Lab 4

To: Ross Snider
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Regarding: Lab 4
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Summary

In this lab I examined the use of the beatcon control panel within MATLAB as well as writing custom beat.m functions for similar purpose. I also examined the use of spectrograms, discovering how they can be used to represent frequency content of vectors in MATLAB and how the number of bits in use by the spectrogram will clarify the value of said content.

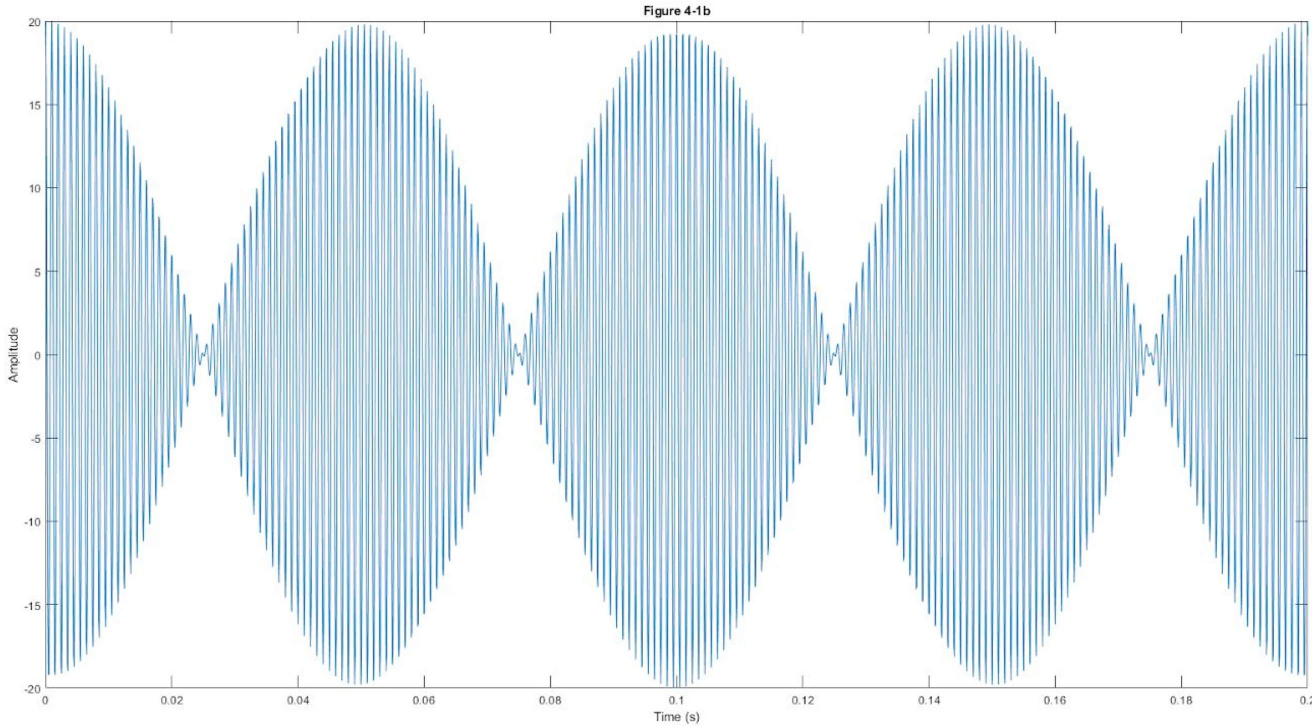
Main Body

Section 4:

4-1a)

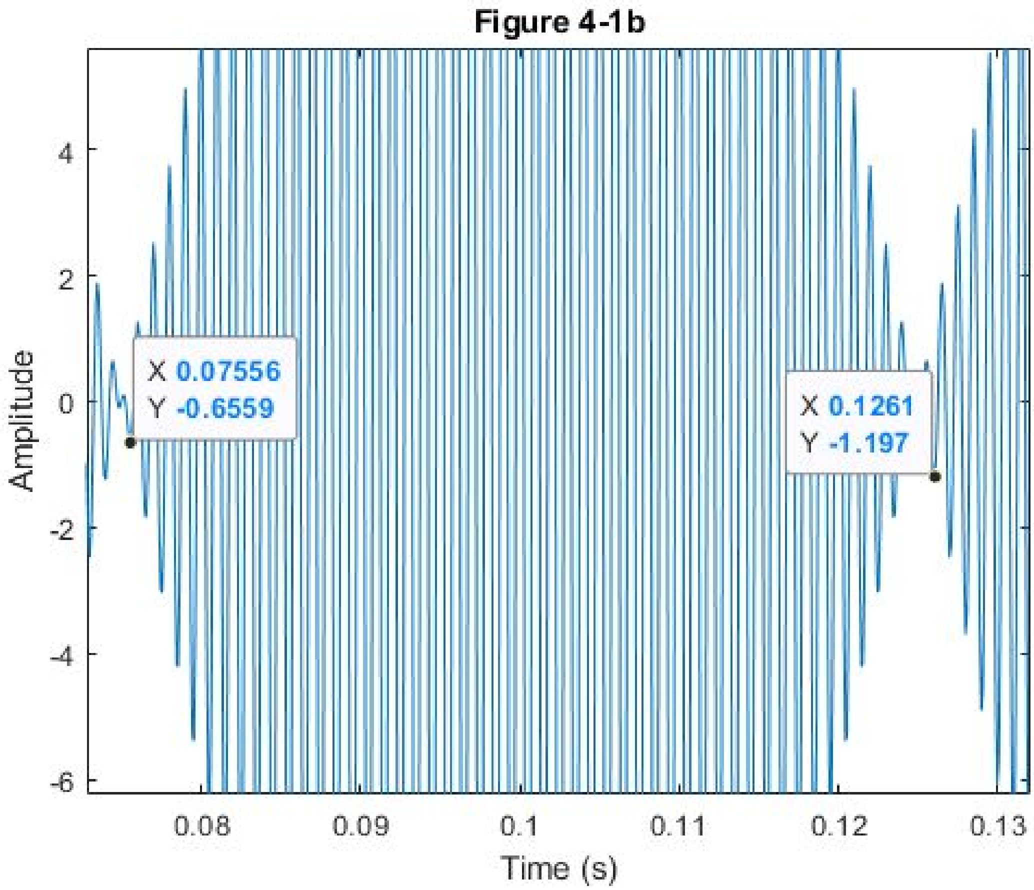
```
function [xx, tt] = beat(A, B, fc, delf, fsamp, dur)
% A = amplitude of lower frequency cosine
% B = amplitude of higher frequency cosine
% fc = center frequency
% delf = frequency difference
% fsamp = sampling rate
% dur = total time duration in seconds
% xx = output vector of samples
%--Second Output:
% tt = time vector corresponding to xx

tt = 0:1/fsamp:dur;

fk = [fc - delf, fc + delf];
xk = [A,B]

[xx,tt1] = syn_sin(fk,xk,fsamp,dur,0);

end
```

4-1b)



The sum of two waves each 10hz off of 1000hz

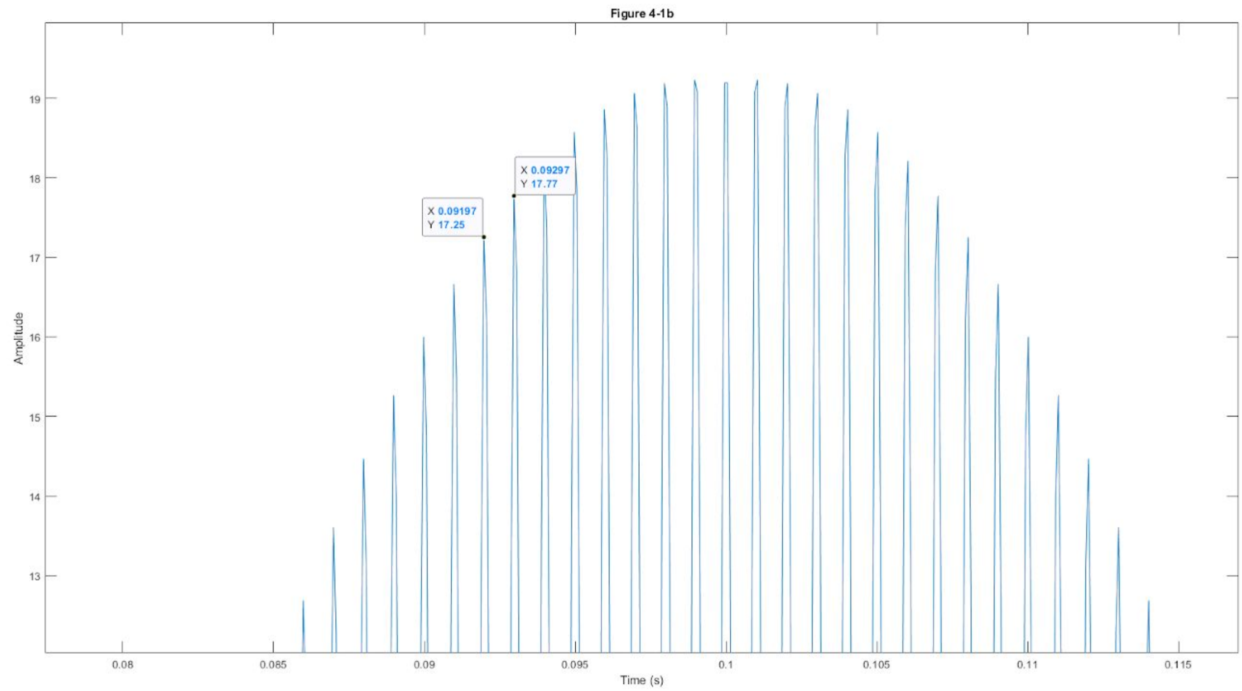
The waveform is effectively a sum of two sine waves that resembles a low frequency envelope with a high frequency component varying underneath the envelope.



Measurement of envelope frequency

Period = 0.1261 - 0.07556 = 0.05054

Frequency = 19.79 hz

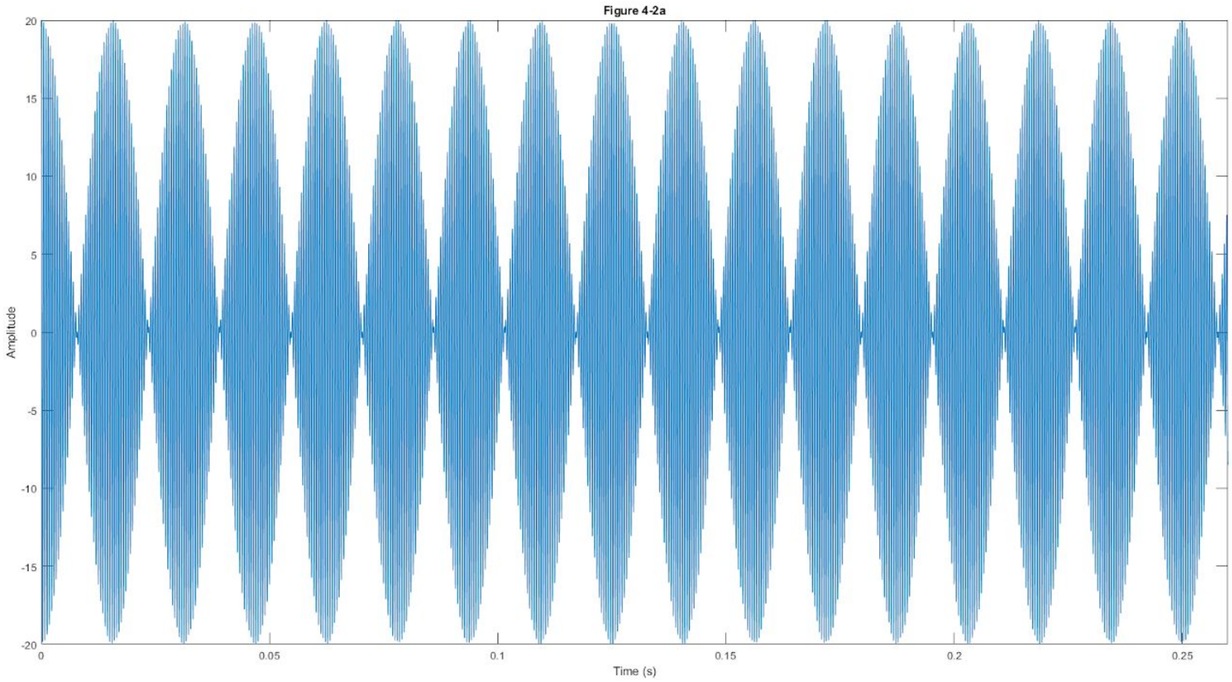


Measurement of higher frequency under envelope

Period = 0.09297 - 0.09197 = 0.001

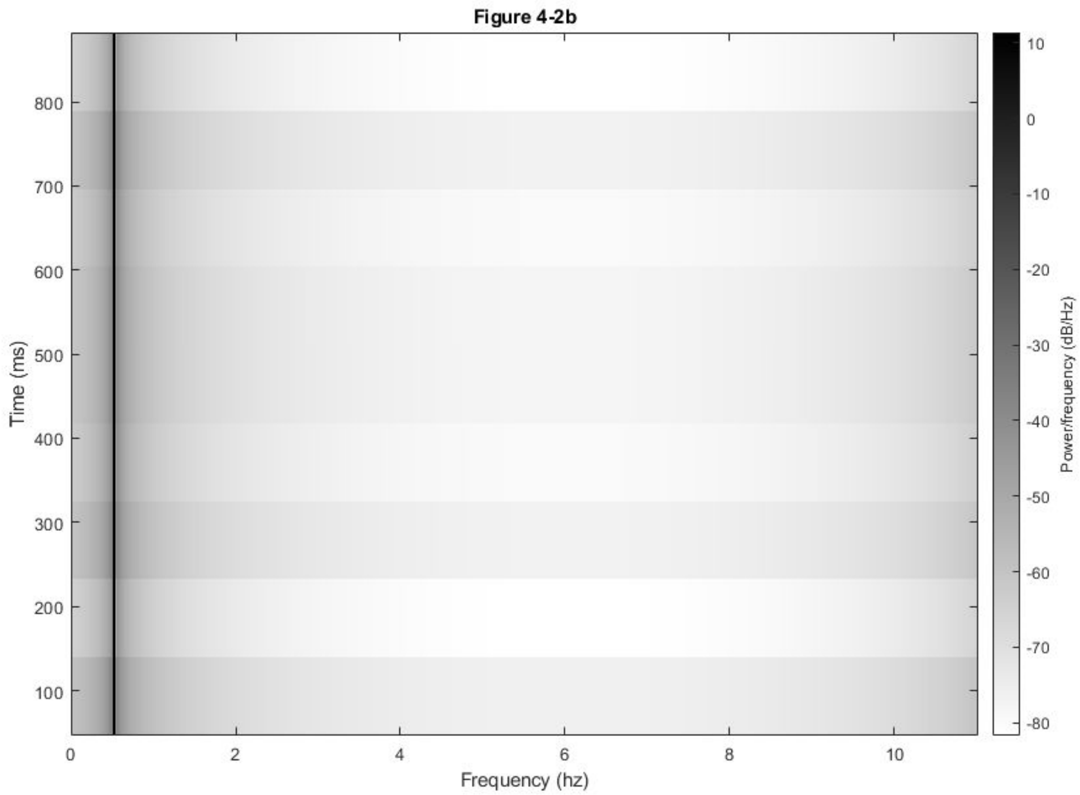
Frequency = 1000 hz

4-2a)

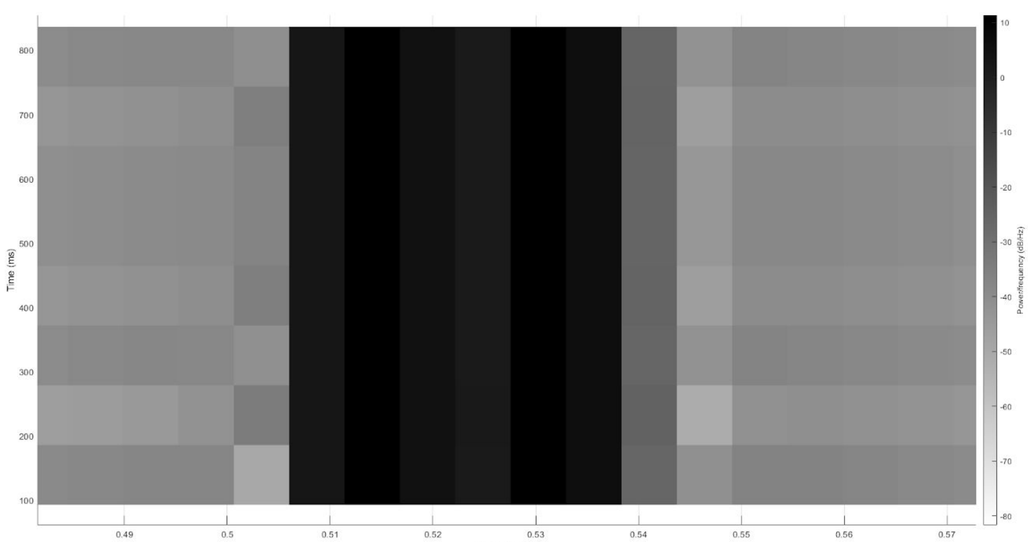


The sum of two waves each 32hz off of 2000hz

4-2b)

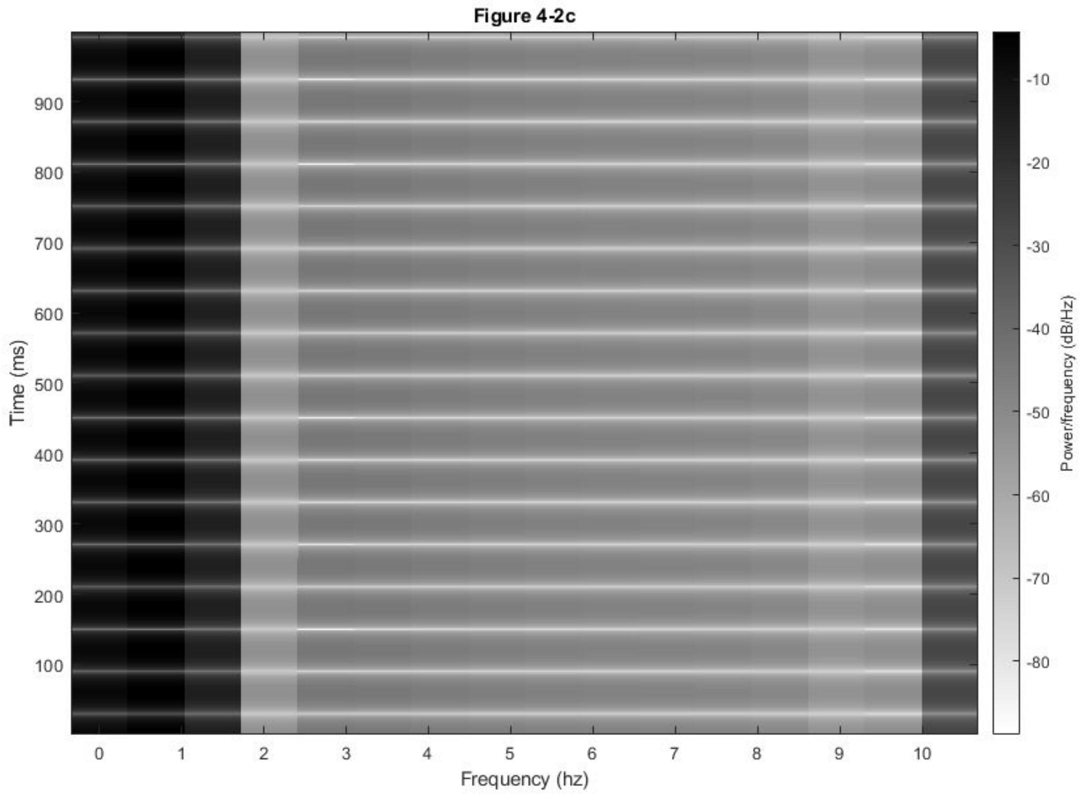


At first sight there is only one apparent frequency shown, at 522 hz



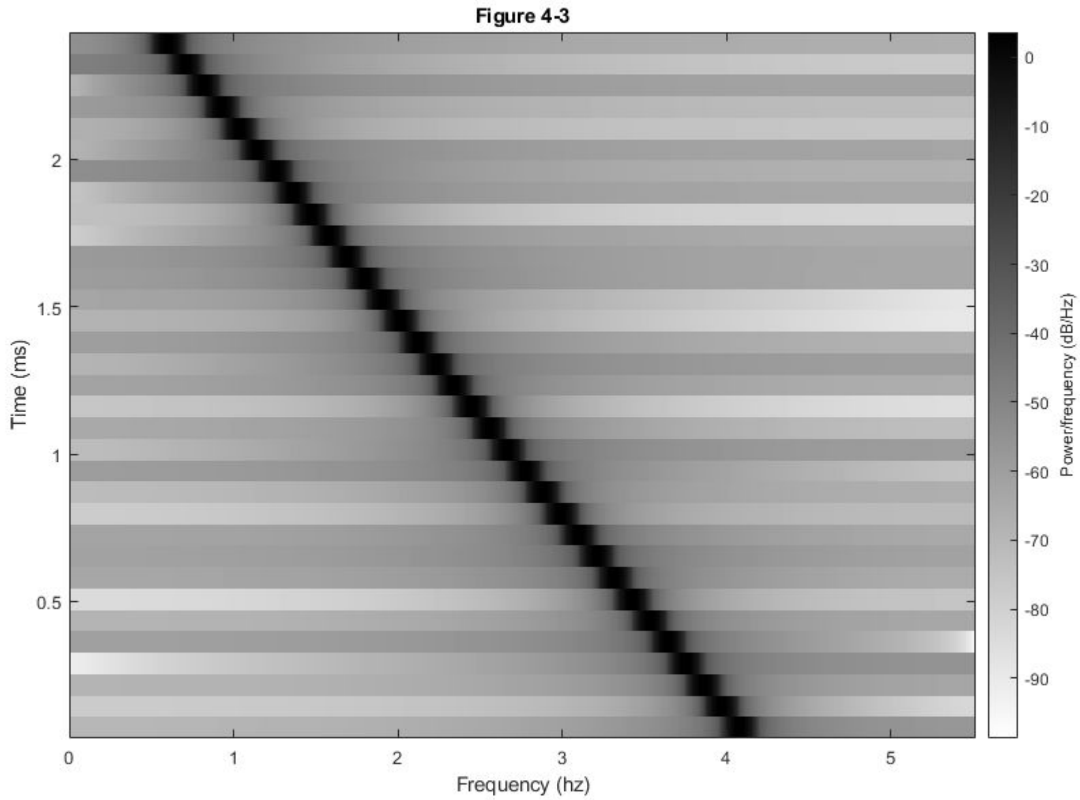
Upon zooming in I notice there is a band of frequencies near that 522 hz mark

4-2c)



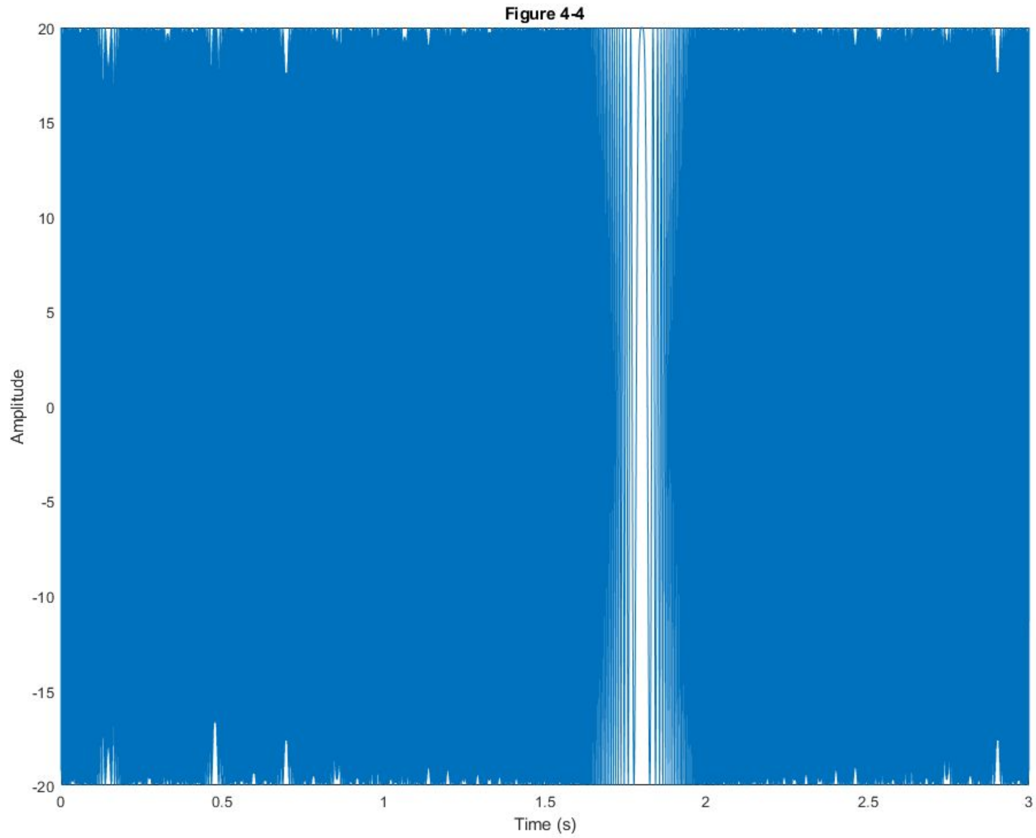
Because the number of bins are reduced in this spectrogram we see frequencies appearing in more bins. Most notably the frequency above 10khz.

4-3)

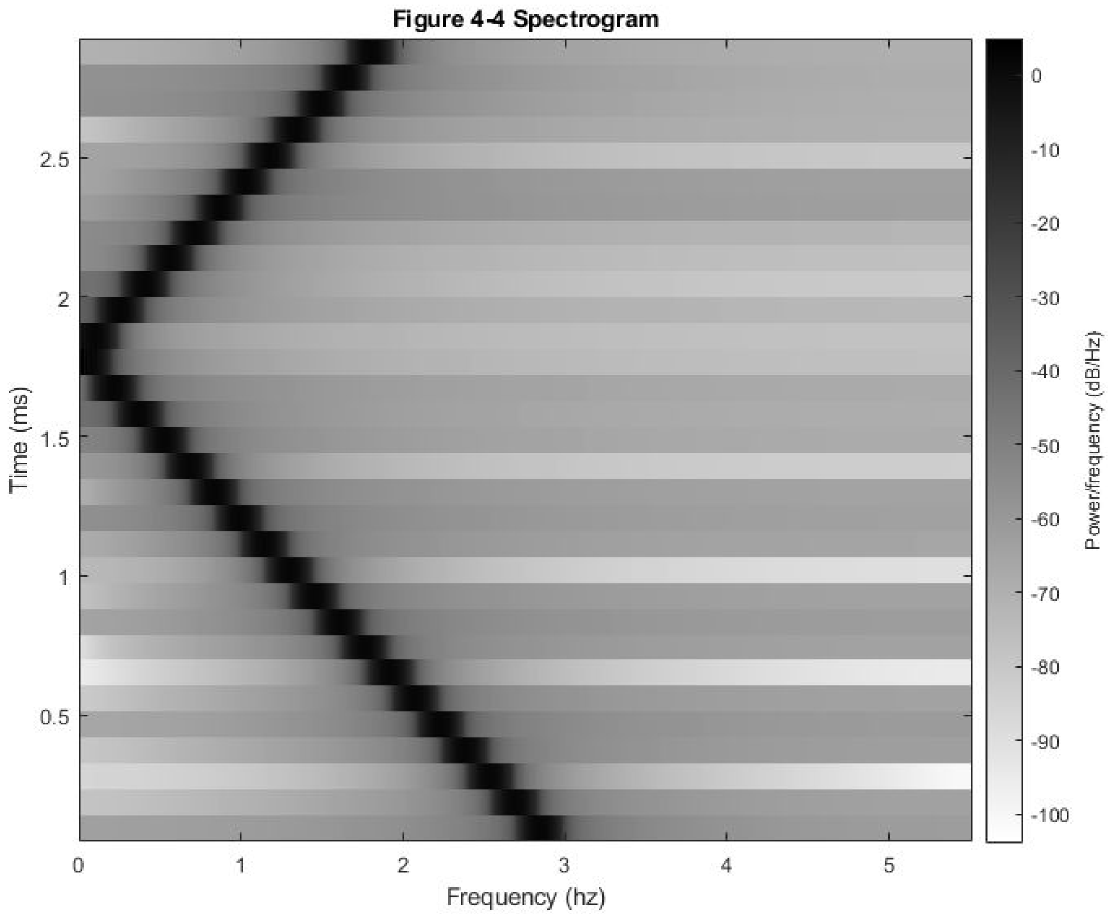


The frequency of the chirp is decreasing over time. Not only that, but the pitch is decreasing linearly. The spectrogram confirms this information.

4-4)



The chirp starts high, goes low, and then goes high again ending at around ⅔ the original frequency.



The spectrogram supports

The spectrogram supports the analysis above. Perhaps the human ear hears negative frequencies at their absolute value or perhaps there only exist positive frequency. The spectrogram shows the pitch rising up to 2000 hz after reaching 0hz.

Conclusion

Matlab will very likely view a negative frequency as a positive frequency, as discovered in the 3000 hz to -2000 hz spectrogram. When a signals frequency changes at a linear rate it is known as a chirp. Two distinct frequencies near a center frequency will produce a high frequency change under the low frequency envelope until they come in tune with each other at the center frequency.