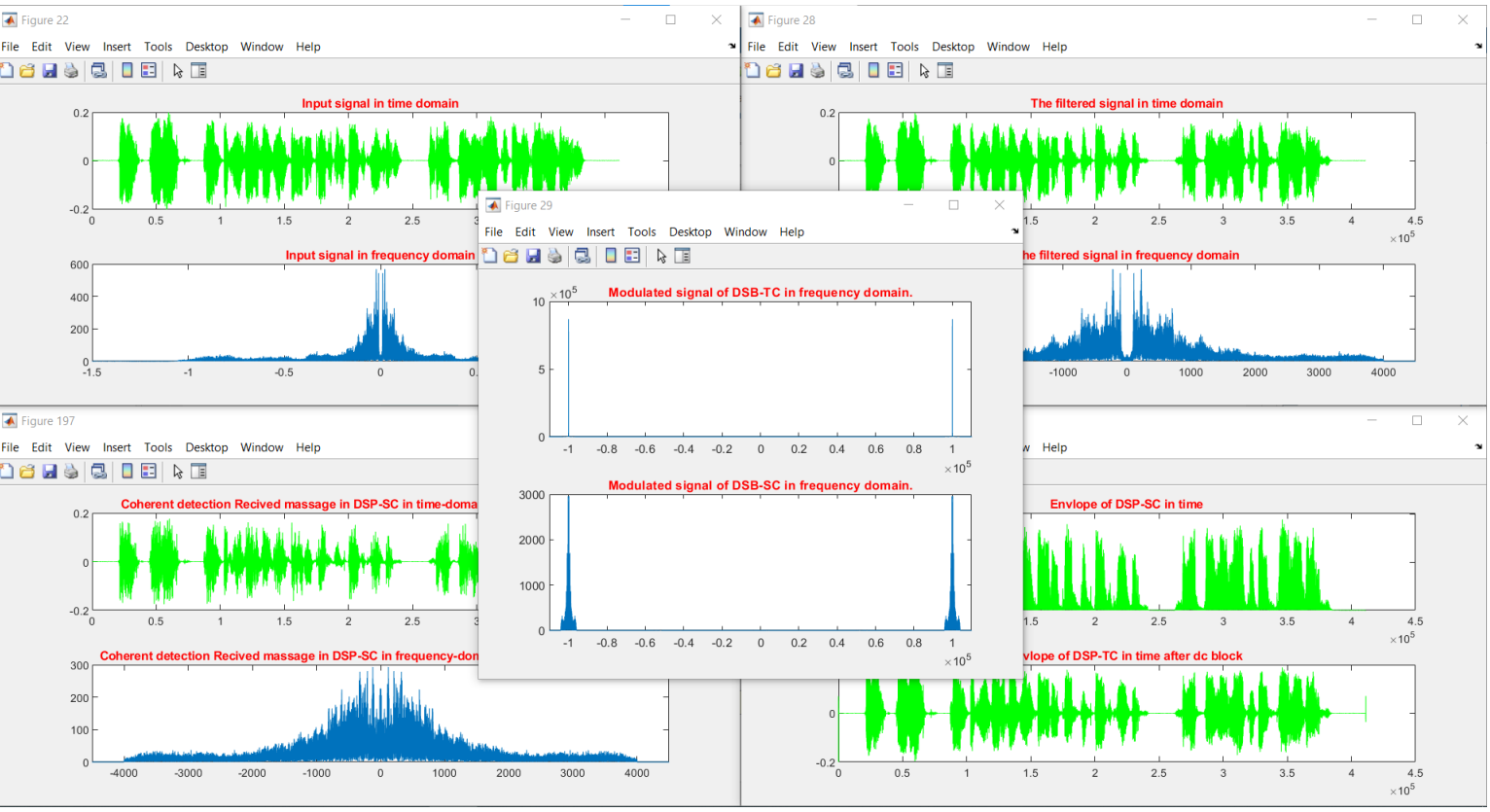

ANALOG COMMUNICATION

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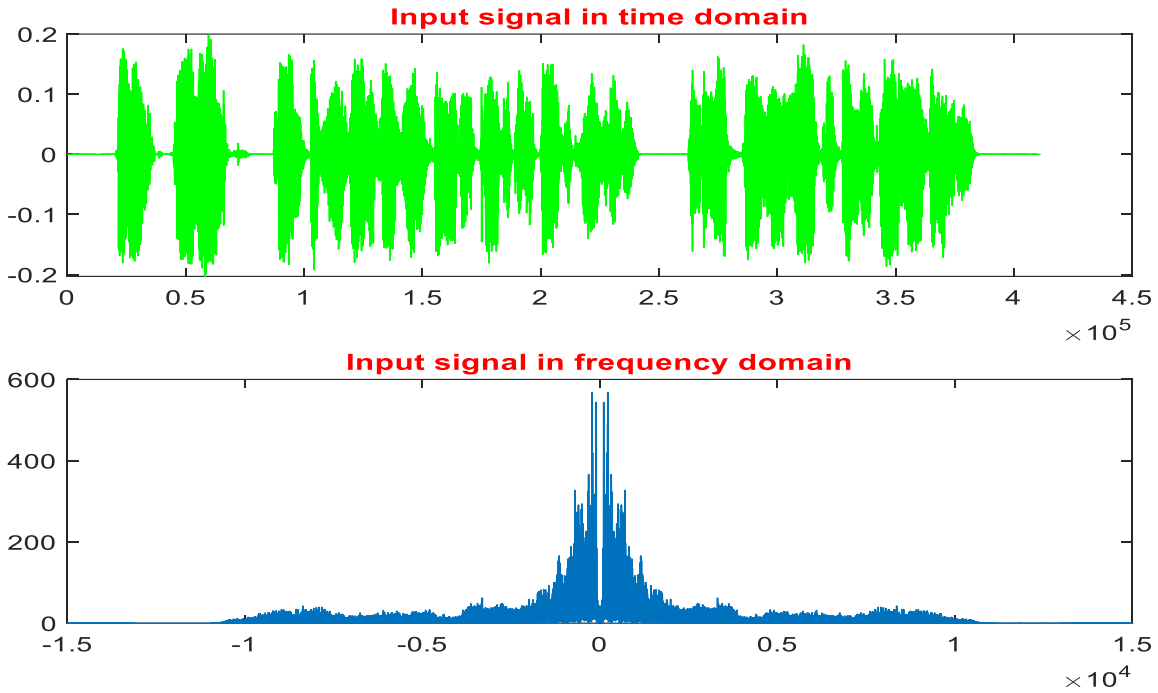
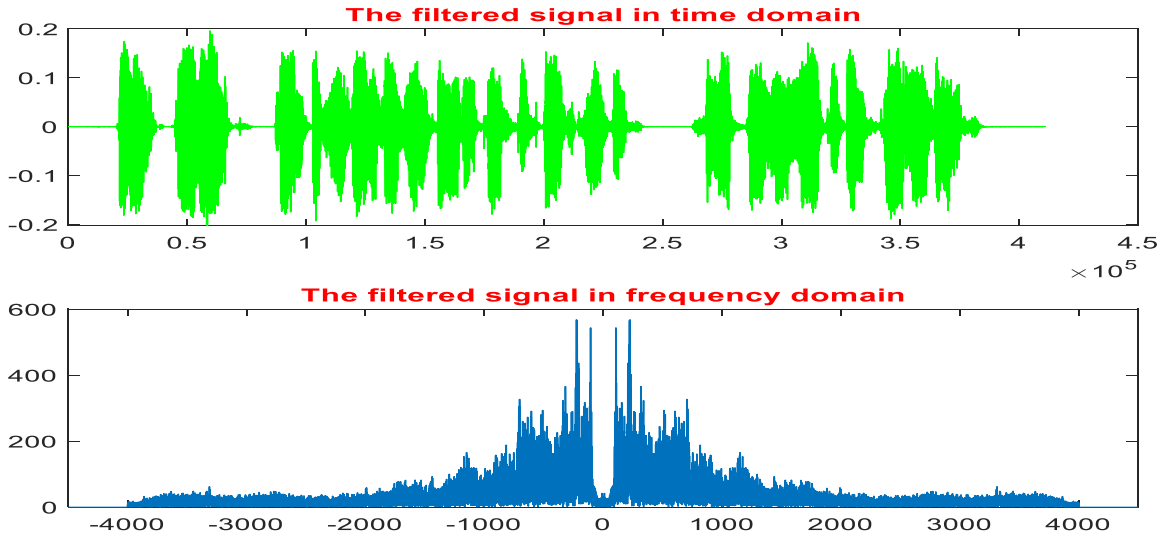
Note: **We plot the signal in time domain by green & in frequency domain by blue**

1 EXPERIMENT ONE: DOUBLE SIDEBAND MODULATION

1. Use MATLAB to read the attached audio file, which has a sampling frequency Fs= 48 KHz. Find the spectrum of this signal (the signal in frequency domain).



2. Using an ideal Filter, remove all frequencies greater than 4 KHz. Obtain the filtered signal in time domain and frequency domain, this is a band limited signal of BW=4 KHz.



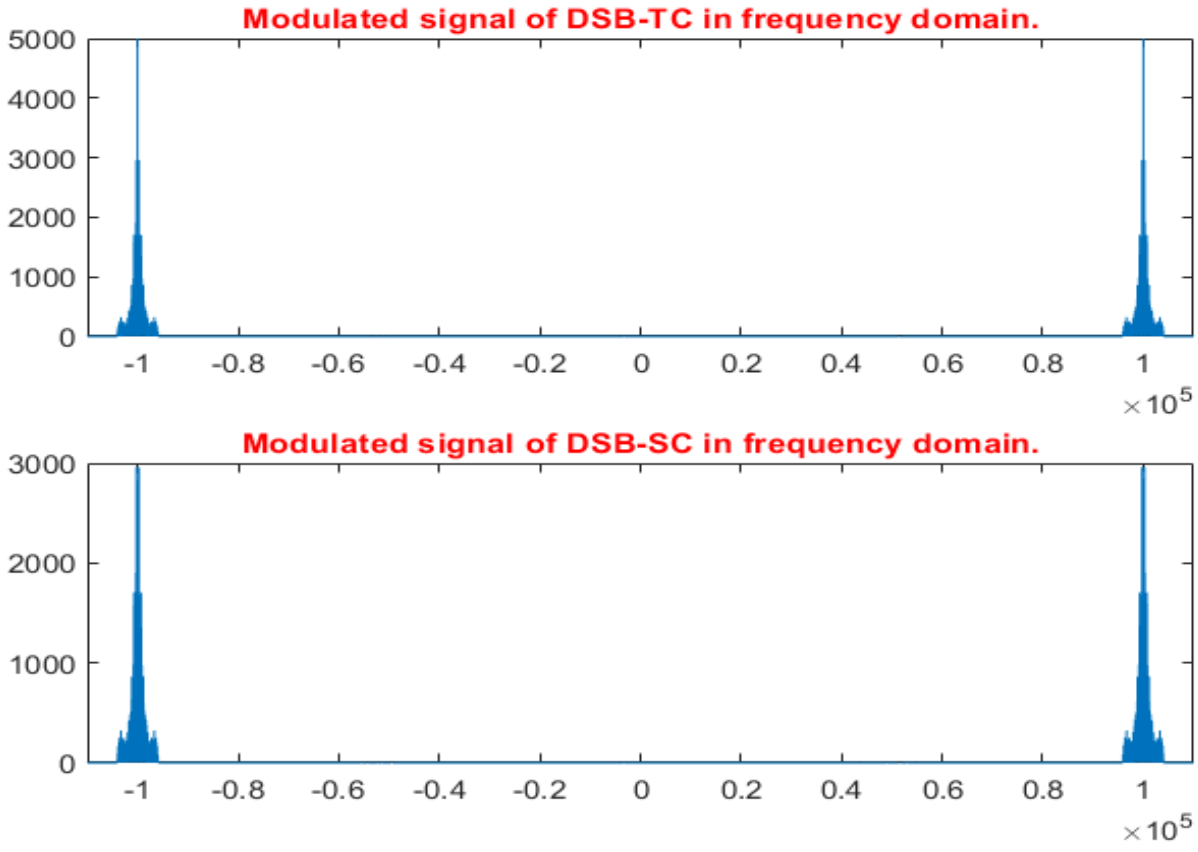
4. sound the filtered audio signal (make sure that there is only a small error in the filtered signal)

-Yes, there is a small error. (Sound (real(dataoffilter), fs)).

5. Modulate the carrier with the filtered signal you obtained, you are required to generate both types of modulation (DSB-TC and DSB-SC). Choose a carrier frequency of 100 KHz. For the DSB-TC take the DC bias added to message before modulation to be twice the maximum of the message (modulation index =0.5 in this case).

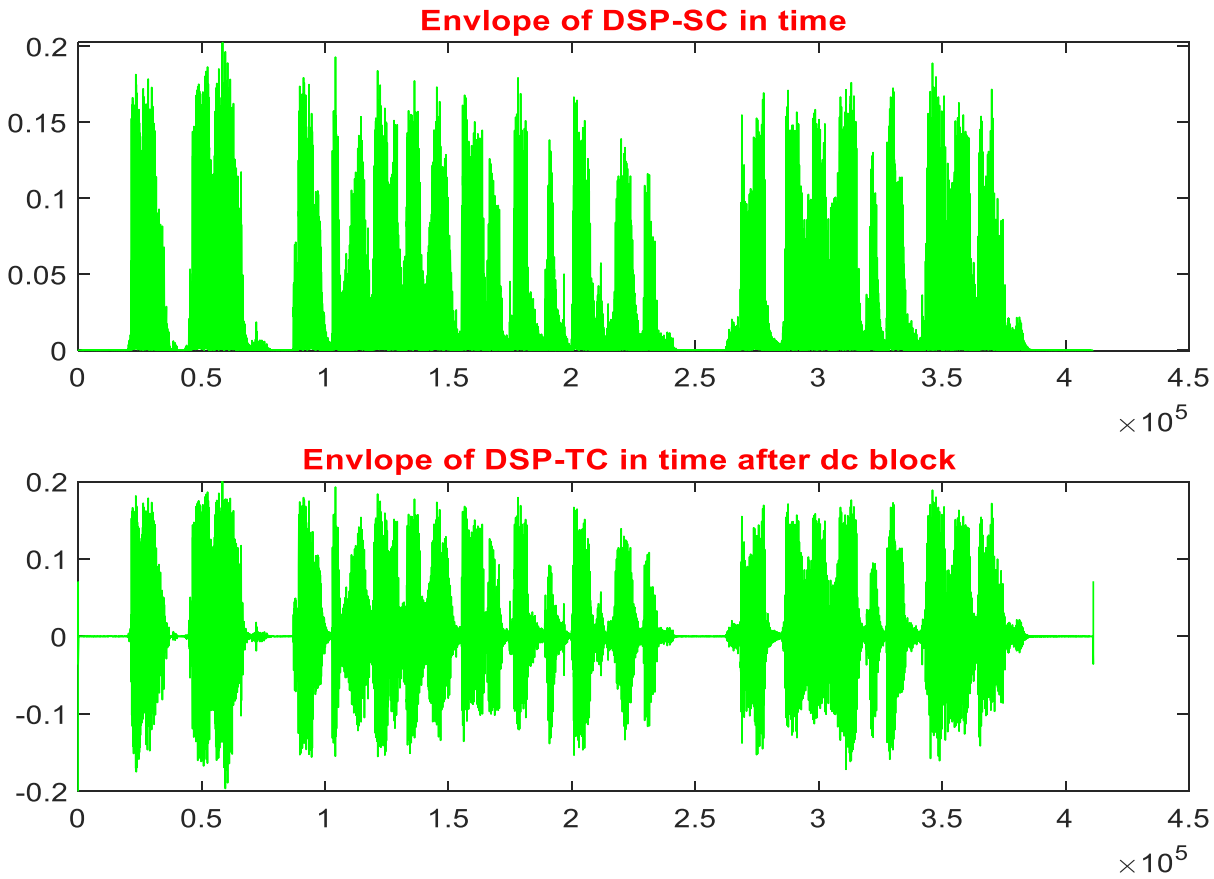
Note: You will also need to increase the sampling frequency of the filtered audio signal, the sampling frequency must be at least 2 times the carrier frequency, in this simulation use Fs = 5 F_C, you must sketch the modulated signal of both DSB-TC & DSB-SC in frequency domain.

First DSB-TC then DSB-SC



Note: we limit the Y axis in DSB-TC because delta of A is very high ~= 9*10^5 so we can't see the massage. If you want to see it as the original comment line of limit(ylim([0 5000])).

6ϕ7. For both types of modulations (DSB-SC & DSB-TC), use envelop detector to receive the message (assume no noise). After the reception of both modulation types using envelope detector, sketch the received signal in time domain, and play the received signal back (Note: to sound signal after demodulation process, you must decrease the sampling frequency again).



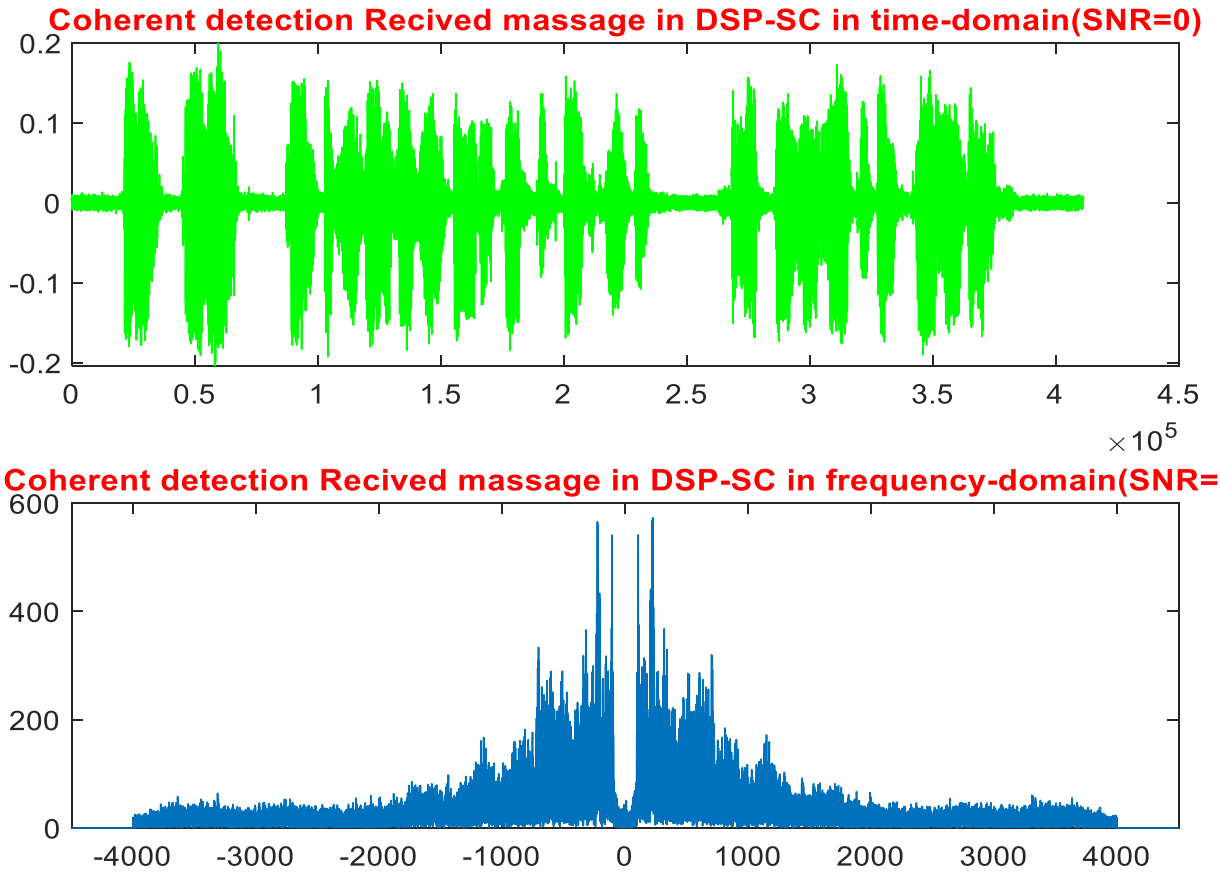
What observation can you make of this or which type of modulation the envelope detector can be used with?

-The envelope detector can't be use with DSB-SC because half of the massage in negative y-axis and the envelope take the positive only, but we can use it with DSB-TC but with a condition (modulation index must be less than or equal one m<=1). In this case m=.5 which less than one.

For DSB-SC, perform steps 9-11.

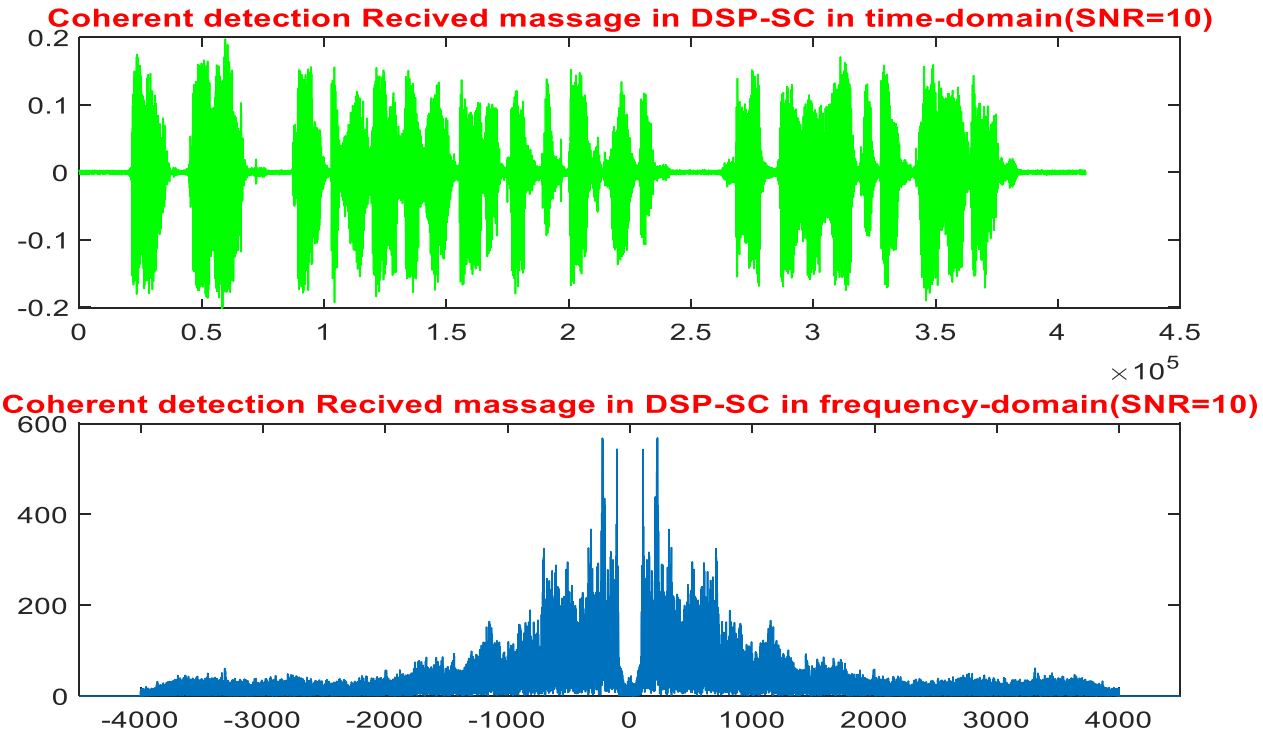
8. Use coherent detection to receive the modulated signal with SNR=0, 10, 30dB then sound the received signals and plot them in both time and frequency domain. (Note: we multiply carrier by 2 to have the same amplitude of the original massage)

At SNR=0 dB

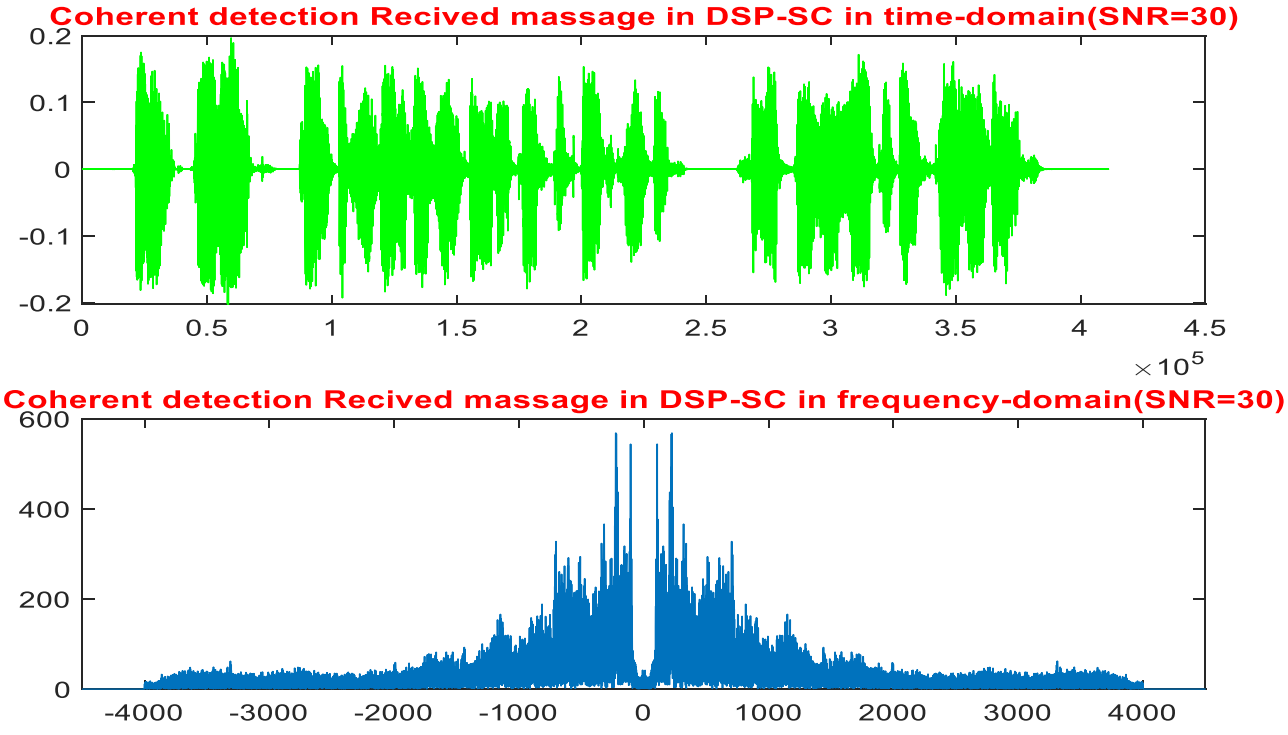


-The thickness of the massage increase because of the noise.
Here the noise is so obvious when we sound the received massage.

At SNR=10 dB

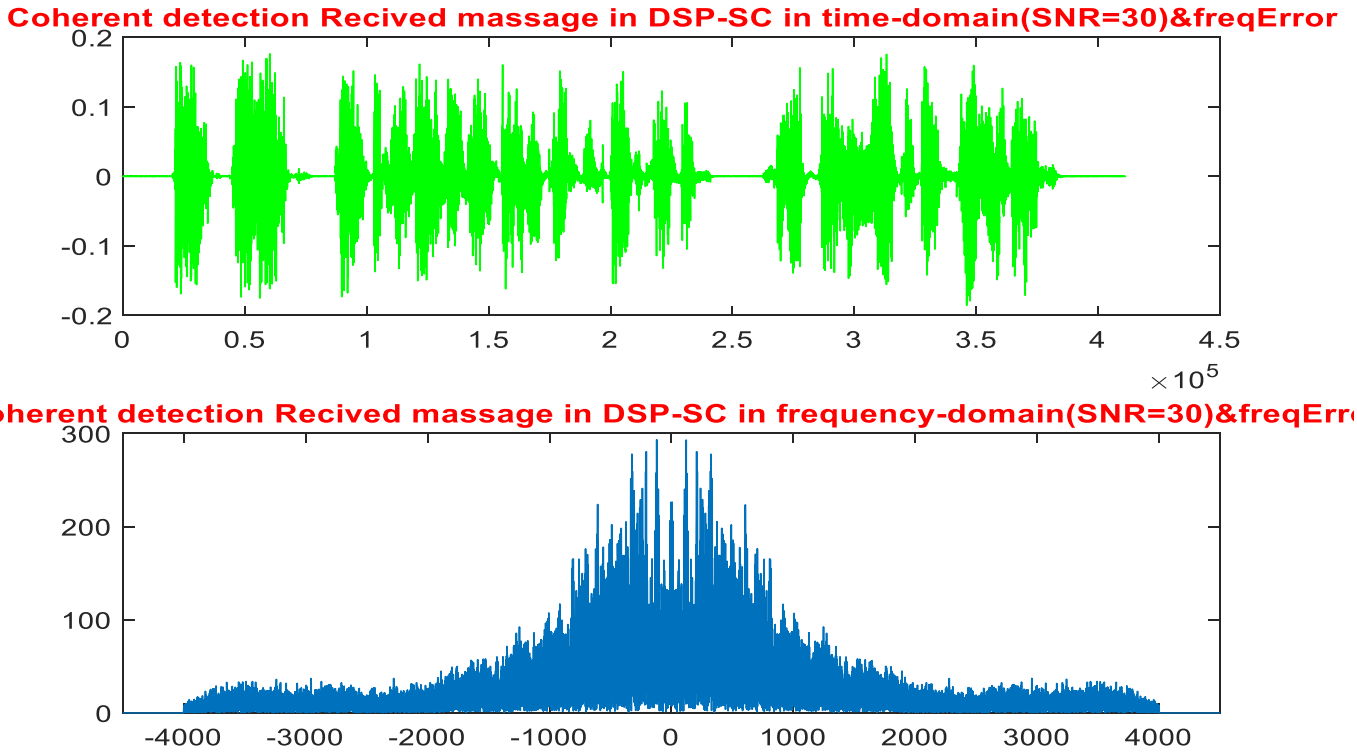


At SNR=30 dB



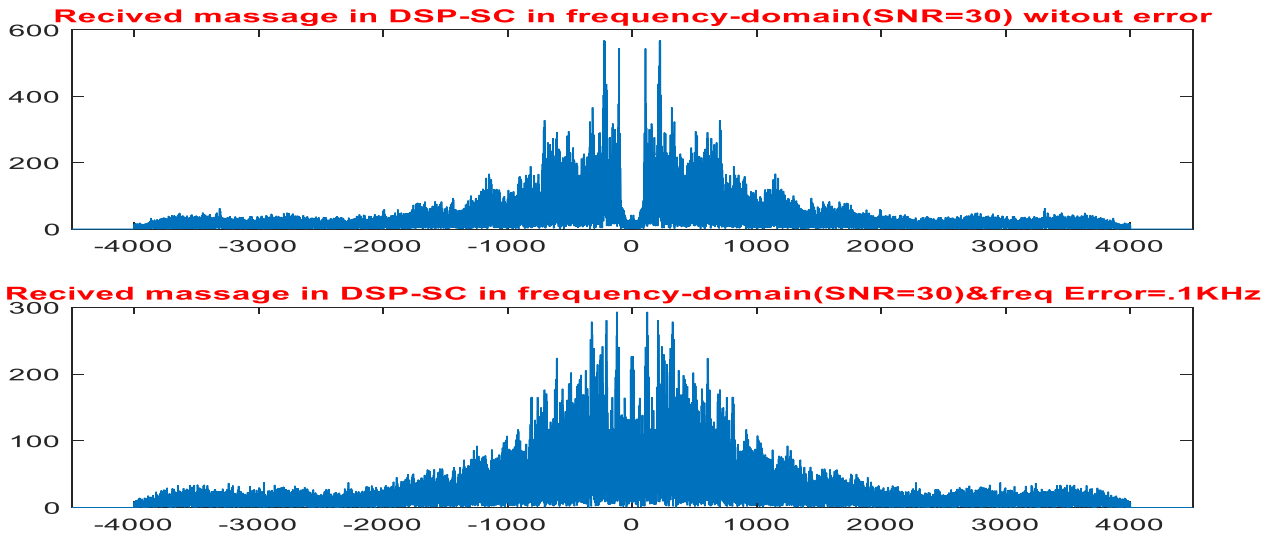
9. Repeat the coherent detection with frequency error, F=100.1 KHz instead of 100 KHz and Find the error.

At SNR=30 dB &frequency error =.1 kHz



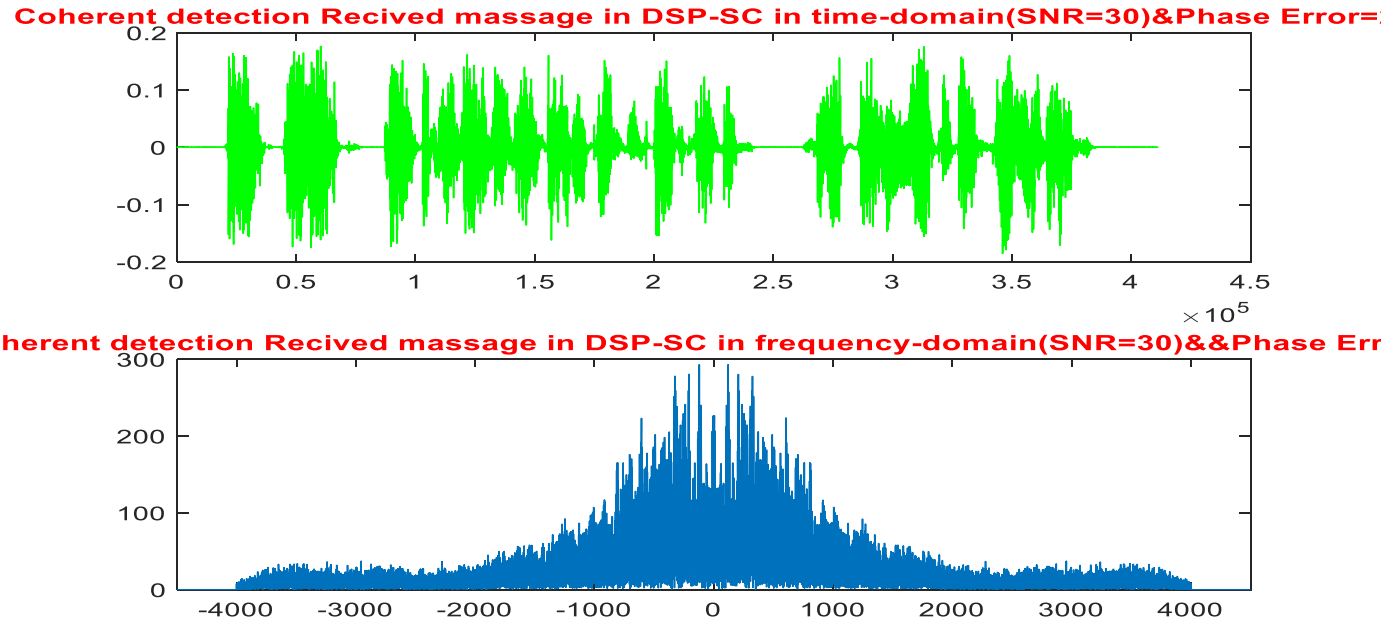
Do you have a name for this phenomenon?

-The signal in frequency domain and time domain is overlapped so if we play it the sound is repeater **this called beat effect.**

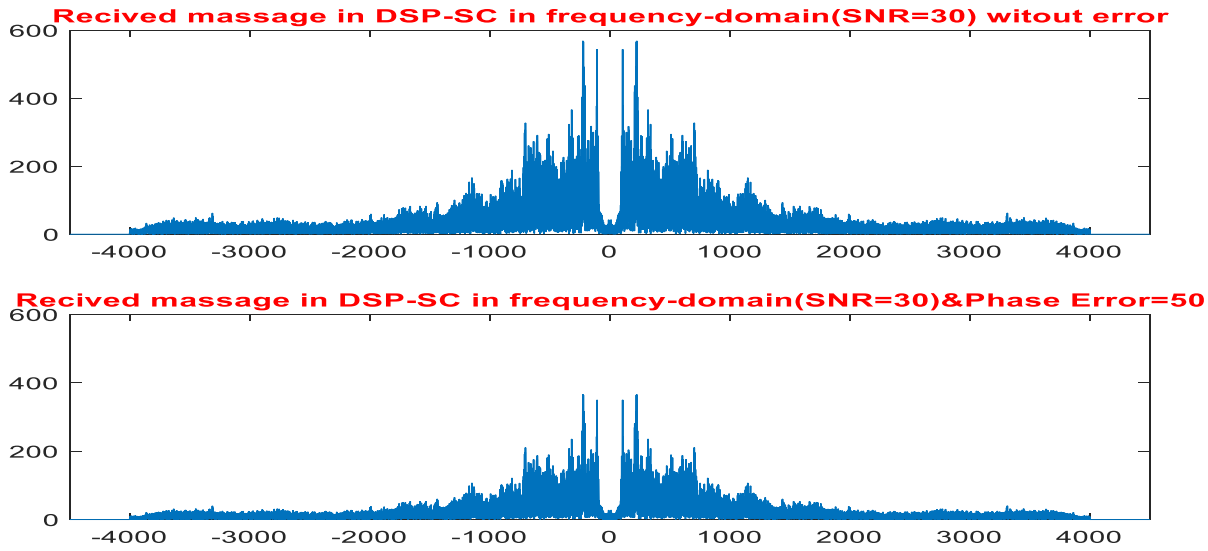


10. Repeat the coherent detection with phase error = 20.

At SNR=30 dB &phase error =20.



Signal in frequency-domain before & after phase error



-Phase error will make attenuation in massage if phase error ~=90.

But if phase error= 90, the massage will be zero.