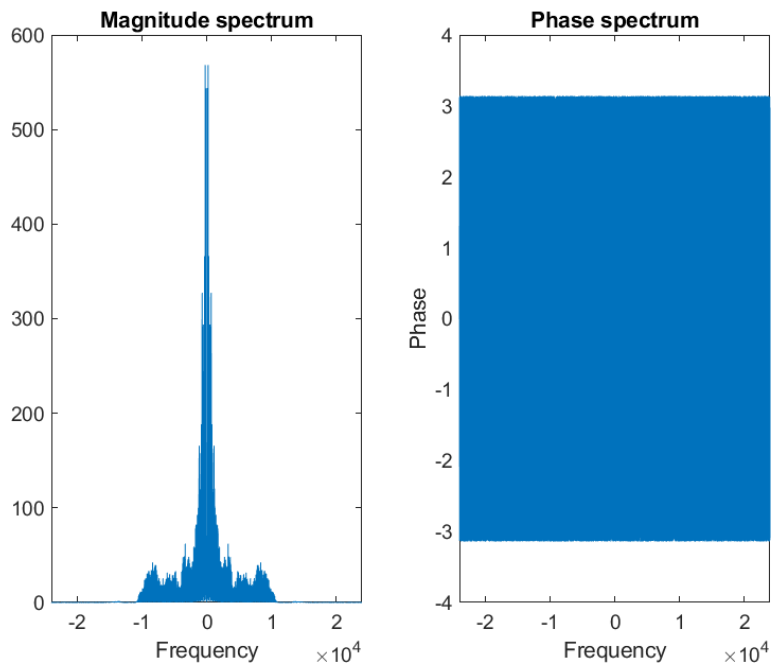
This phenomenon is called beat effect

- Coherent Detection for DSB-SC with phase error



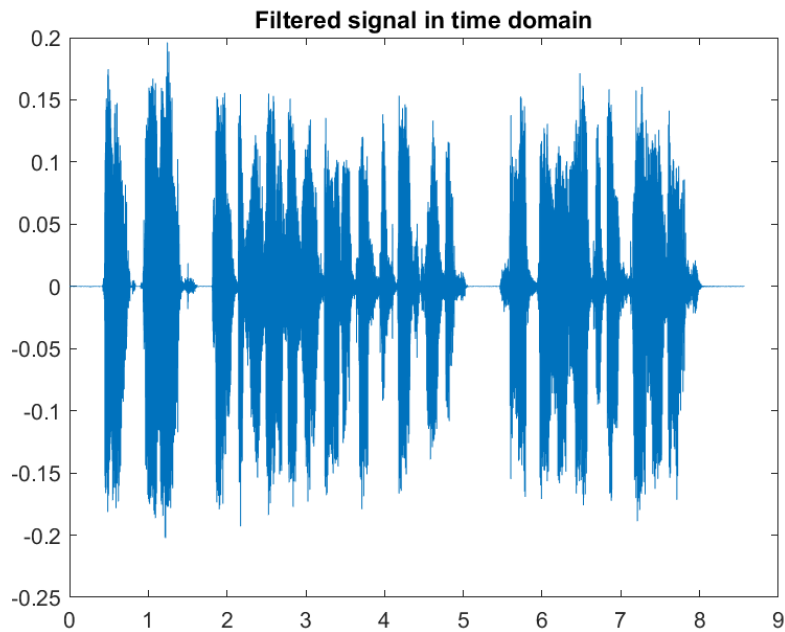
Experiment 2: Single Sided Band Modulation

- Spectrum of attached audio file

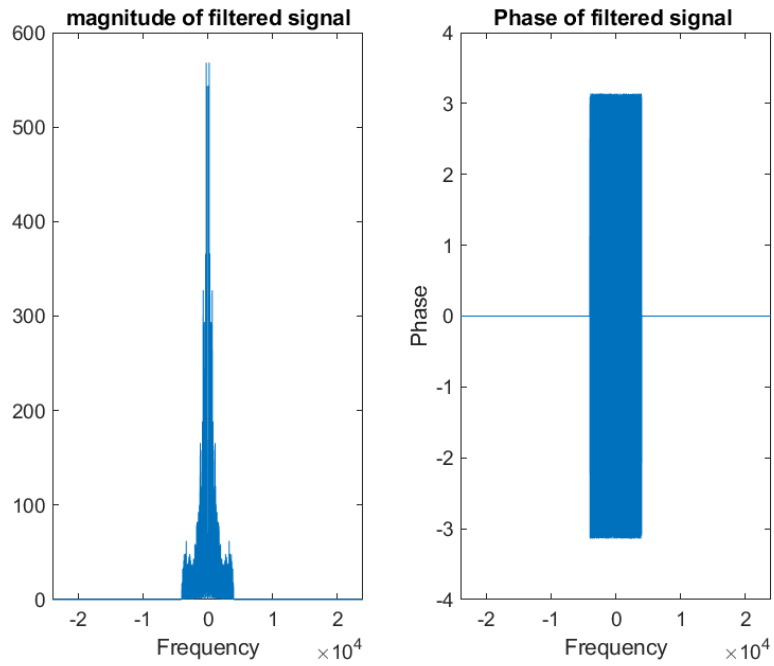


- Ideal low pass filter ($BW = 4000Hz$)

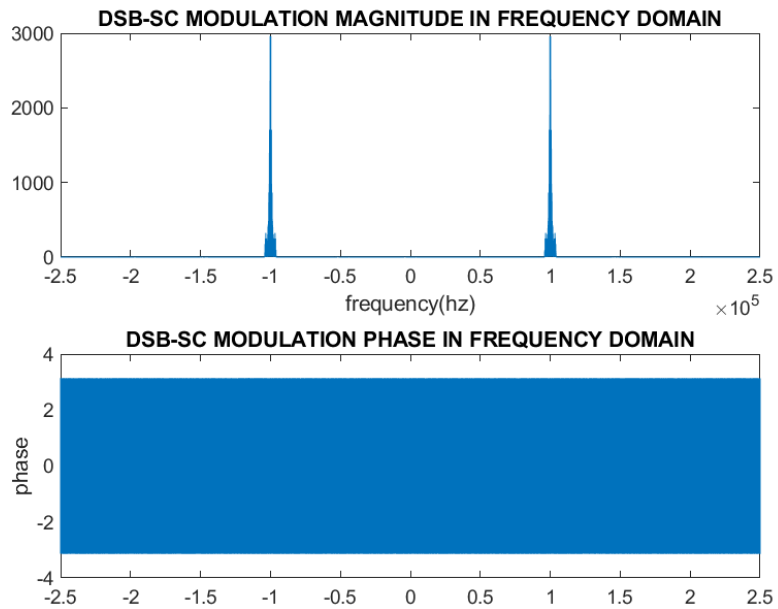
Time Domain



Frequency Domain

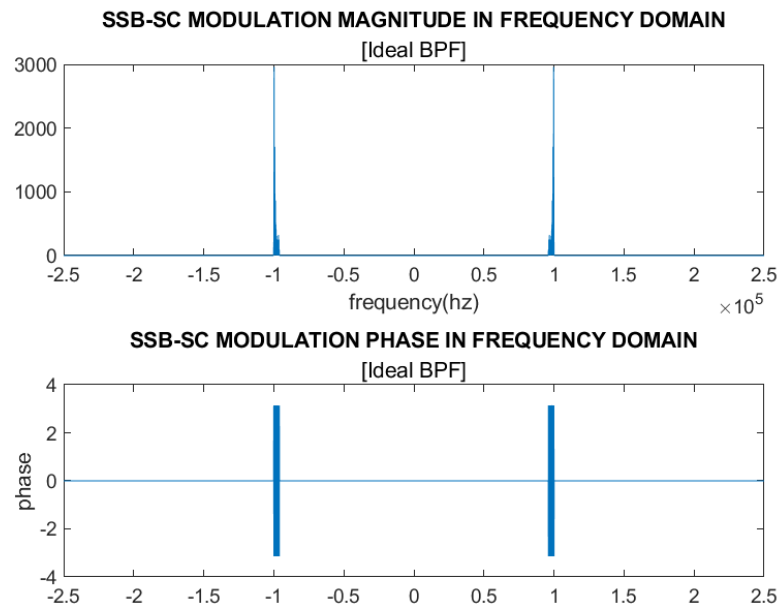


- DSB-SC modulated in frequency domain

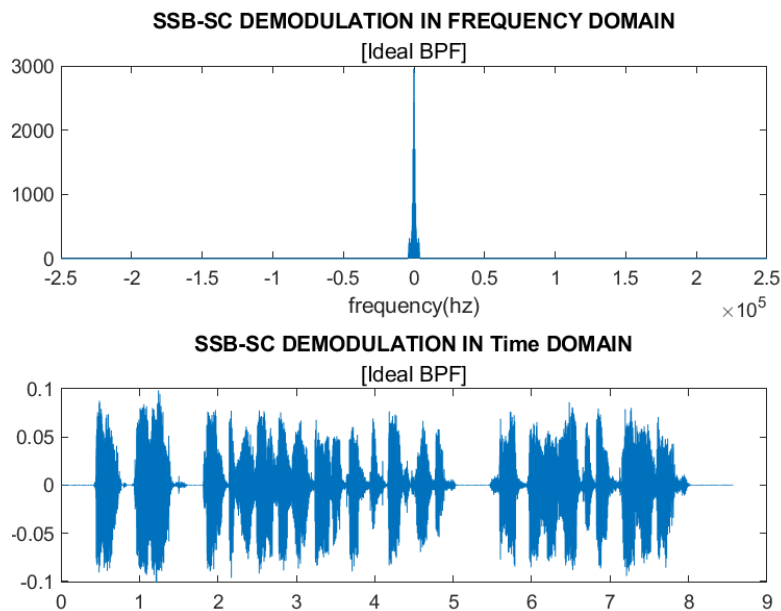


- Demodulation with ideal LPF

SSB LSB obtained from DSB-SC

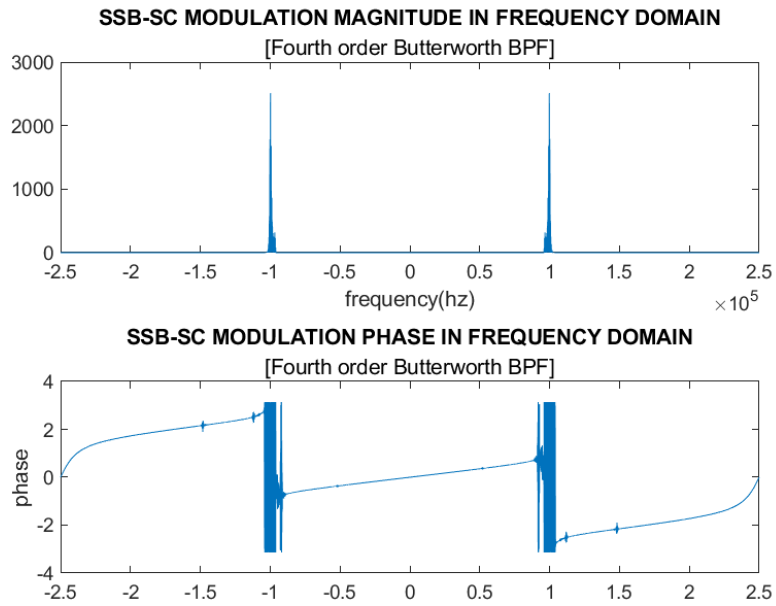


Coherent detection demodulation for SSB-SC

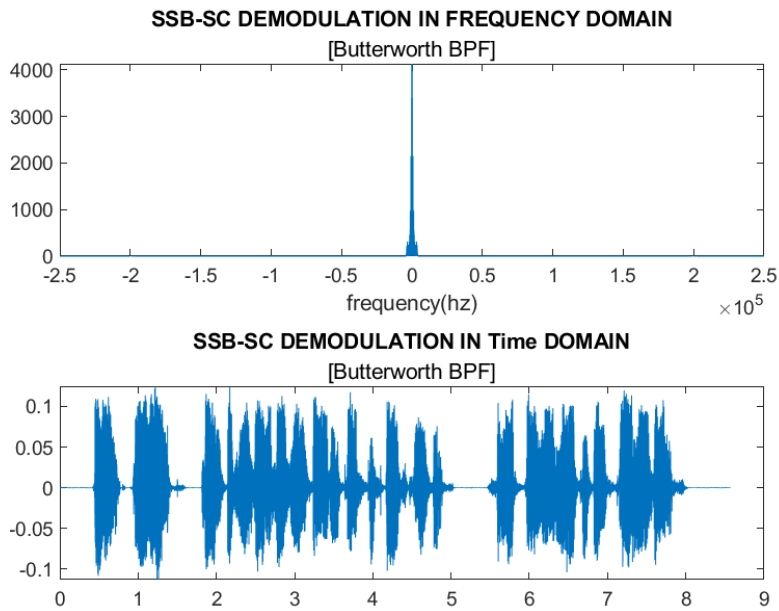


- Demodulation with 4th order butterworth filter

SSB LSB obtained from DSB-SC

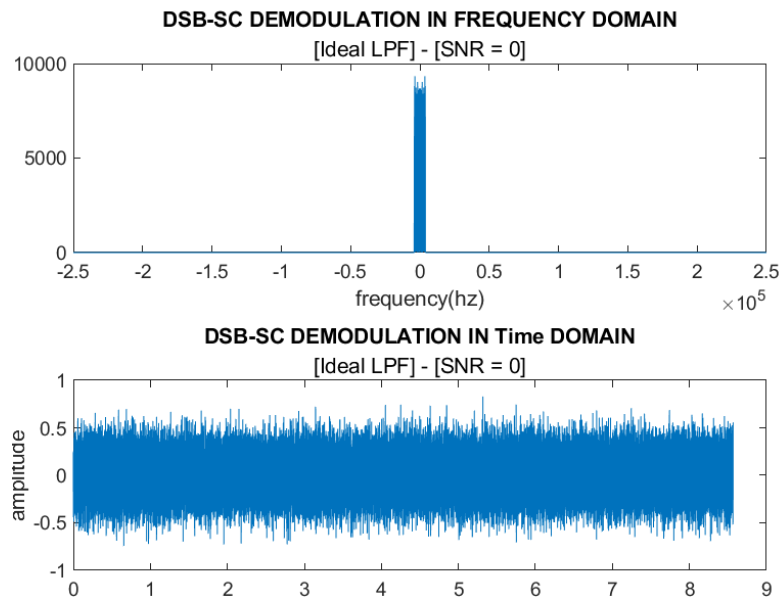


Coherent detection demodulation for SSB-SC

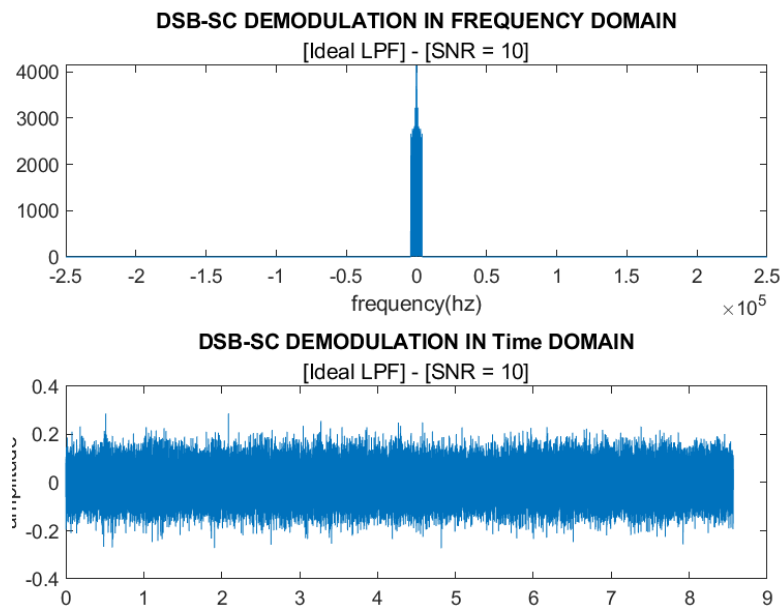


- Recieved signal with added noise (ideal LPF)

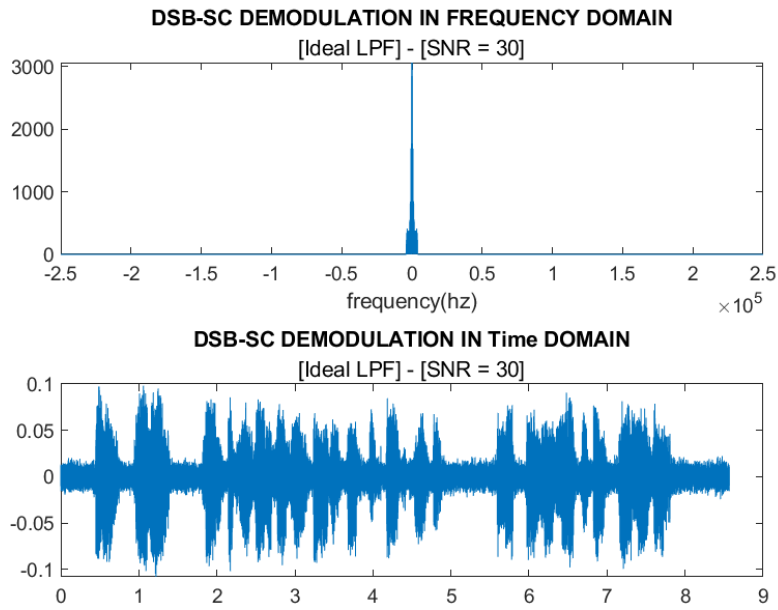
Signal to noise ratio ($SNR = 0$)



Signal to noise ratio ($SNR = 10$)

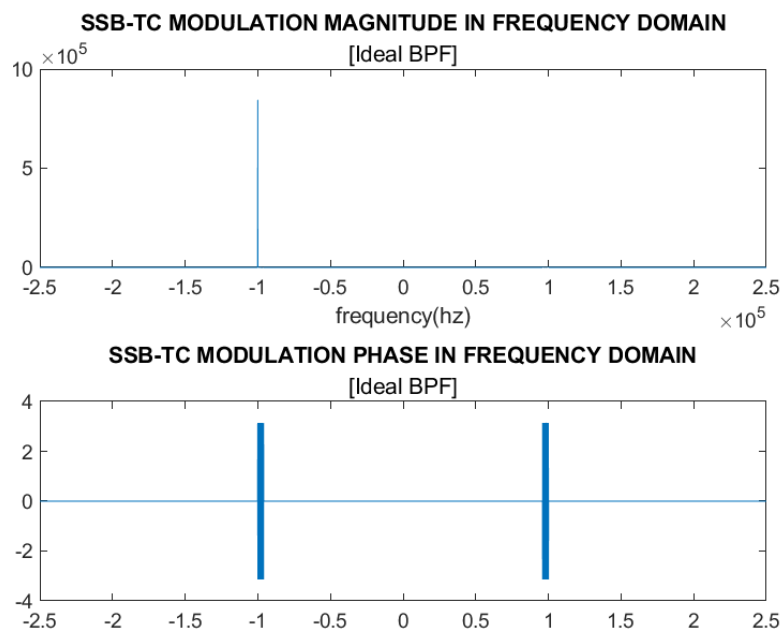


Signal to noise ratio ($SNR = 30$)



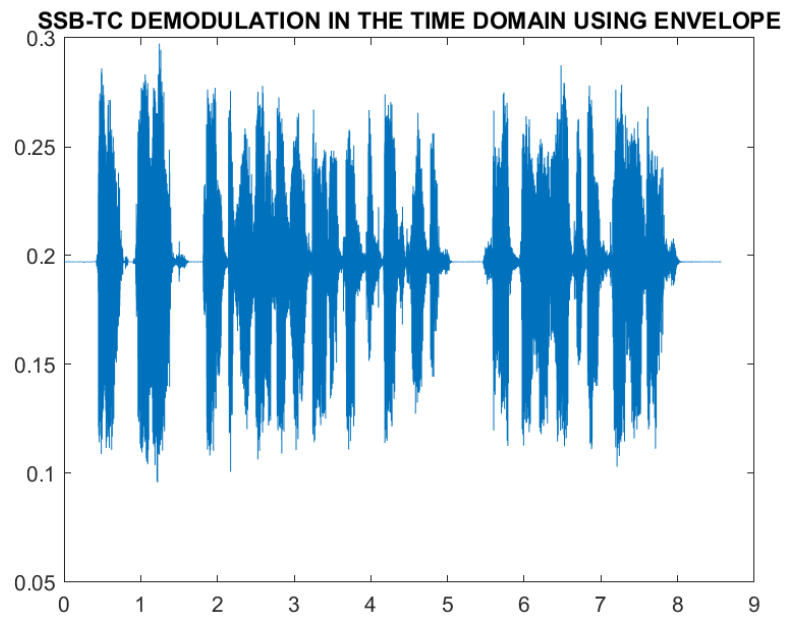
- **Generated SSB-TC**

Frequency Domain



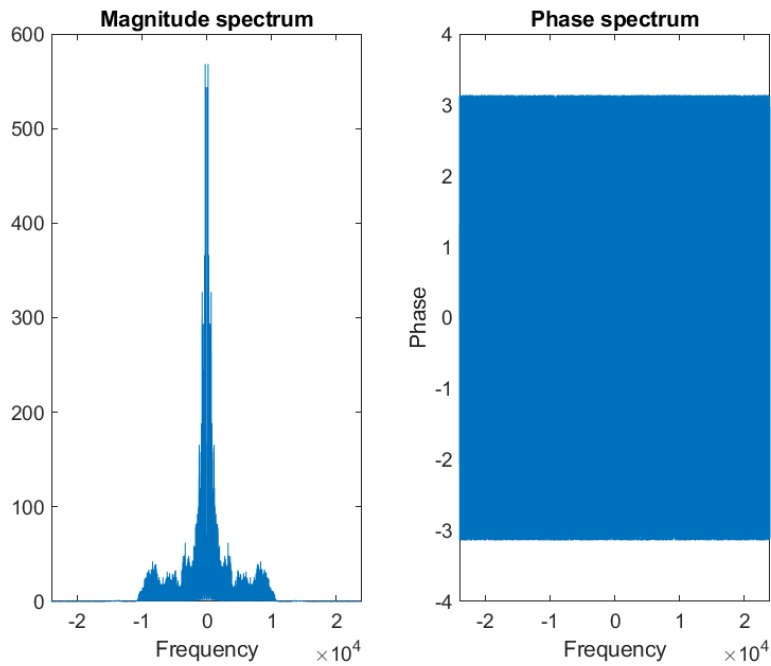
- Envelop detected SSB-TC

Frequency Domain



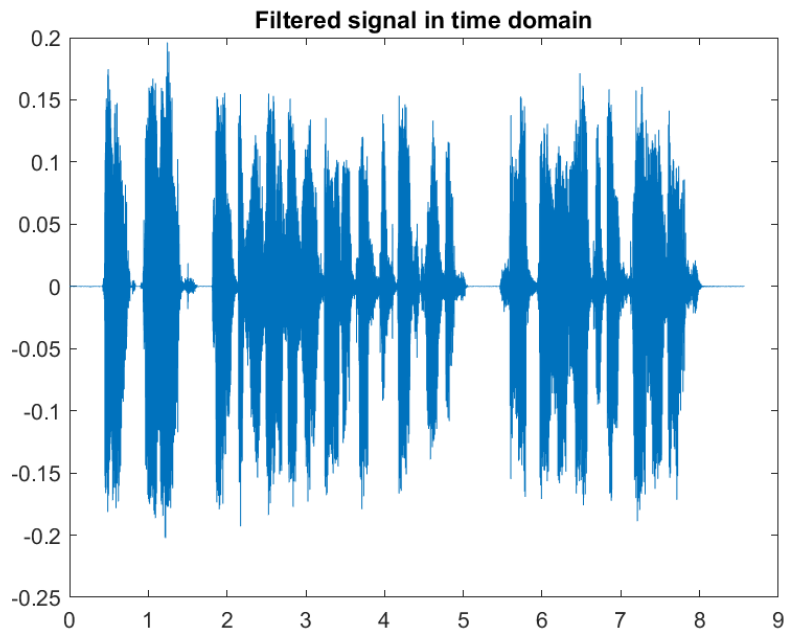
Experiment 3: Single Sided Band Modulation

- Spectrum of attached audio file

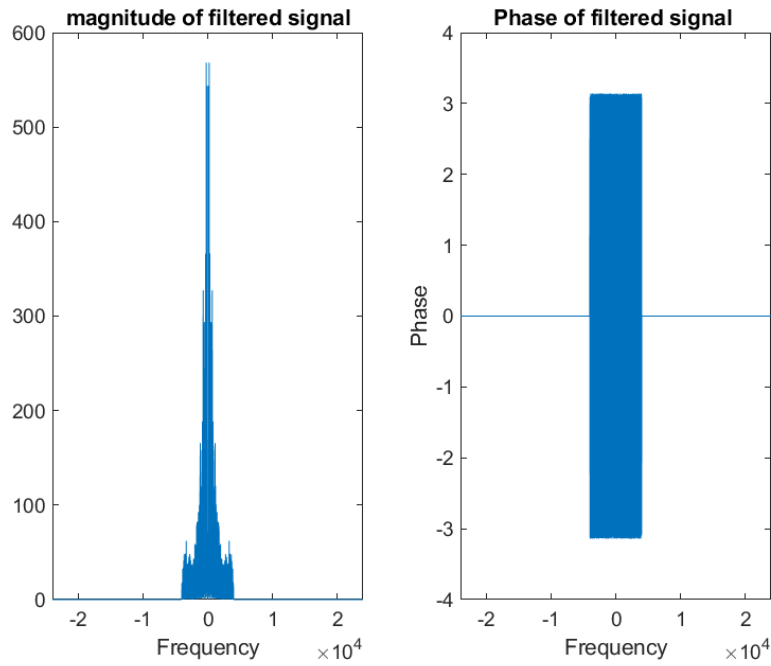


- Ideal low pass filter ($BW = 4000Hz$)

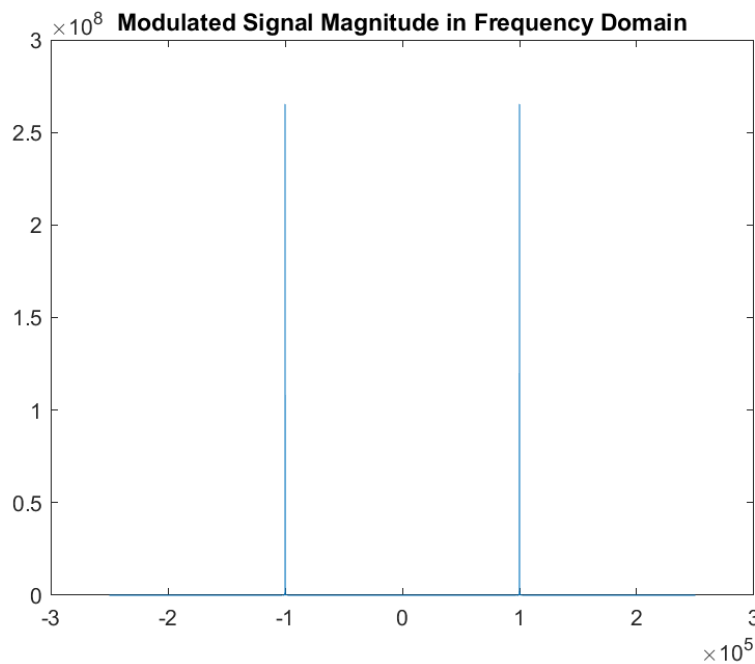
Time Domain



Frequency Domain



- Generated NBFM signal in frequency domain



The condition to achieve narrow band frequency modulation is having small frequency deviation, $Q(t) \leq \frac{\pi}{6}$

- Demodulation of NBFM signal

