Contents


```
%{
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ECES 352 - Lab 4

%}
clear; clc; close all
```
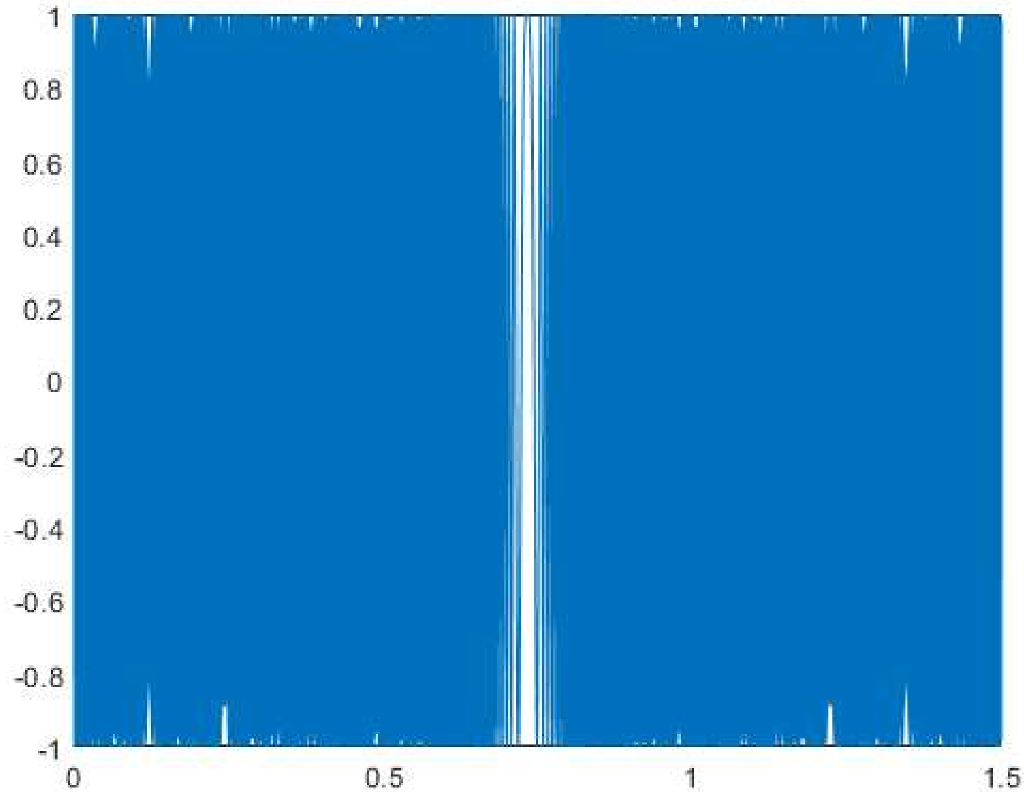

2.4 MATLAB Synthesis of Chirp Signals

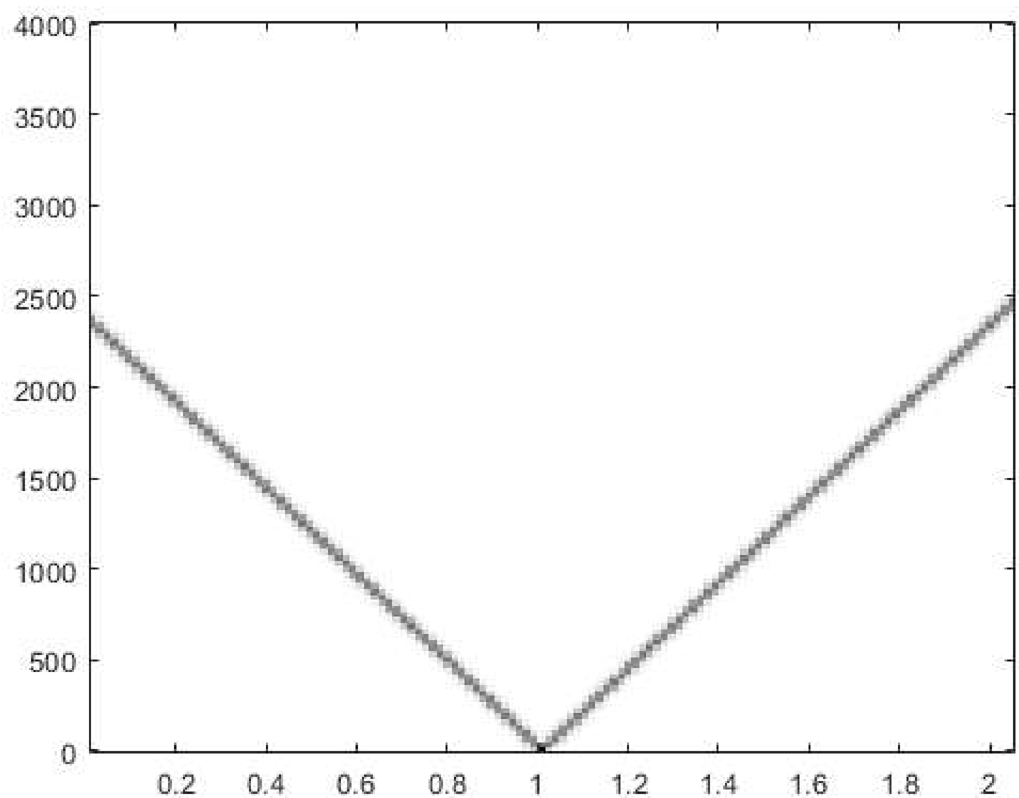
```
fsamp = 11025;
dt = 1/fsamp;
dur = 1.8;
tt = 0 : dt : dur;
psi = 2 * pi * ( 100 + 200 * tt + 500 * tt .* tt );
xx = real( 7.7 * exp(1j * psi) );
soundsc( xx, fsamp );
```

3.2 Function for a Chirp

```
% function [xx, tt] = chirpsyn( f1, f2, dur, fsamp )
f1 = 3300;      % 3300 Hz
f2 = 300;       % 300 Hz
dur = 1.5;      % 1.5 seconds

[xx, tt] = chirpsyn( f1, f2, dur );

figure
plot(tt,xx)
figure
plotspec(xx);
% specgram(xx)
% soundsc(xx)
```

```
PLOTSPEC: Sampling Frequency defaulting to 8000 Hz
```



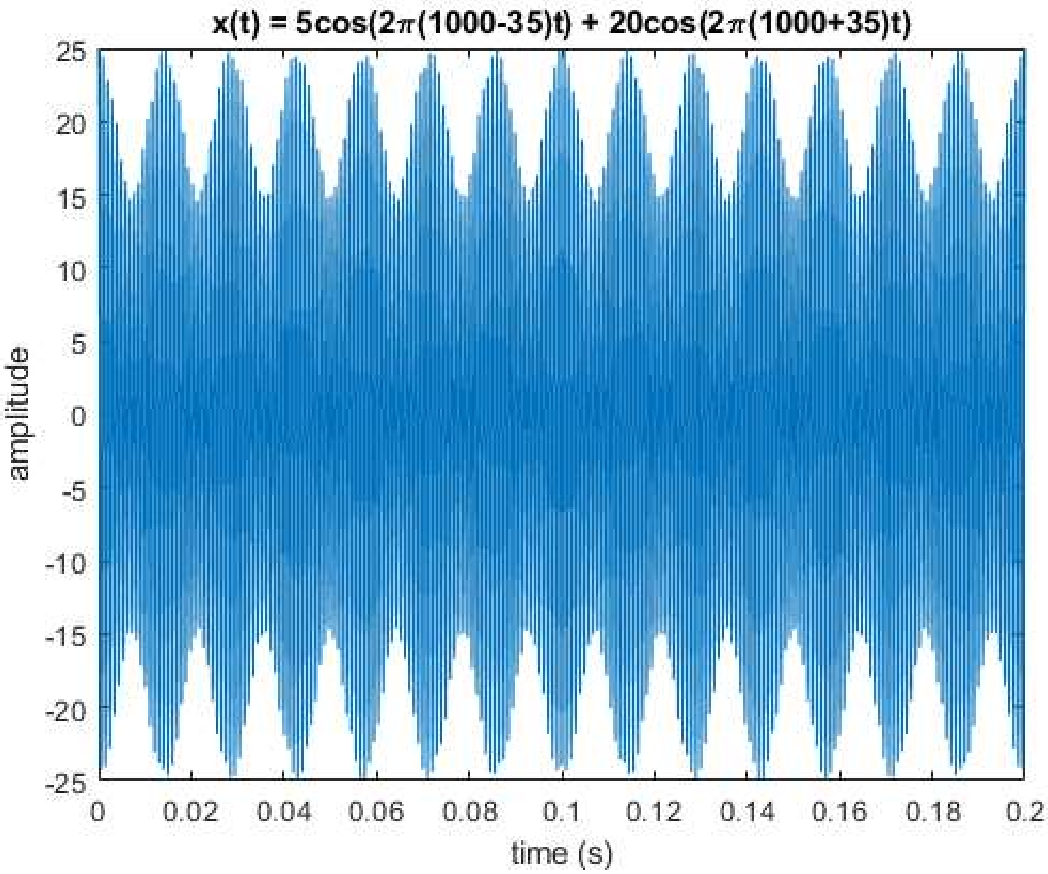


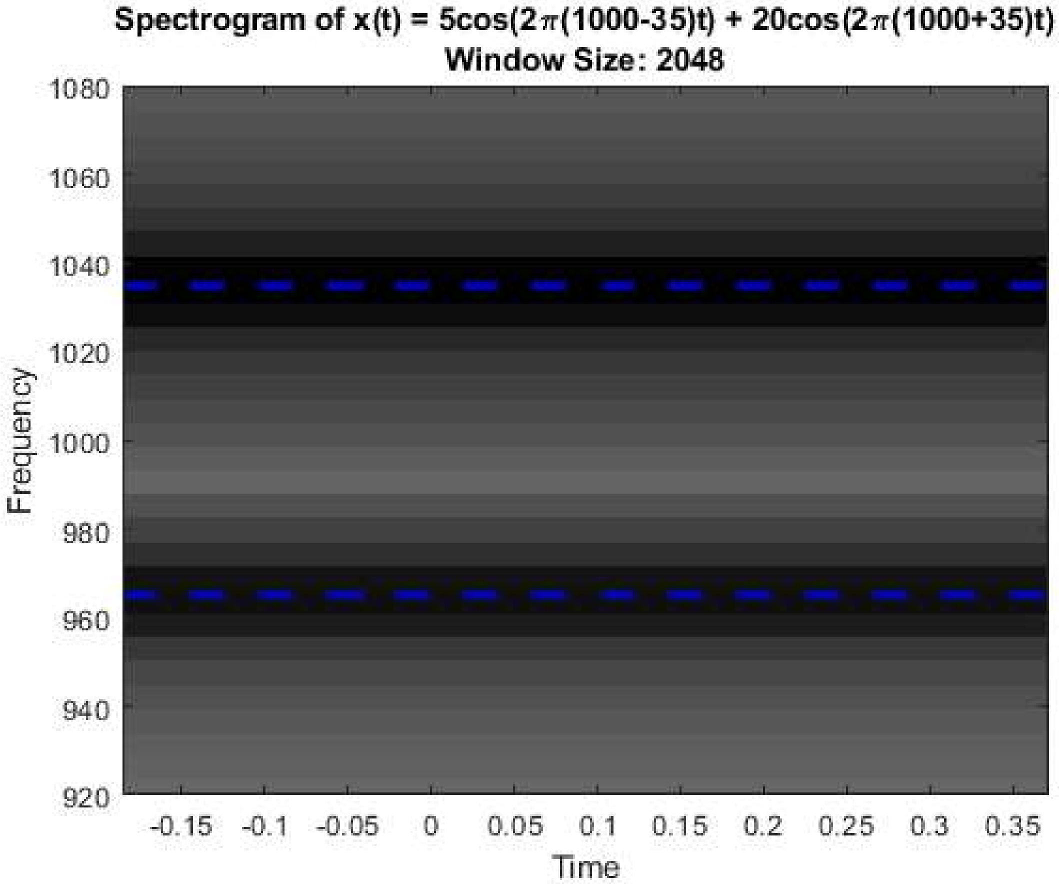
4.1/4.2 Beat Notes & More on Spectrograms

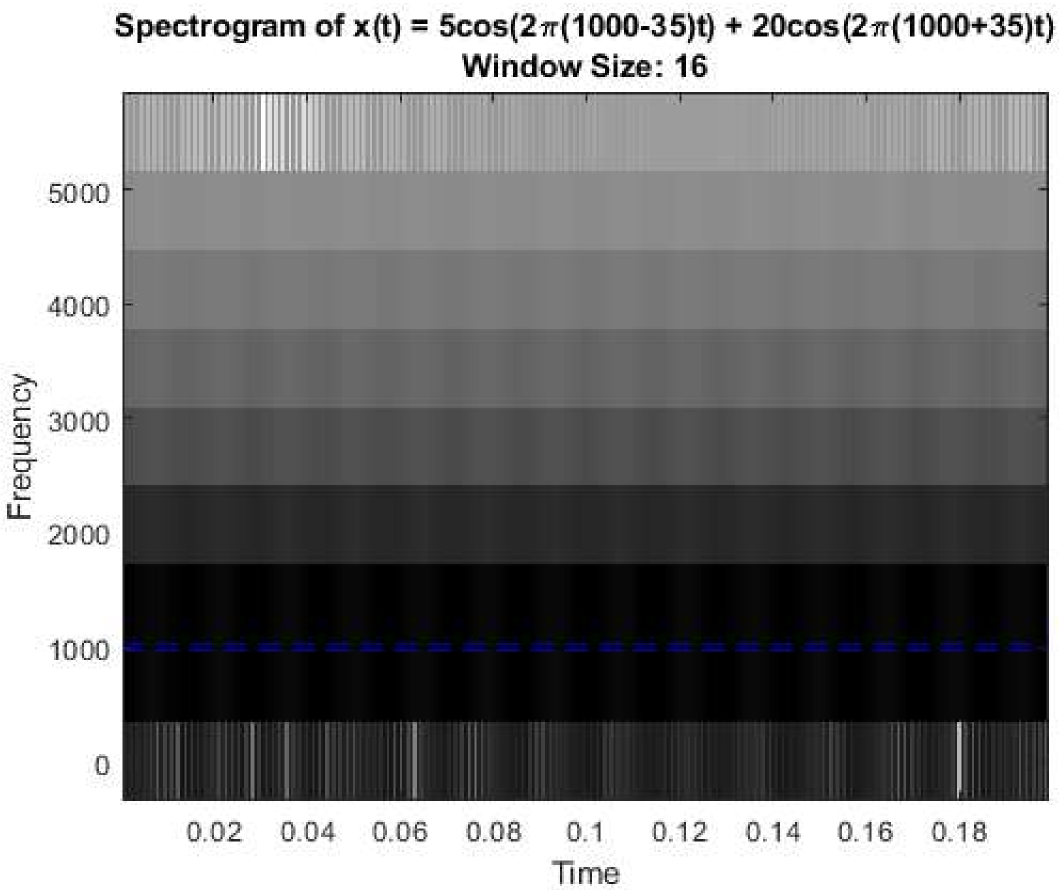
(a)

```
delf = 35;              % 35 Hz
dur = 0.2;              % 0.2 sec
fsamp = 11025;  % 11025 Hz
fc = 1000;              % 1650 Hz
A = 5;
B = 20;

% function [xx, tt] = beat( A, B, fc, delf, fsamp, dur )
[xx, tt] = beat(A, B, fc, delf, fsamp, dur);

figure
plot(tt, xx)
title(['x(t) = ', num2str(A), 'cos(2\pi(', num2str(fc), '-', num2str(delf), ...
        ')t) + ', num2str(B), 'cos(2\pi(', num2str(fc), '+', num2str(delf), ')t)'])
xlabel('time (s)')
ylabel('amplitude')

% (b)
figure
specgram(xx, 2048, fsamp);
colormap(1-gray(256))
title({['Spectrogram of x(t) = ', num2str(A), 'cos(2\pi(', num2str(fc), '-', num2str(delf), .
..
        ')t) + ', num2str(B), 'cos(2\pi(', num2str(fc), '+', num2str(delf), ')t)'], 'Window S
ize: 2048'})
ylim([920 1080])        % zoom into the relevant region with frequency peaks
yline(1035, 'b--', 'LineWidth', 3);
yline(965, 'b--', 'LineWidth', 3);

% There are two significant spikes in the spectrogram plot due to the
% original signal being the sum of two cosines at frequencies 965 and 1035
% Hz respectively
% The frequency plot has been zoomed in so that the user can verify that
% the frequency peaks (denoted by the black horizontal lines) are at the
% correct frequencies (965Hz and 1035Hz). Additionally, there are blue
% dashed lines inserted at the corresponding frequencies.

% Other frequency spectrum plotting functions:
% spectrogram(xx, 1024, 'yaxis')
% plotspec(xx);

% To generate a sound:
% soundsc(xx)

% (b)
figure
specgram(xx, 16, fsamp);
colormap(1-gray(256));
yline(1035, 'b--');
yline(965, 'b--');
title({['Spectrogram of x(t) = ', num2str(A), 'cos(2\pi(', num2str(fc), '-', num2str(delf), .
..
        ')t) + ', num2str(B), 'cos(2\pi(', num2str(fc), '+', num2str(delf), ')t)'], 'Window S
ize: 16'})
```

```
% This spectrogram appears to lose the resolution given in the plot above.
% There are still two blue lines inserted at the frequency peaks however
% they appear to blend together.
```

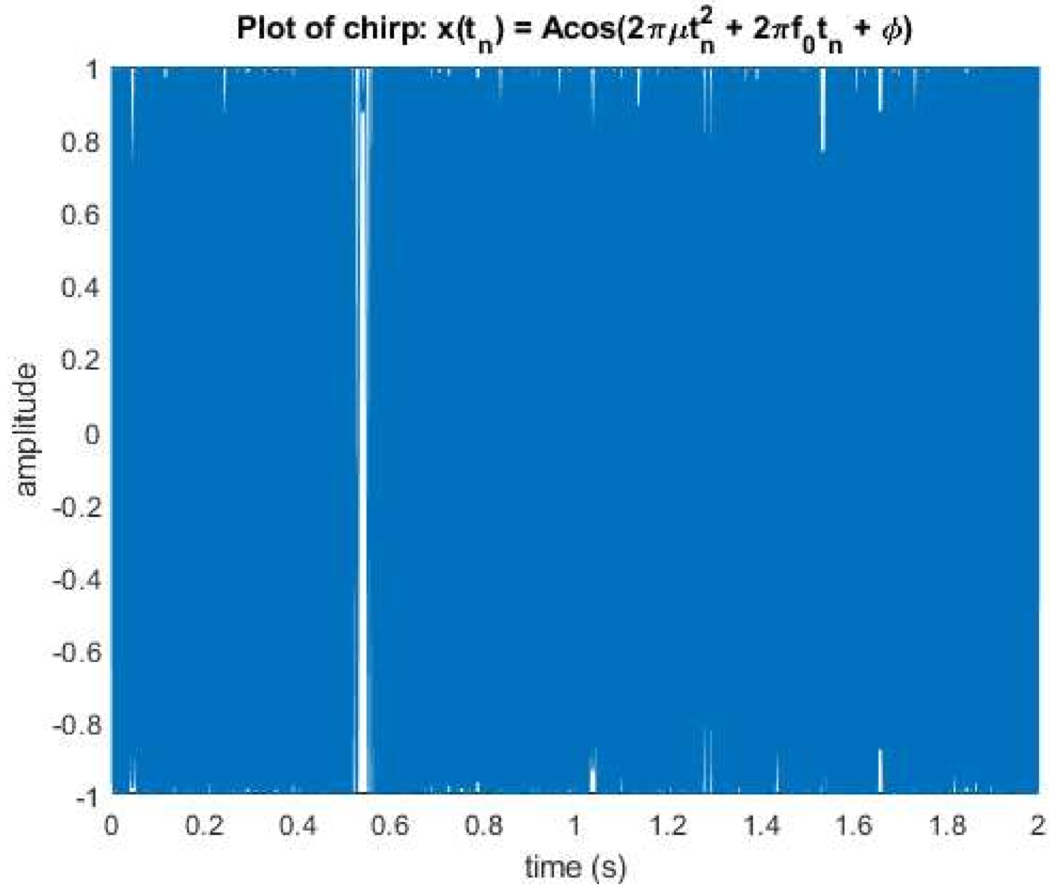


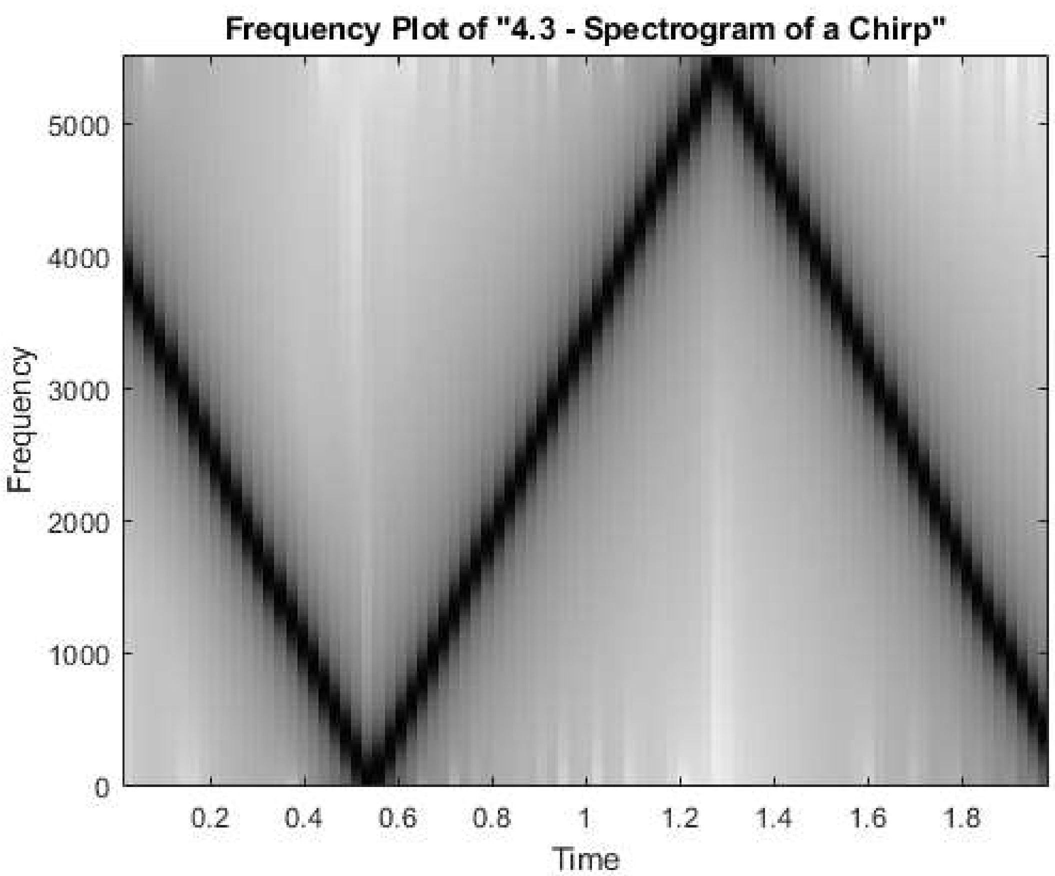




4.3 Spectrogram of a Chirp

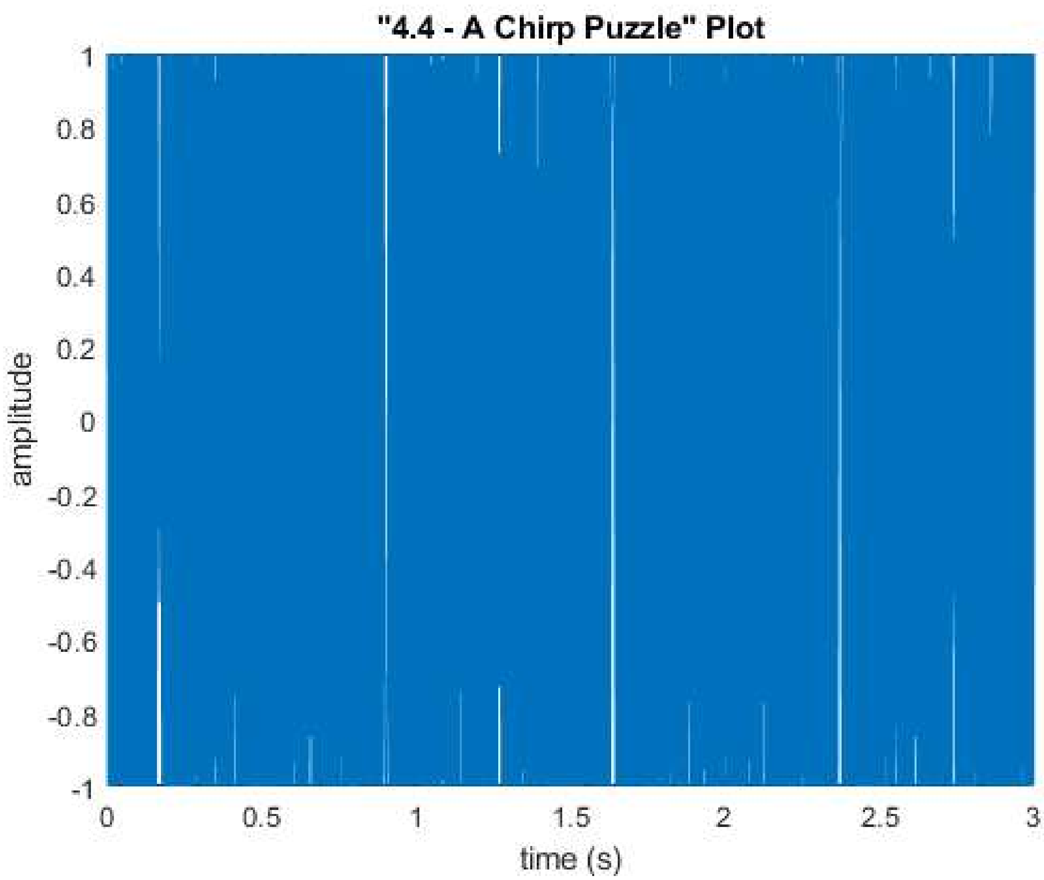
```
% function [xx, tt] = chirpsyn( f1, f2, dur, fsamp )
f1 = 4000;
f2 = 300;
dur = 2;
fsamp = 11025;

[xx, tt] = chirpsyn( f1, f2, dur, fsamp );

figure
plot(tt,xx)
title('Plot of chirp: x(t_n) = Acos(2\pi\mut_n^2 + 2\pif_0t_n + \phi)')
xlabel('time (s)')
ylabel('amplitude')
% It is unknown why the beginning of the time plot is condensed and why the
% signal does not originate at 0. This has been discussed with Taha and we
% are still unable to figure out the reasoning behind this.

figure
specgram(xx, 512, fsamp);
colormap(1-gray(256))
title('Frequency Plot of "4.3 - Spectrogram of a Chirp"')

% plotspec(xx);

% Upon listening to the signal, the chirp appears to go up then down then
% back up. This is likely due to aliasing. Additionally, the signal appears
% to increase and decrease linearly.

% soundsc(xx)
```

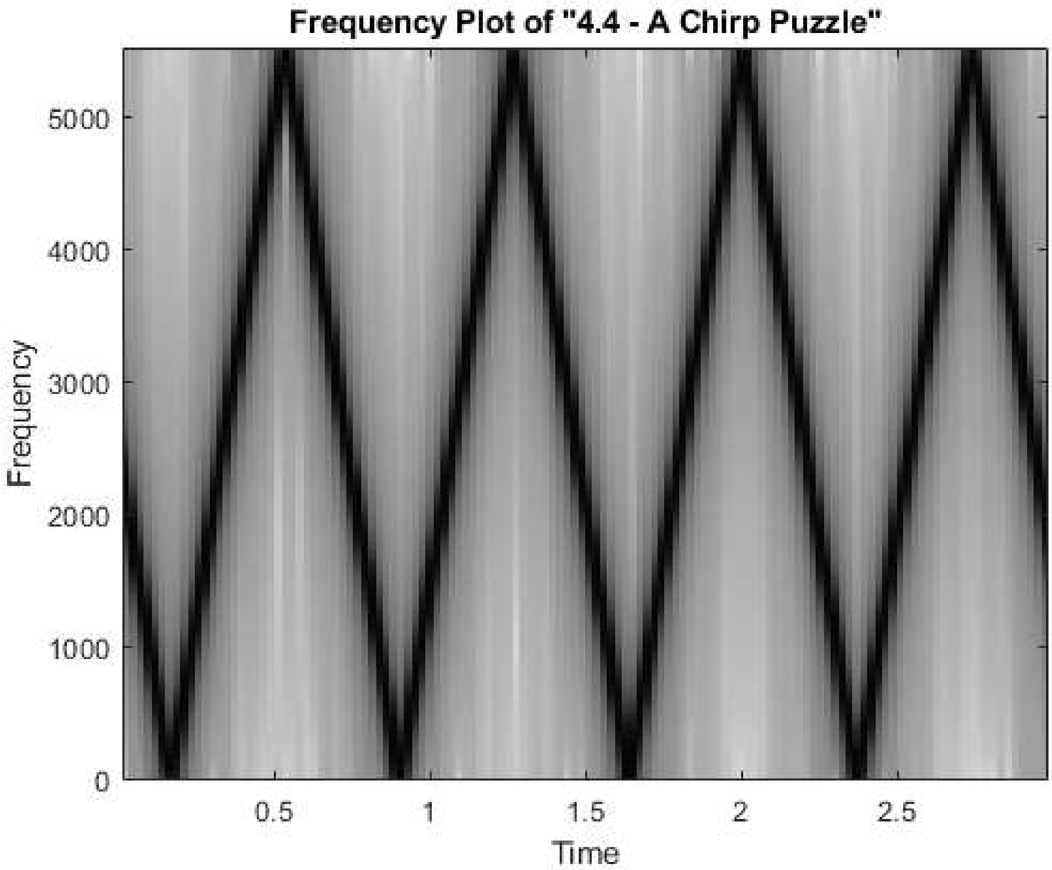




4.4 A Chirp Puzzle

```
% function [xx, tt] = chirpsyn( f1, f2, dur, fsamp )
f1 = -2500;
f2 = 2500;
dur = 3;
fsamp = 11025;

[xx, tt] = chirpsyn( f1, f2, dur, fsamp );

figure
plot(tt,xx)
title('"4.4 - A Chirp Puzzle" Plot')
xlabel('time (s)')
ylabel('amplitude')

figure
specgram(xx, 512, fsamp);
colormap(1-gray(256))
title('Frequency Plot of "4.4 - A Chirp Puzzle"')

% plotspec(xx);

% The signal appears to go both up and down.
% soundsc(xx)
```




Frequency Plot of "4.4 - A Chirp Puzzle"
Frequency
5000
4000
3000
2000
1000
0
0.5
1
1.5
2
2.5
Time