```
% Part 1
```

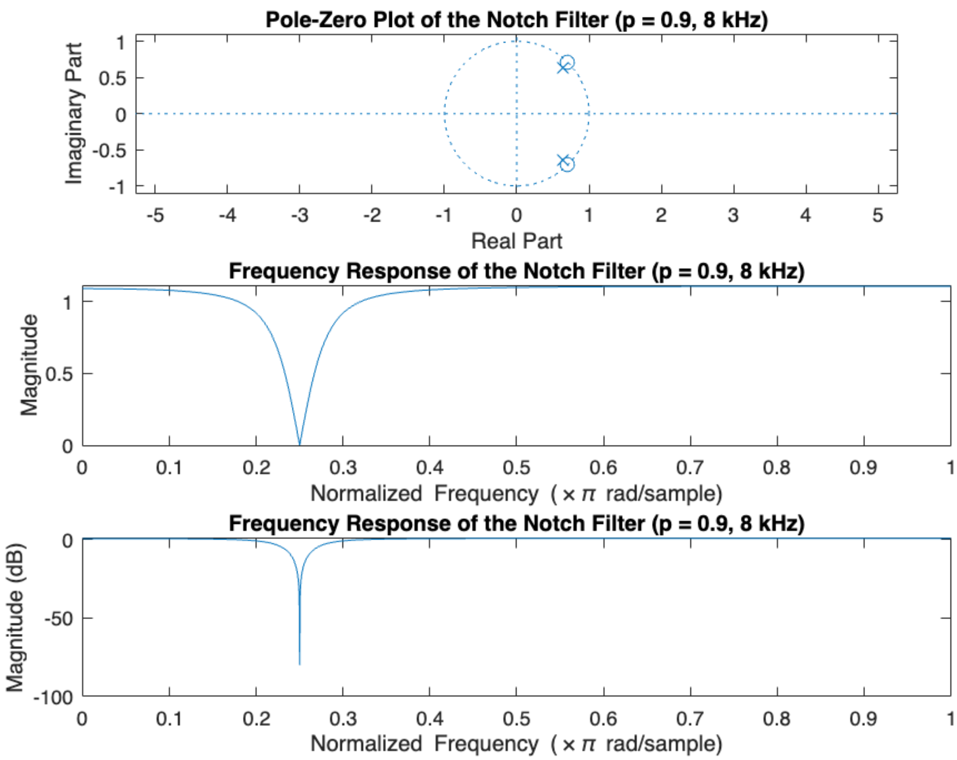
```
file1 = 'Bambi1.wav';
[y1, fs1] = audioread(file1);
sound(y1, fs1);
```

```
file2 = 'freqSweep.wav';
[y2, fs2] = audioread(file2);
sound(y2, fs2);
```

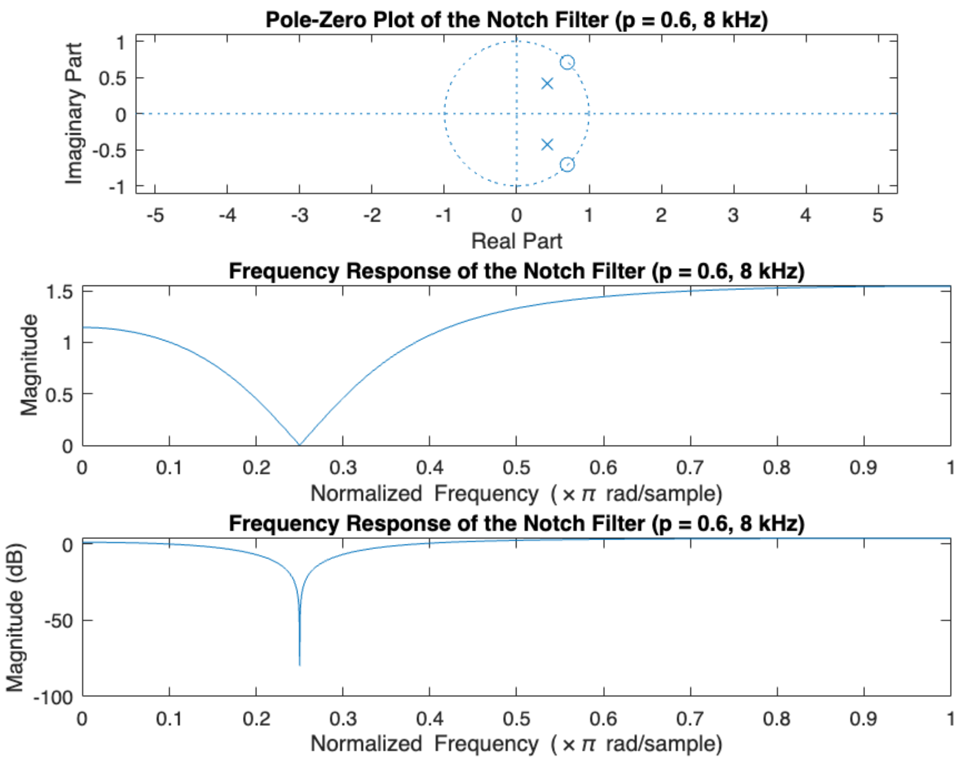
```
file3 = 'alarm.mp3';
[y3, fs3] = audioread(file3);
sound(y3, fs3);
y3 = y3(1:length(y3)/16,1);
```

```
Warning: Integer operands are required for colon operator when used as index.
```

```
% Sampling frequency of 8 kHz
fs = 8000;
fo = 1000;
wo = 2*pi*fo/fs;

% Get filter coefficients for p = 0.9
p = 0.9;
b1 = [1, -2*cos(wo), 1];
a1 = [1, -2*p*cos(wo), p^2];

figure;
subplot(3, 1, 1);
zplane(b1, a1);
title('Pole-Zero Plot of the Notch Filter (p = 0.9, 8 kHz)');

subplot(3, 1, 2);
[h, w] = freqz(b1, a1, 2048);
plot(w/pi, abs(h));
title('Frequency Response of the Notch Filter (p = 0.9, 8 kHz)');
xlabel('Normalized Frequency (\times\pi rad/sample)');
ylabel('Magnitude');

subplot(3, 1, 3);
plot(w/pi, 20*log10(abs(h)+0.0001));
title('Frequency Response of the Notch Filter (p = 0.9, 8 kHz)');
xlabel('Normalized Frequency (\times\pi rad/sample)');
ylabel('Magnitude (dB)');
```




```
% Get filter coefficients for p = 0.6
p = 0.6;
b2 = [1, -2*cos(wo), 1];
a2 = [1, -2*p*cos(wo), p^2];

figure;
subplot(3, 1, 1);
zplane(b2, a2);
title('Pole-Zero Plot of the Notch Filter (p = 0.6, 8 kHz)');

subplot(3, 1, 2);
[h, w] = freqz(b2, a2, 2048);
plot(w/pi, abs(h));
title('Frequency Response of the Notch Filter (p = 0.6, 8 kHz)');
xlabel('Normalized Frequency (\times\pi rad/sample)');
ylabel('Magnitude');

subplot(3, 1, 3);
plot(w/pi, 20*log10(abs(h)+0.0001));
title('Frequency Response of the Notch Filter (p = 0.6, 8 kHz)');
xlabel('Normalized Frequency (\times\pi rad/sample)');
ylabel('Magnitude (dB)');
```




```
% Apply the notch filter to the Bambi1.wav file
y1_filtered1 = filter(b1, a1, y1);
y1_filtered2 = filter(b2, a2, y1);
```

```
sound(y1_filtered1, fs1);
```

```
sound(y1_filtered2, fs1);
```

```
% Apply notch filter to the freqSweep.wav file
y2_filtered1 = filter(b1, a1, y2);
y2_filtered2 = filter(b2, a2, y2);
```

```
sound(y2_filtered1, fs2);
```

```
sound(y2_filtered2, fs2);
```

```
% Apply the notch filter to alarm.mp3 file
y3_filtered1 = filter(b1, a1, y3);
y3_filtered2 = filter(b2, a2, y3);
```

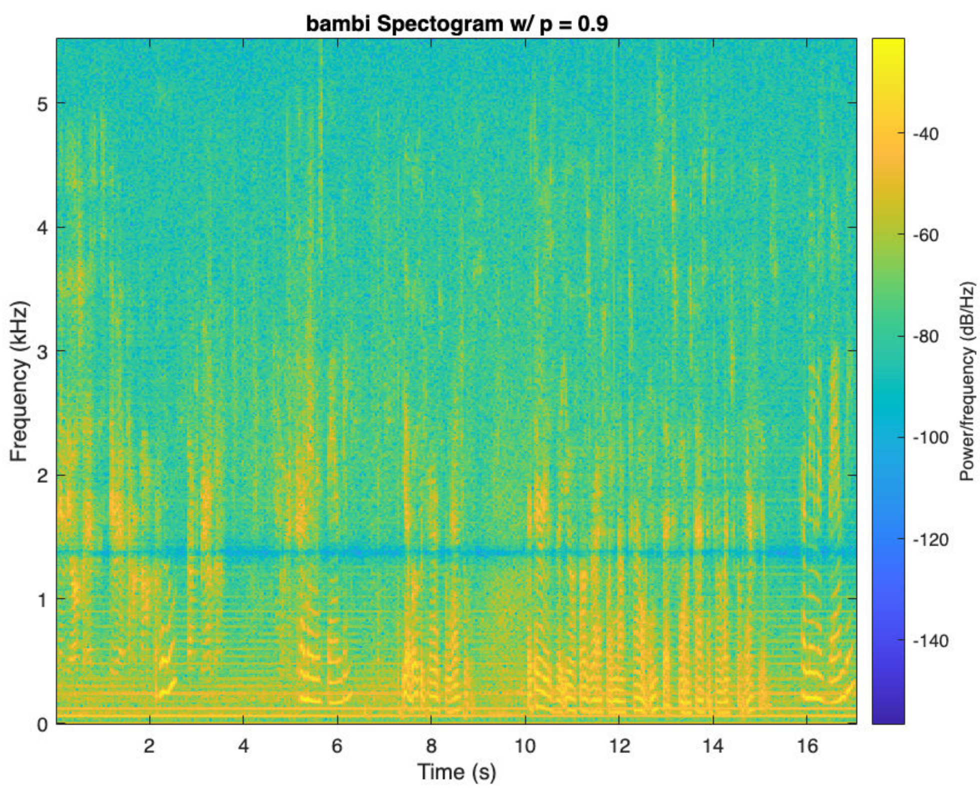
```
sound(y3_filtered1, fs3);
```

```
sound(y3_filtered2, fs3);
```

```
fprintf("The filters sound the same as the actual signals. \n" + ...
    "This is likely due to the fact that were only notching out a particular frequency. \n" + ...
    "Surrounding frequencies are not affected enough to make a noticable difference to the overall sound.")
```

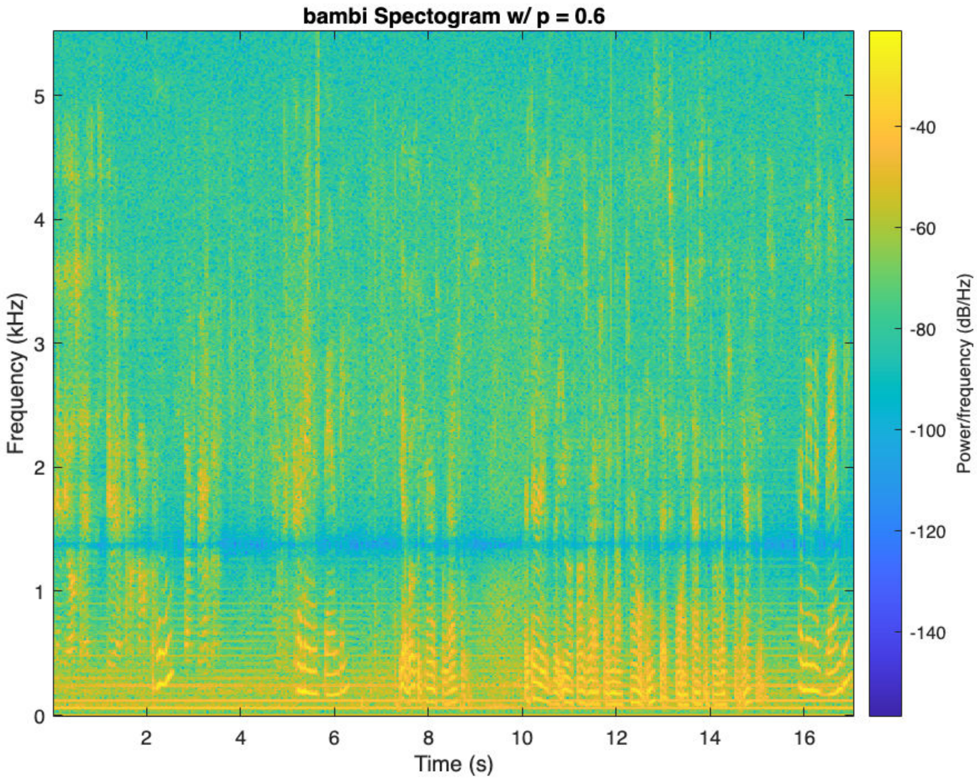
```
The filters sound the same as the actual signals.
This is likely due to the fact that were only notching out a particular frequency.
Surrounding frequencies are not affected enough to make a noticable difference to the overall sound.
```

```
% Spectogram of filtered bambi signal
sp_win = 1024;
sp_ovr = 512;
sp_fftN = 1024;

figure;
spectrogram(y1_filtered1, sp_win, sp_ovr, sp_fftN, fs1, 'yaxis')
title('bambi Spectogram w/ p = 0.9')
```




```
figure;
```

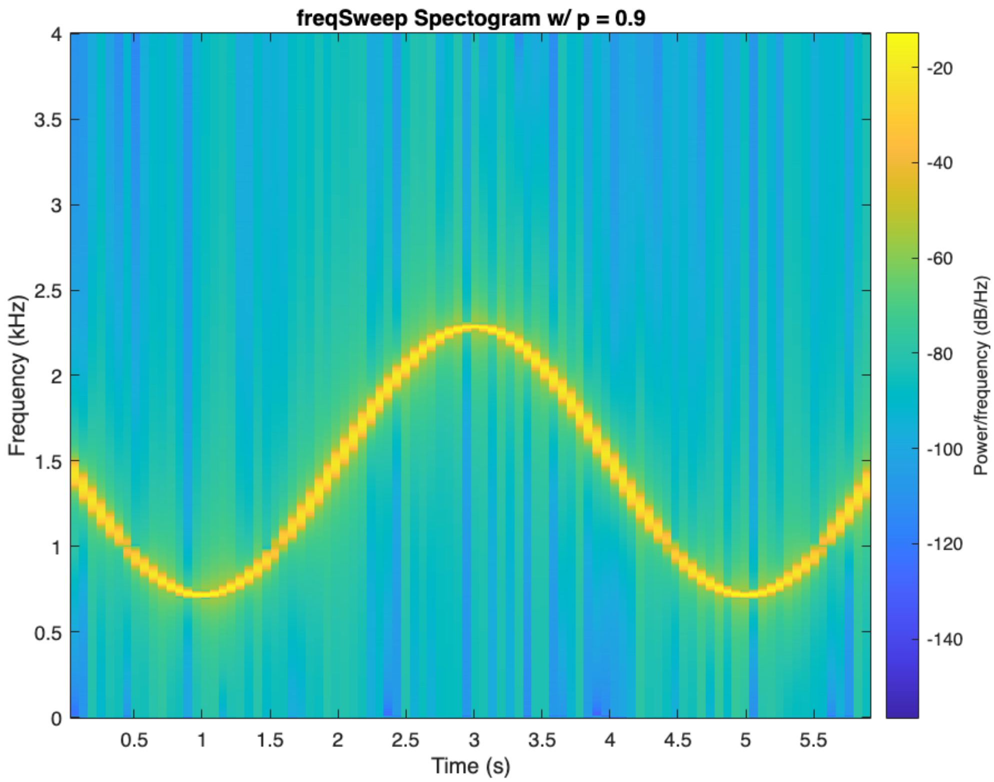
```
spectrogram(y1_filtered2, sp_win, sp_ovr, sp_fftN, fs1, 'yaxis')
title('bambi Spectogram w/ p = 0.6')
```



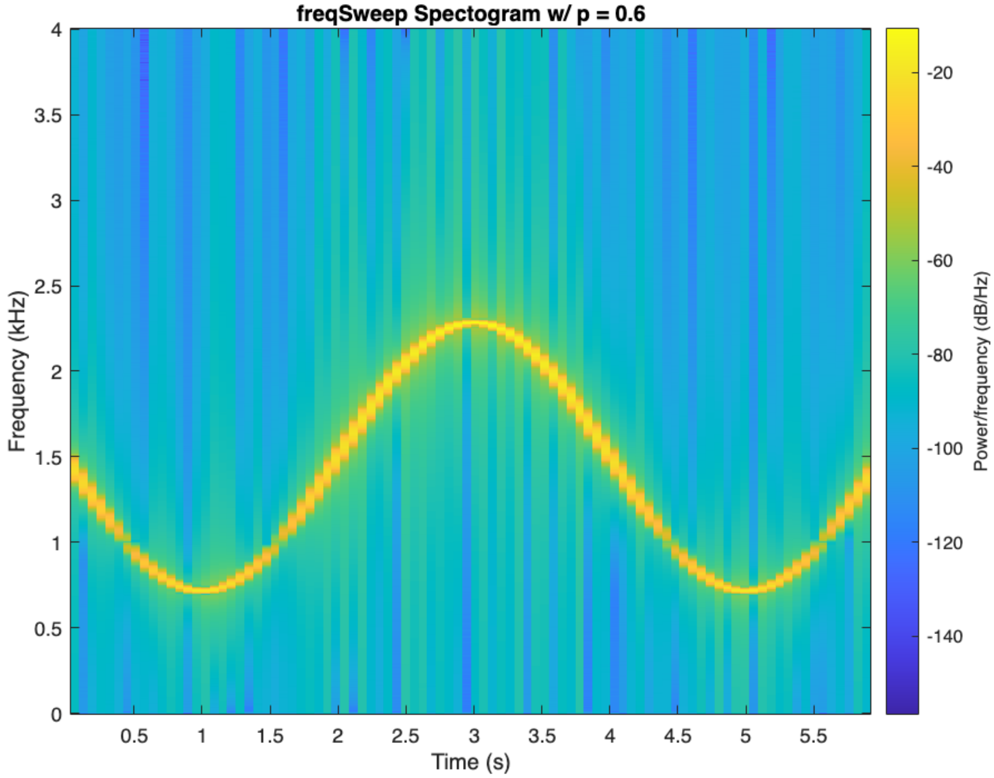

```
fprintf("The 1000 Hz frequency is being attenuated. This is reflected in
the spectogram with a horizontal line through the signal.")
```

```
The 1000 Hz frequency is being attenuated. This is reflected in the spectogram with a horizontal line thro
```

```
% Spectogram of filtered freqSweep signal
sp_win = 1024;
sp_ovr = 512;
sp_fftN = 1024;

figure;
spectrogram(y2_filtered1, sp_win, sp_ovr, sp_fftN, fs2, 'yaxis')
title('freqSweep Spectogram w/ p = 0.9')
```



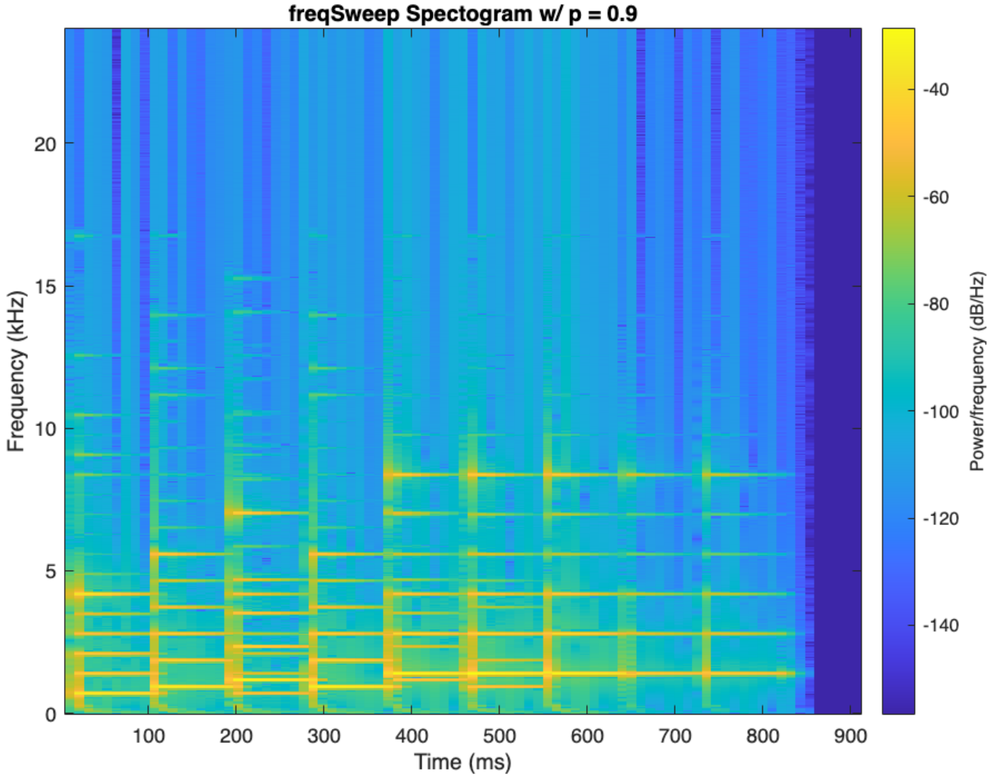

```
figure;
spectrogram(y2_filtered2, sp_win, sp_ovr, sp_fftN, fs2, 'yaxis')
title('freqSweep Spectogram w/ p = 0.6')
```



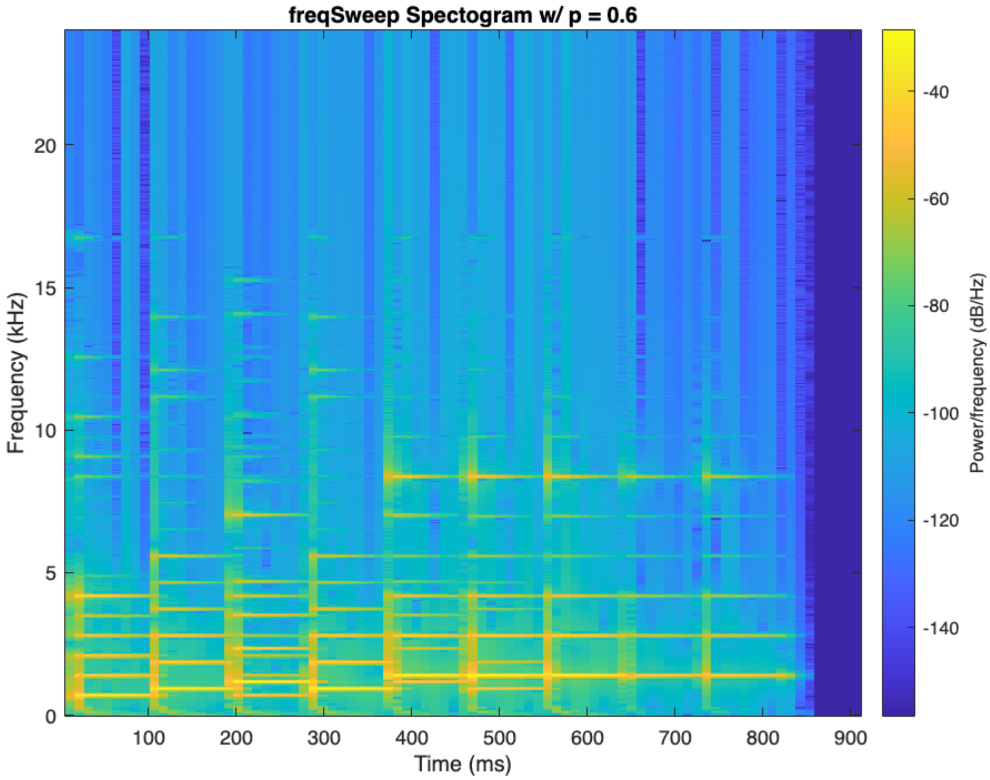

```
fprintf("The 1000 Hz frequency is being attenuated. This is reflected in
the spectogram with a horizontal line through the signal.")
```

```
The 1000 Hz frequency is being attenuated. This is reflected in the spectogram with a horizontal line thro
```

```
% Spectogram of filtered alarm signal
sp_win = 1024;
sp_ovr = 512;
sp_fftN = 1024;

figure;
spectrogram(y3_filtered1, sp_win, sp_ovr, sp_fftN, fs3, 'yaxis')
title('freqSweep Spectogram w/ p = 0.9')
```




```
figure;
spectrogram(y3_filtered2, sp_win, sp_ovr, sp_fftN, fs3, 'yaxis')
title('freqSweep Spectogram w/ p = 0.6')
```

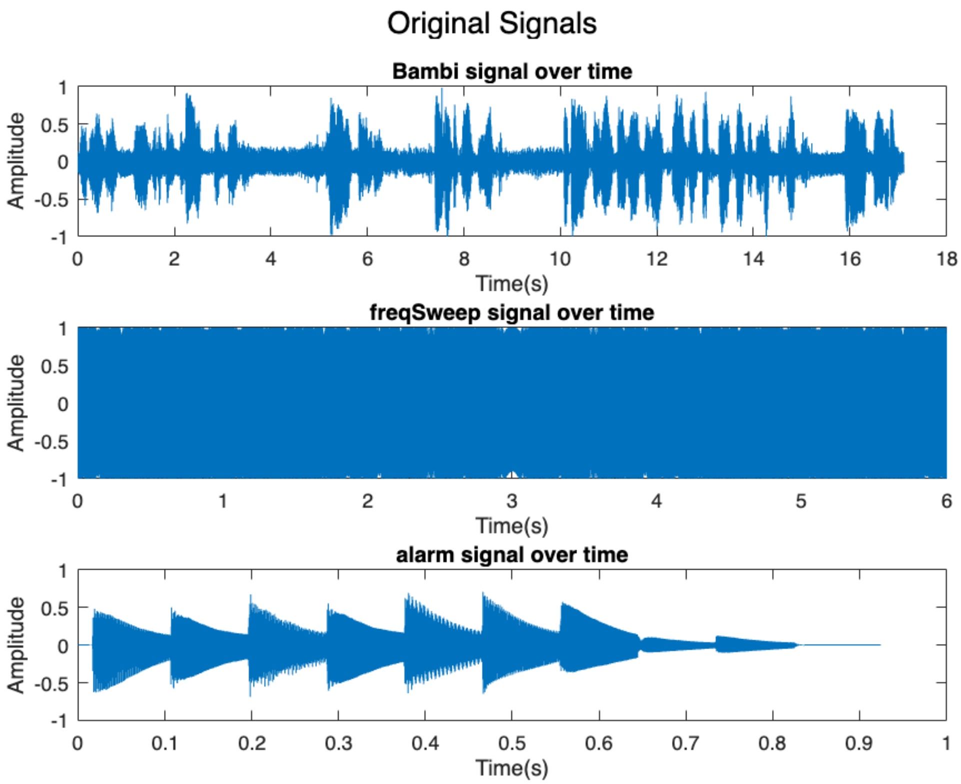



```
fprintf("The 1000 Hz frequency is being attenuated. This is reflected in
the spectogram with a horizontal line through the signal.")
```

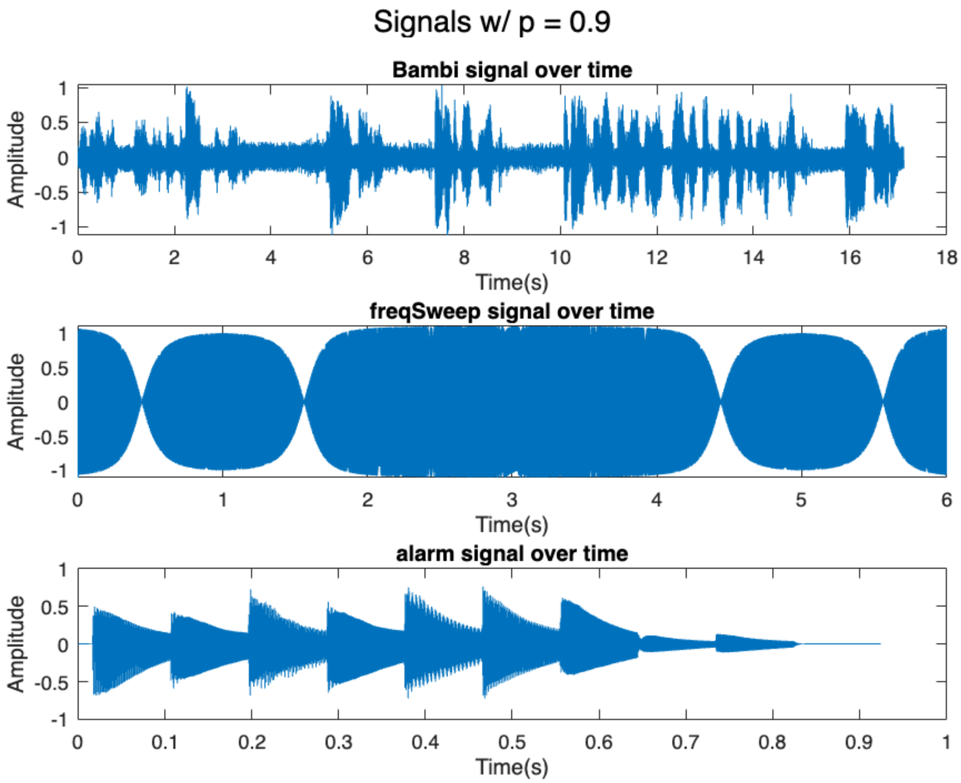
```
The 1000 Hz frequency is being attenuated. This is reflected in the spectogram with a horizontal line thro
```

```
t1 = 0:1/fs1:1/fs1*(length(y1)-1);
t2 = 0:1/fs2:1/fs2*(length(y2)-1);
t3 = 0:1/fs3:1/fs3*(length(y3)-1);

figure;
sgtitle('Original Signals')
subplot(3, 1, 1);
plot(t1, y1);
title("Bambi signal over time");
xlabel("Time(s)");
ylabel("Amplitude");

subplot(3, 1, 2);
plot(t2, y2);
title("freqSweep signal over time");
xlabel("Time(s)");
ylabel("Amplitude");

subplot(3, 1, 3);
```

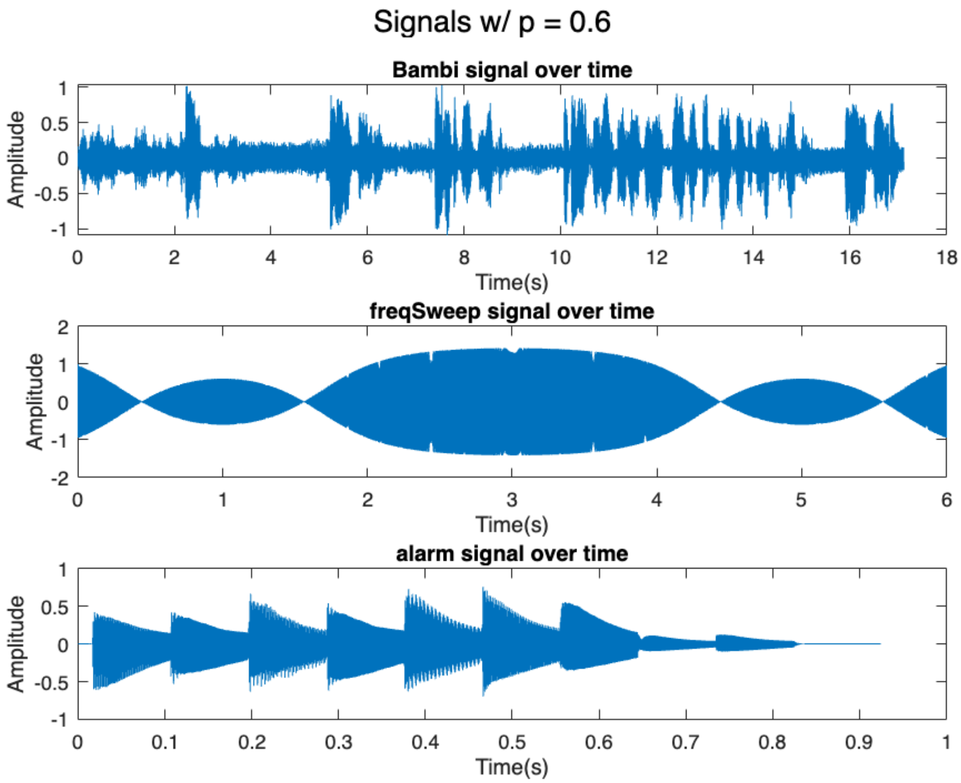
```
plot(t3, y3);
title("alarm signal over time");
xlabel("Time(s)");
ylabel("Amplitude");
```




```
figure;
sgtitle('Signals w/ p = 0.9')
subplot(3, 1, 1);
plot(t1, y1_filtered1);
title("Bambi signal over time");
xlabel("Time(s)");
ylabel("Amplitude");

subplot(3, 1, 2);
plot(t2, y2_filtered1);
title("freqSweep signal over time");
xlabel("Time(s)");
ylabel("Amplitude");

subplot(3, 1, 3);
plot(t3, y3_filtered1);
title("alarm signal over time");
xlabel("Time(s)");
ylabel("Amplitude");
```




```
figure;
sgtitle('Signals w/ p = 0.6')
subplot(3, 1, 1);
plot(t1, y1_filtered2);
title("Bambi signal over time");
xlabel("Time(s)");
ylabel("Amplitude");

subplot(3, 1, 2);
plot(t2, y2_filtered2);
title("freqSweep signal over time");
xlabel("Time(s)");
ylabel("Amplitude");

subplot(3, 1, 3);
plot(t3, y3_filtered2);
title("alarm signal over time");
xlabel("Time(s)");
ylabel("Amplitude");
```

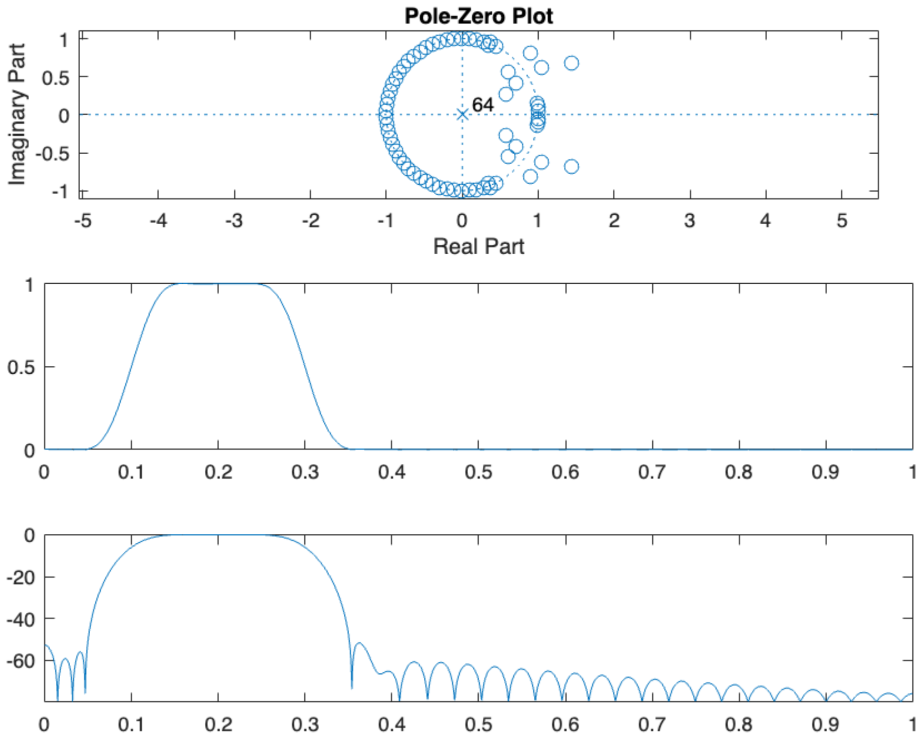



```
% For the speech signal there isn't an overall difference in amplitudes.
% For the freqsweep signal, the highest values are values outside of
% 1000Hz. 1000Hz is where the amplitude is the smallest.
```

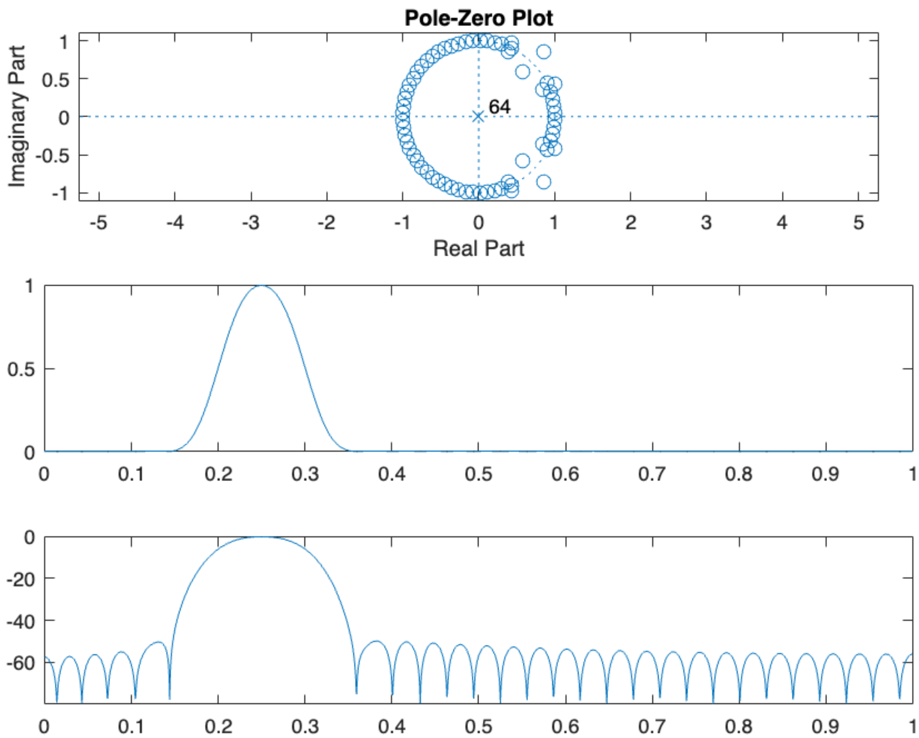
```
% Part 2
```

```
% Bandpass filter w/ f1 = 400 and f2 = 1200
fs = 8000;
f1 = 400;
f2 = 1200;

w1 = 2*f1/fs;
w2 = 2*f2/fs;

[b1,a1] = fir1(64, [w1,w2],'BANDPASS');
figure;
subplot(3,1,1);
zplane(b1,a1);

subplot(3,1,2)
[h, w] = freqz(b1,a1, 2048);
plot(w/pi, abs(h))
```

```
subplot(3,1,3);
plot(w/pi, 20*log10(abs(h)+0.0001))
```




```
% Bandpass filter w/ f1 = 800 and f2 = 1200
fs = 8000;
f1 = 800;
f2 = 1200;

w1 = 2*f1/fs;
w2 = 2*f2/fs;

[b2,a2] = fir1(64, [w1,w2],'BANDPASS');
figure;
subplot(3,1,1);
zplane(b2,a2);

subplot(3,1,2)
[h, w] = freqz(b2,a2, 2048);
plot(w/pi, abs(h))

subplot(3,1,3);
plot(w/pi, 20*log10(abs(h)+0.0001))
```




```
% Bambi sound w/ bandpass filter 1
y1_bp1 = filter(b2,a2,y1);
sound(y1_bp1,fs1);
```

```
% Bambi sound w/ bandpass filter 2
y1_bp2 = filter(b2,a2,y1);
sound(y1_bp2,fs1);
```

```
% freqSweep sound w/ bandpass filter 1
y2_bp1 = filter(b1, a1, y2);
sound(y2_bp1,fs2);
```

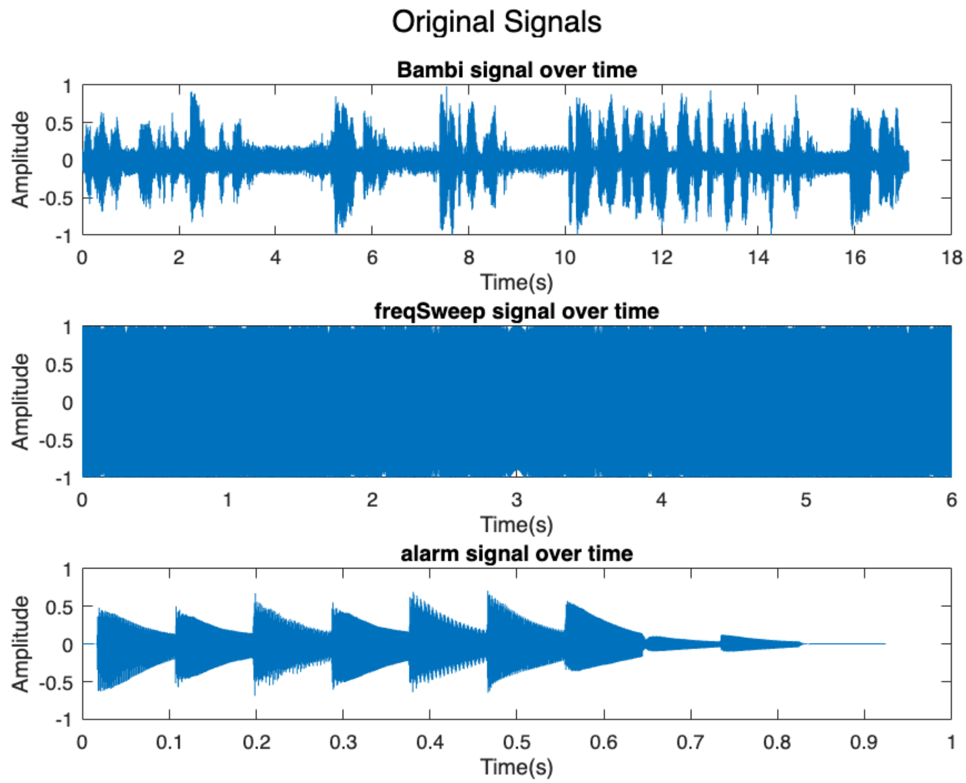
```
% freqSweep sound w/ bandpass filter 2
y2_bp2 = filter(b2, a2, y2);
sound(y2_bp2,fs2);
```

```
% alarm sound w/ bandpass filter 1
y3_bp1 = filter(b1, a1, y3);
sound(y3_bp1,fs3);
```

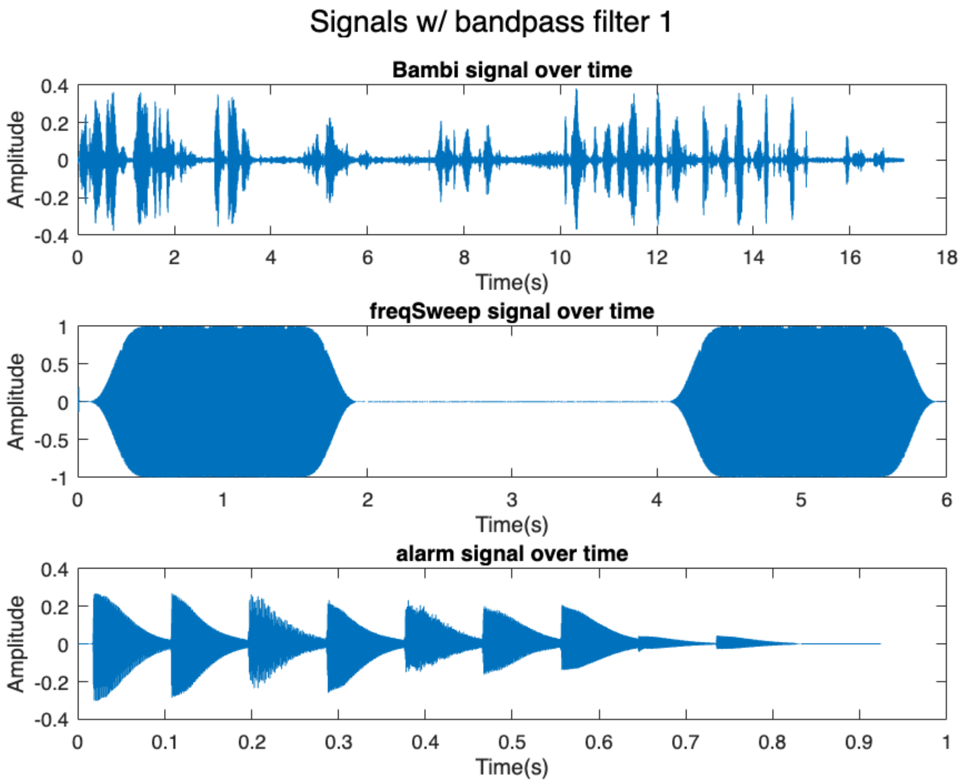
```
% alarm sound w/ bandpass filter 2
```

```
y3_bp2 = filter(b2, a2, y3);
sound(y3_bp2,fs3);
```

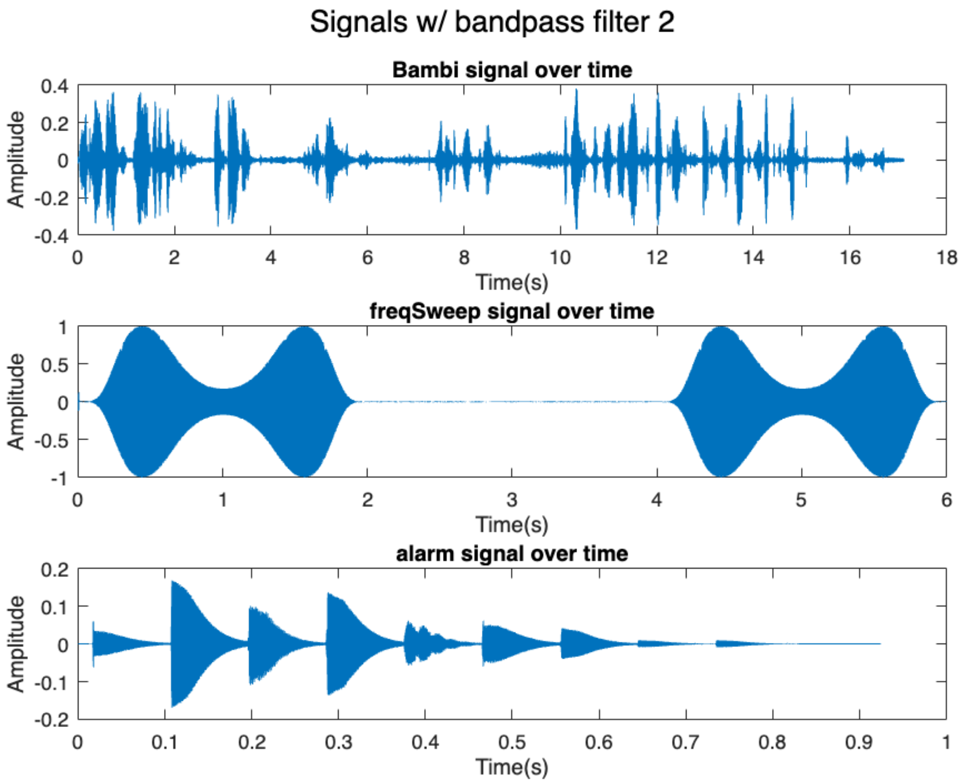
```
% Output signals

t1 = 0:1/fs1:1/fs1*(length(y1)-1);
t2 = 0:1/fs2:1/fs2*(length(y2)-1);
t3 = 0:1/fs3:1/fs3*(length(y3)-1);

figure;
sgtitle('Original Signals')
subplot(3, 1, 1);
plot(t1, y1);
title("Bambi signal over time");
xlabel("Time(s)");
ylabel("Amplitude");

subplot(3, 1, 2);
plot(t2, y2);
title("freqSweep signal over time");
xlabel("Time(s)");
ylabel("Amplitude");

subplot(3, 1, 3);
plot(t3, y3);
title("alarm signal over time");
xlabel("Time(s)");
ylabel("Amplitude");
```




```
figure;
sgtitle('Signals w/ bandpass filter 1')
subplot(3, 1, 1);
plot(t1, y1_bp1);
title("Bambi signal over time");
xlabel("Time(s)");
ylabel("Amplitude");

subplot(3, 1, 2);
plot(t2, y2_bp1);
title("freqSweep signal over time");
xlabel("Time(s)");
ylabel("Amplitude");

subplot(3, 1, 3);
plot(t3, y3_bp1);
title("alarm signal over time");
xlabel("Time(s)");
ylabel("Amplitude");
```

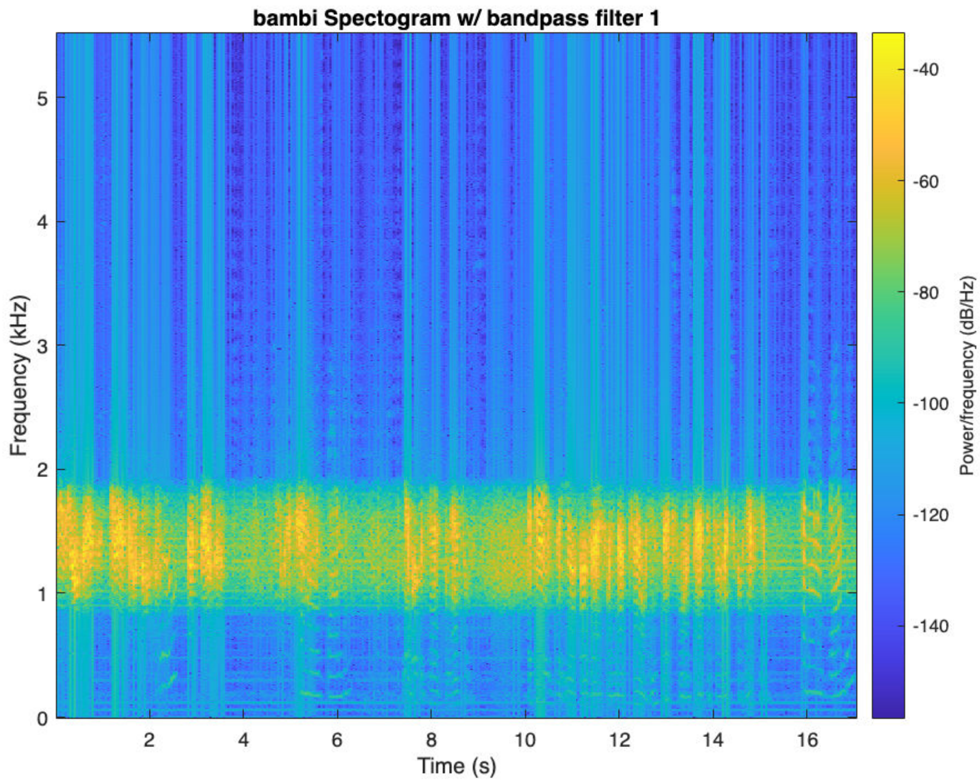



```
figure;
sgtitle('Signals w/ bandpass filter 2')
subplot(3, 1, 1);
plot(t1, y1_bp2);
title("Bambi signal over time");
xlabel("Time(s)");
ylabel("Amplitude");

subplot(3, 1, 2);
plot(t2, y2_bp2);
title("freqSweep signal over time");
xlabel("Time(s)");
ylabel("Amplitude");

subplot(3, 1, 3);
plot(t3, y3_bp2);
title("alarm signal over time");
xlabel("Time(s)");
ylabel("Amplitude");
```

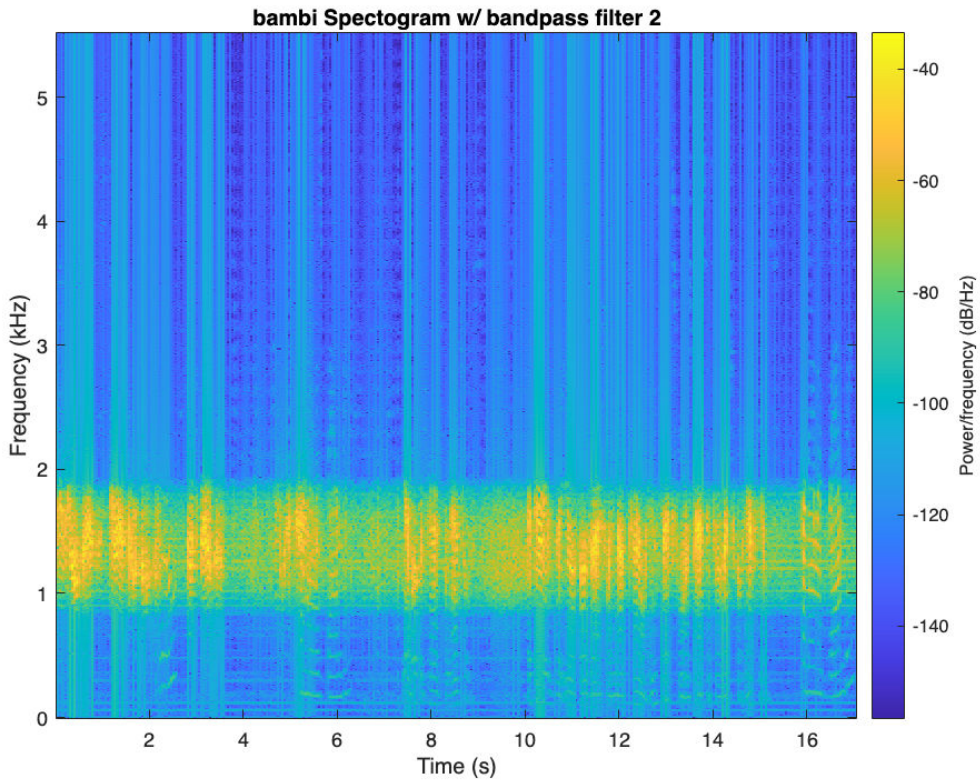



```
% The output is highly attenuated outside of the bandpass/bandstop
frequencies which
% is what we'd expect.

% For the filtered speech signal, it still looks relativley the same as the
original
```

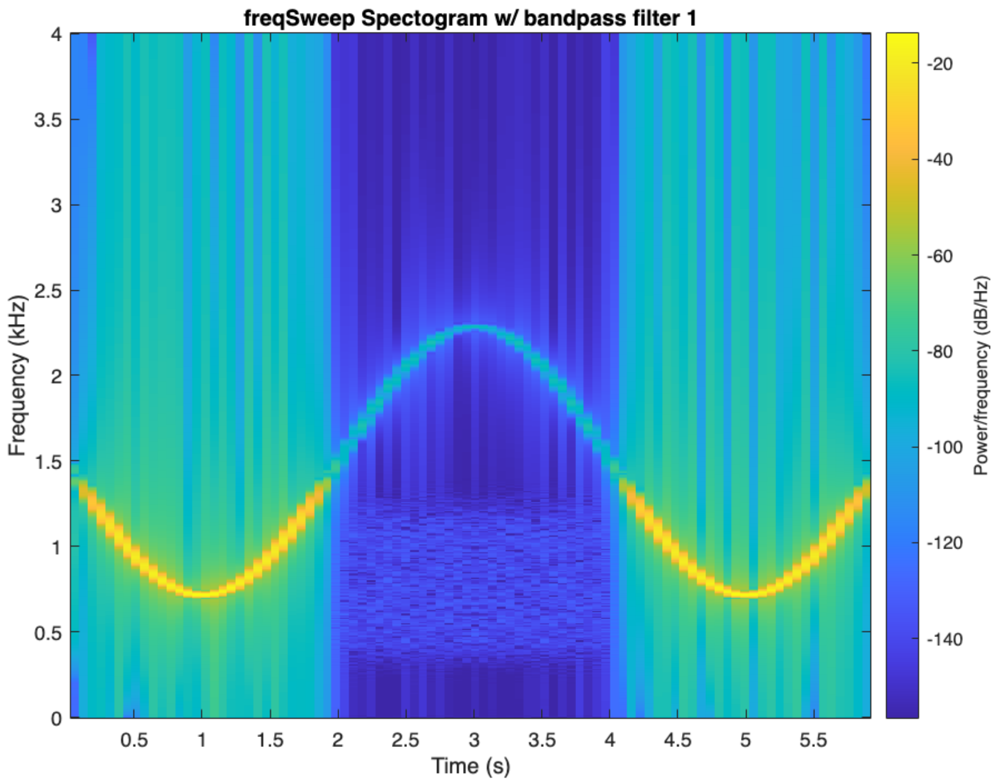
```
% Spectogram of filtered bambi signal
sp_win = 1024;
sp_ovr = 512;
sp_fftN = 1024;

figure;
spectrogram(y1_bp1, sp_win, sp_ovr, sp_fftN, fs1, 'yaxis')
title('bambi Spectogram w/ bandpass filter 1')
```



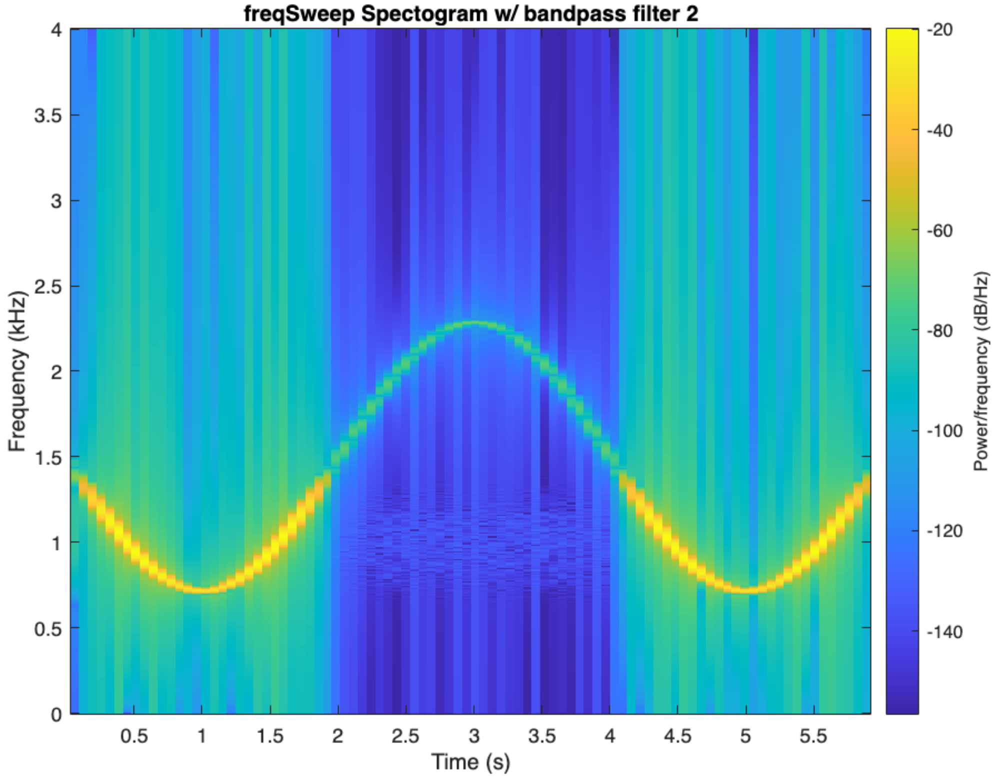

```
figure;
spectrogram(y1_bp2, sp_win, sp_ovr, sp_fftN, fs1, 'yaxis')
title('bambi Spectogram w/ bandpass filter 2')
```



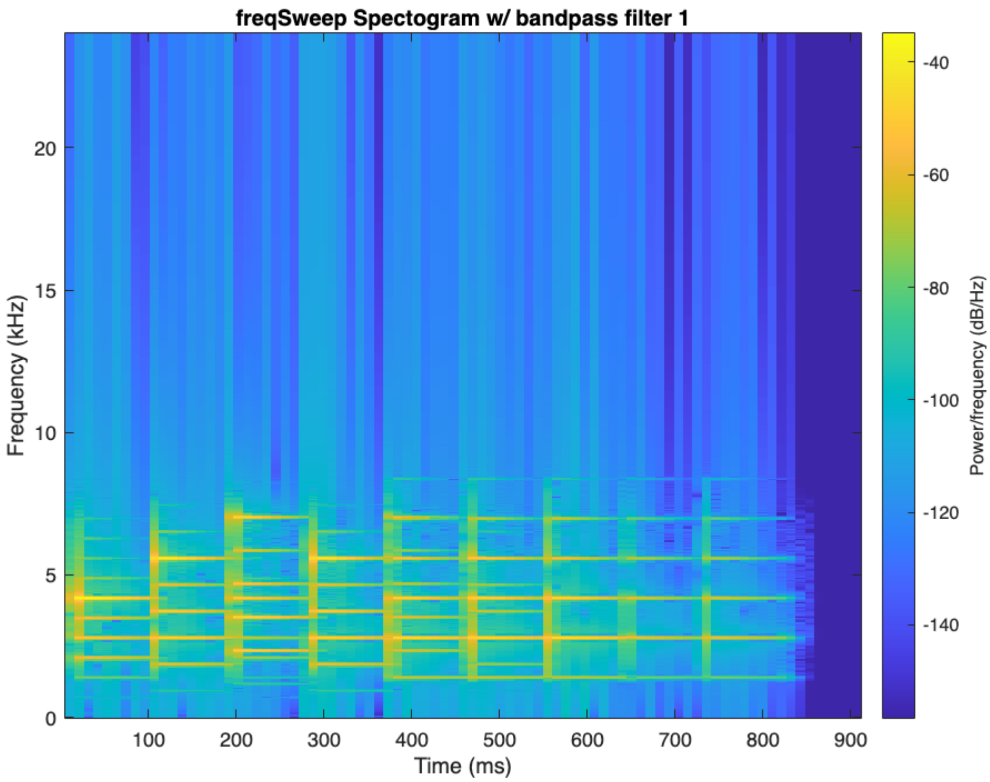

```
% Spectogram of filtered freqSweep signal
sp_win = 1024;
sp_ovr = 512;
sp_fftN = 1024;

figure;
spectrogram(y2_bp1, sp_win, sp_ovr, sp_fftN, fs2, 'yaxis')
title('freqSweep Spectogram w/ bandpass filter 1')
```



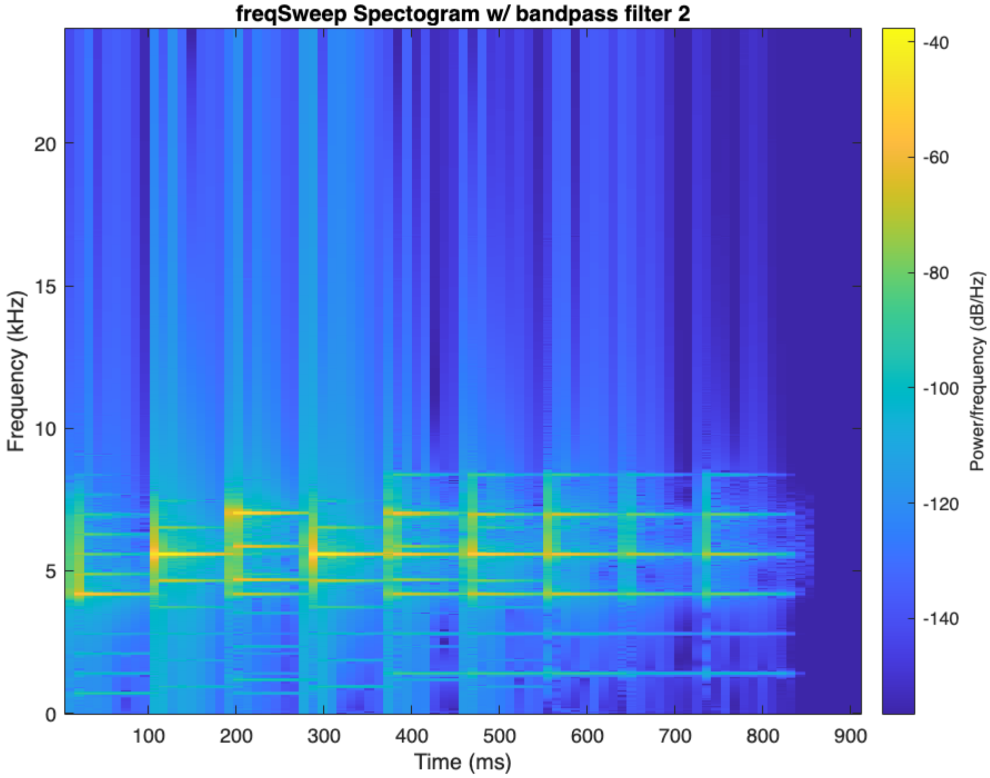

```
figure;
spectrogram(y2_bp2, sp_win, sp_ovr, sp_fftN, fs2, 'yaxis')
title('freqSweep Spectogram w/ bandpass filter 2')
```




```
% Spectogram of filtered alarm signal
sp_win = 1024;
sp_ovr = 512;
sp_fftN = 1024;

figure;
spectrogram(y3_bp1, sp_win, sp_ovr, sp_fftN, fs3, 'yaxis')
title('freqSweep Spectogram w/ bandpass filter 1')
```



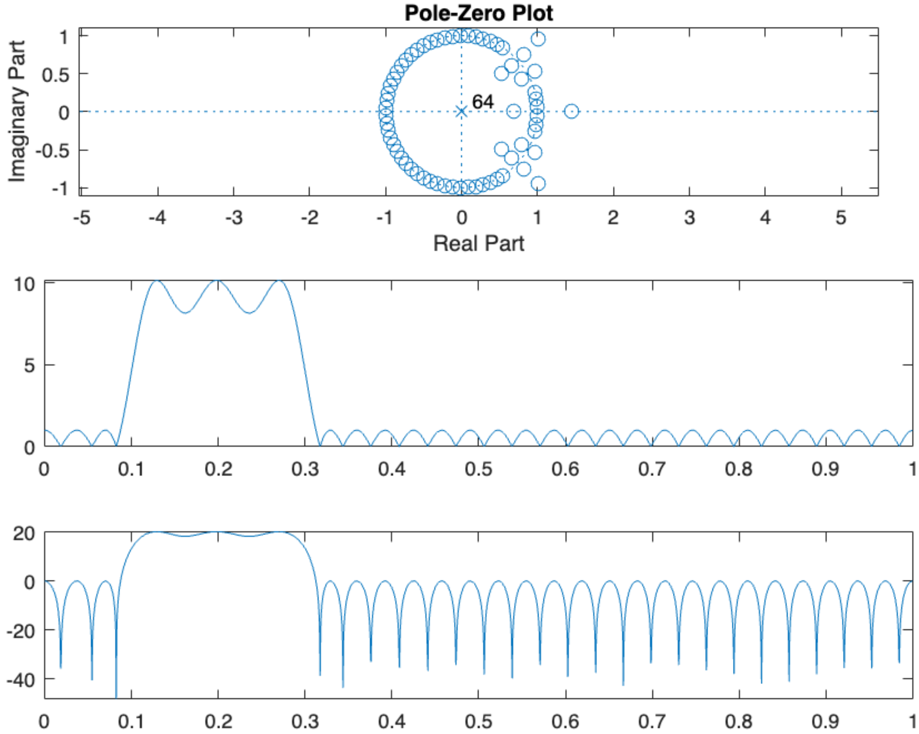

```
figure;
spectrogram(y3_bp2, sp_win, sp_ovr, sp_fftN, fs3, 'yaxis')
title('freqSweep Spectogram w/ bandpass filter 2')
```



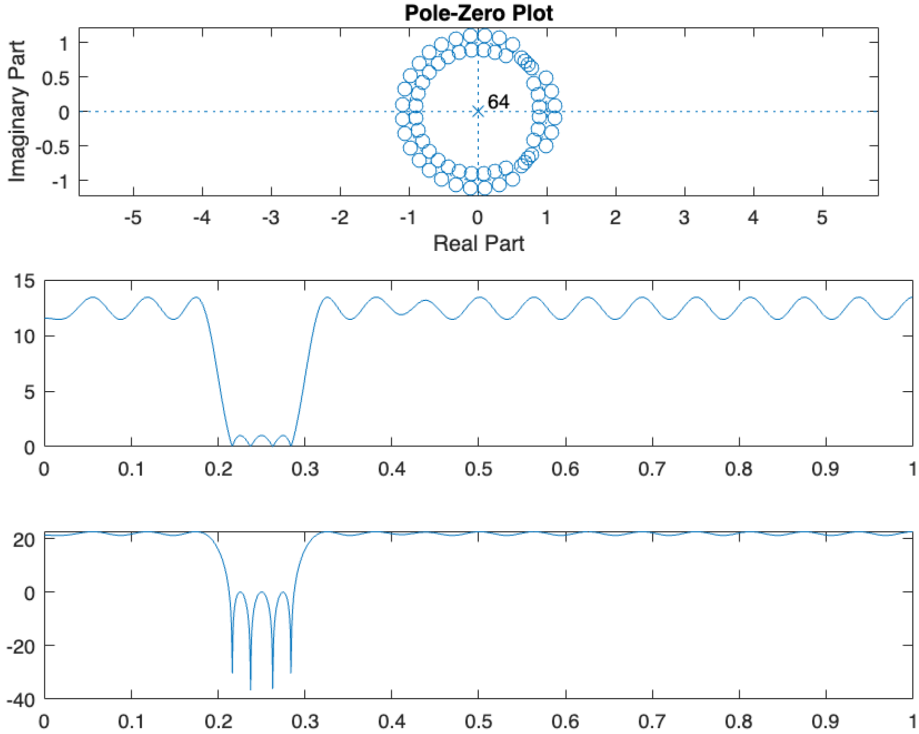

```
% The frequencies outside the bandpass and bandstop are heavily attenuated
% as seen throughout the spectograms for freqsweep
```

```
% Part 3
```

```
% Bandpass filter
fs = 8000;
fpm = [0, 350, 450, 1150, 1250, fs/2];
apm = [0 0 1 1 0 0];

[b1,a1] = firpm(64, fpm/(fs/2), apm);
figure;
subplot(3,1,1);
zplane(b1,a1);

subplot(3,1,2)
[h, w] = freqz(b1,a1, 2048);
plot(w/pi, abs(h))

subplot(3,1,3);
plot(w/pi, 20*log10(abs(h)+0.0001))
```




```
% Bandstop filter
fs = 8000;
fpm = [0, 750, 850, 1150, 1250, fs/2];
apm= [1 1 0 0 1 1];

[b2,a2] = firpm(64, fpm/(fs/2), apm);
figure;
subplot(3,1,1);
zplane(b2,a2);

subplot(3,1,2)
[h, w] = freqz(b2,a2, 2048);
plot(w/pi, abs(h))

subplot(3,1,3);
plot(w/pi, 20*log10(abs(h)+0.0001))
```




```
% Bambi sound w/ firpm bandpass filter
y1_pm1 = filter(b1,a1,y1);
sound(y1_pm1,fs1);
```

```
% Bambi sound w/ firpm bandstop filter
y1_pm2 = filter(b2,a2,y1);
sound(y1_pm2,fs1);
```

```
% freqSweep sound w/ firpm bandpass filter
y2_pm1 = filter(b1,a1,y2);
sound(y2_pm1,fs2);
```

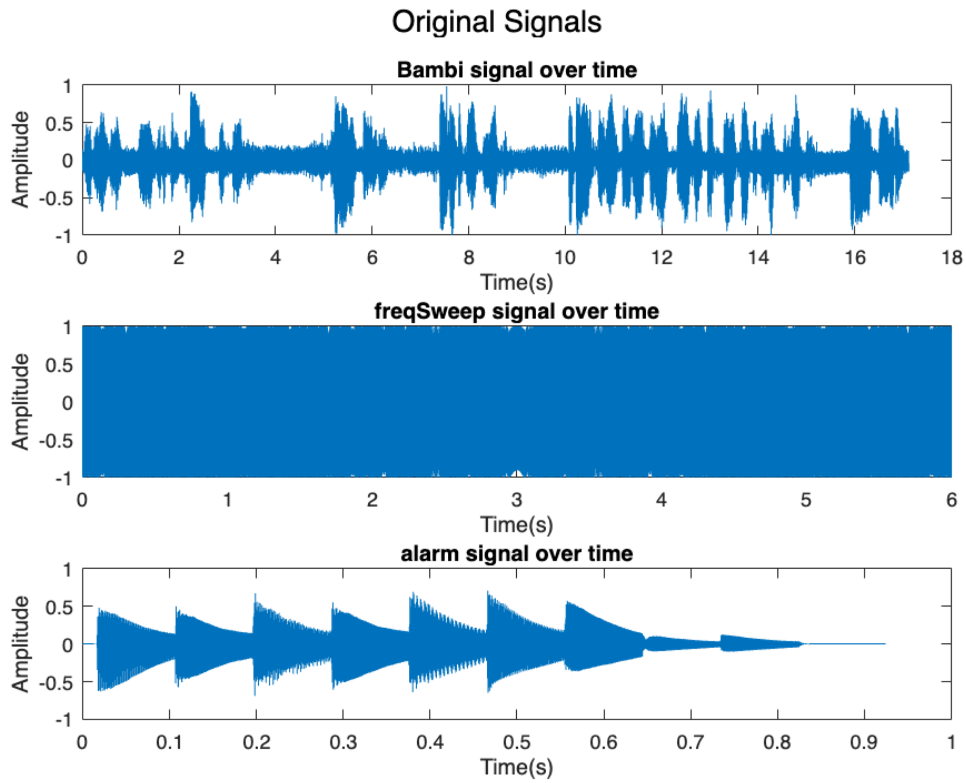
```
% freqSweep sound w/ firpm bandpass filter
y2_pm2 = filter(b2,a2,y2);
sound(y2_pm2,fs2);
```

```
% alarm sound w/ firpm bandpass filter
y3_pm1 = filter(b1,a1,y3);
sound(y3_pm1,fs3);
```

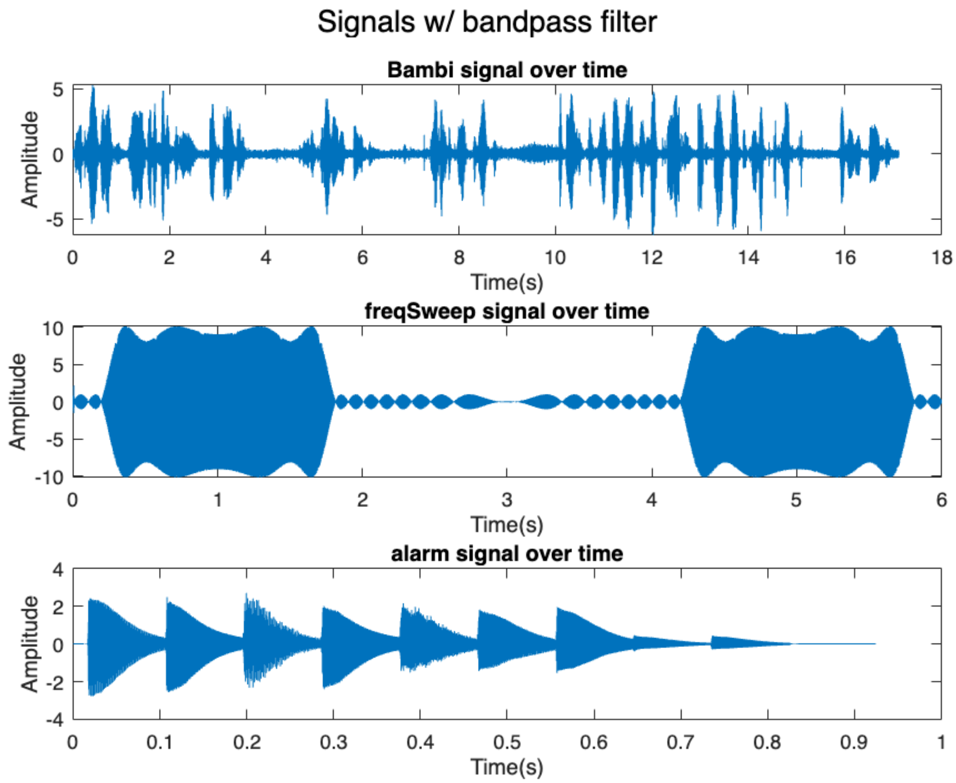
```
% alarm sound w/ firpm bandpass filter
```

```
y3_pm2 = filter(b2,a2,y3);
sound(y3_pm2,fs3);
```

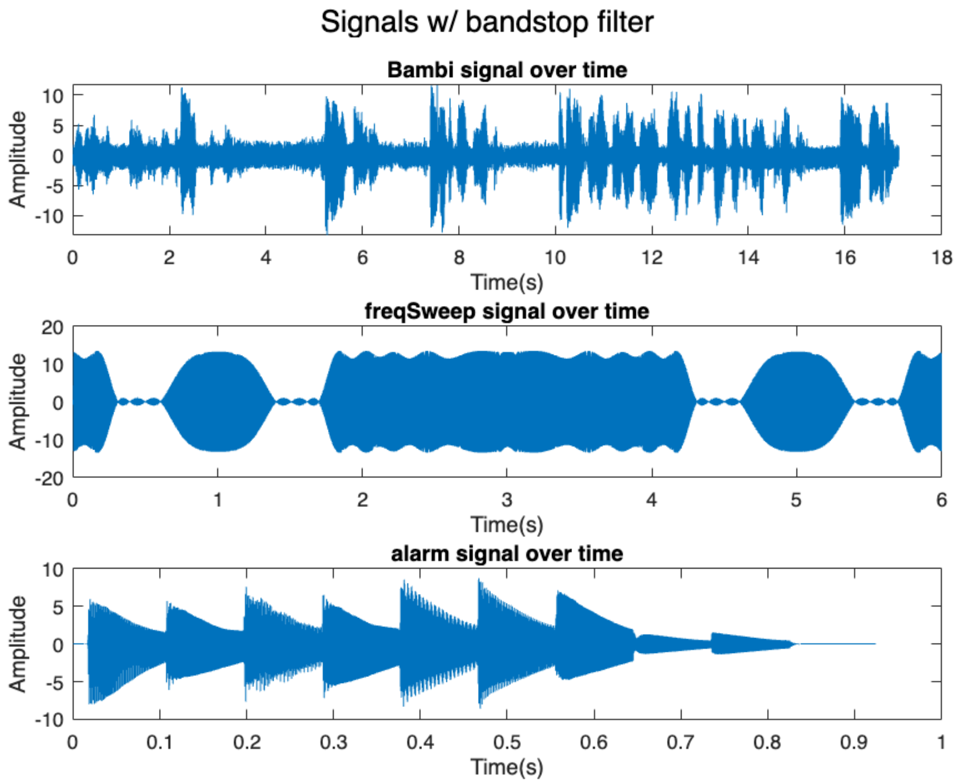
```
% Output signals

t1 = 0:1/fs1:1/fs1*(length(y1)-1);
t2 = 0:1/fs2:1/fs2*(length(y2)-1);
t3 = 0:1/fs3:1/fs3*(length(y3)-1);

figure;
sgtitle('Original Signals')
subplot(3, 1, 1);
plot(t1, y1);
title("Bambi signal over time");
xlabel("Time(s)");
ylabel("Amplitude");

subplot(3, 1, 2);
plot(t2, y2);
title("freqSweep signal over time");
xlabel("Time(s)");
ylabel("Amplitude");

subplot(3, 1, 3);
plot(t3, y3);
title("alarm signal over time");
xlabel("Time(s)");
ylabel("Amplitude");
```




```
figure;
sgtitle('Signals w/ bandpass filter')
subplot(3, 1, 1);
plot(t1, y1_pm1);
title("Bambi signal over time");
xlabel("Time(s)");
ylabel("Amplitude");

subplot(3, 1, 2);
plot(t2, y2_pm1);
title("freqSweep signal over time");
xlabel("Time(s)");
ylabel("Amplitude");

subplot(3, 1, 3);
plot(t3, y3_pm1);
title("alarm signal over time");
xlabel("Time(s)");
ylabel("Amplitude");
```

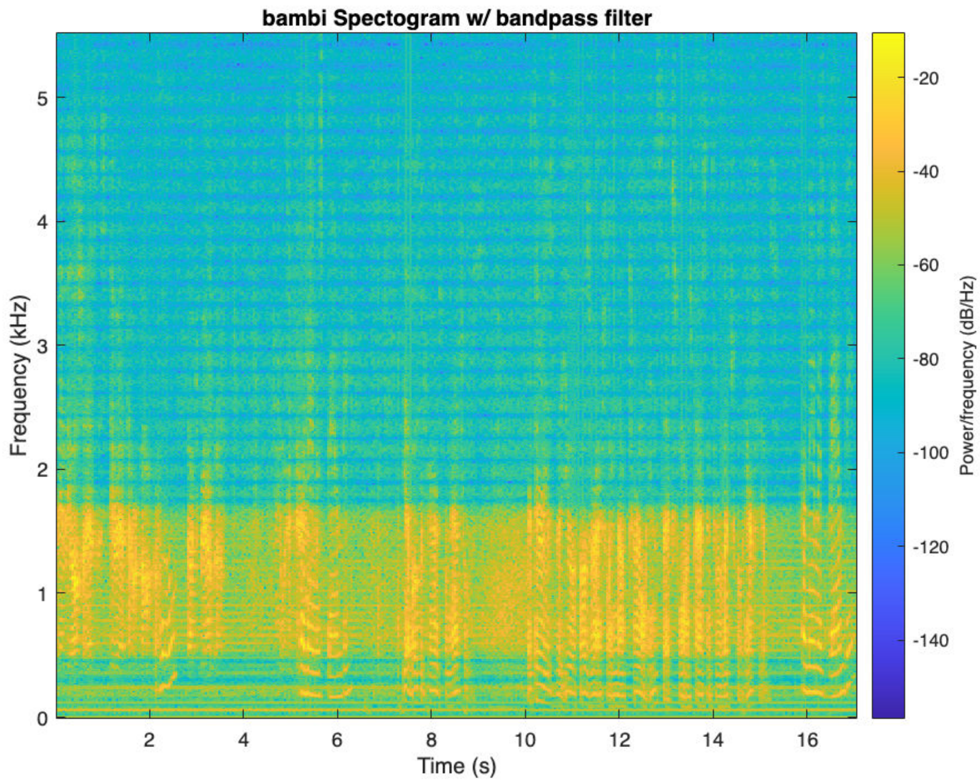



```
figure;
sgtitle('Signals w/ bandstop filter')
subplot(3, 1, 1);
plot(t1, y1_pm2);
title("Bambi signal over time");
xlabel("Time(s)");
ylabel("Amplitude");

subplot(3, 1, 2);
plot(t2, y2_pm2);
title("freqSweep signal over time");
xlabel("Time(s)");
ylabel("Amplitude");

subplot(3, 1, 3);
plot(t3, y3_pm2);
title("alarm signal over time");
xlabel("Time(s)");
ylabel("Amplitude");
```

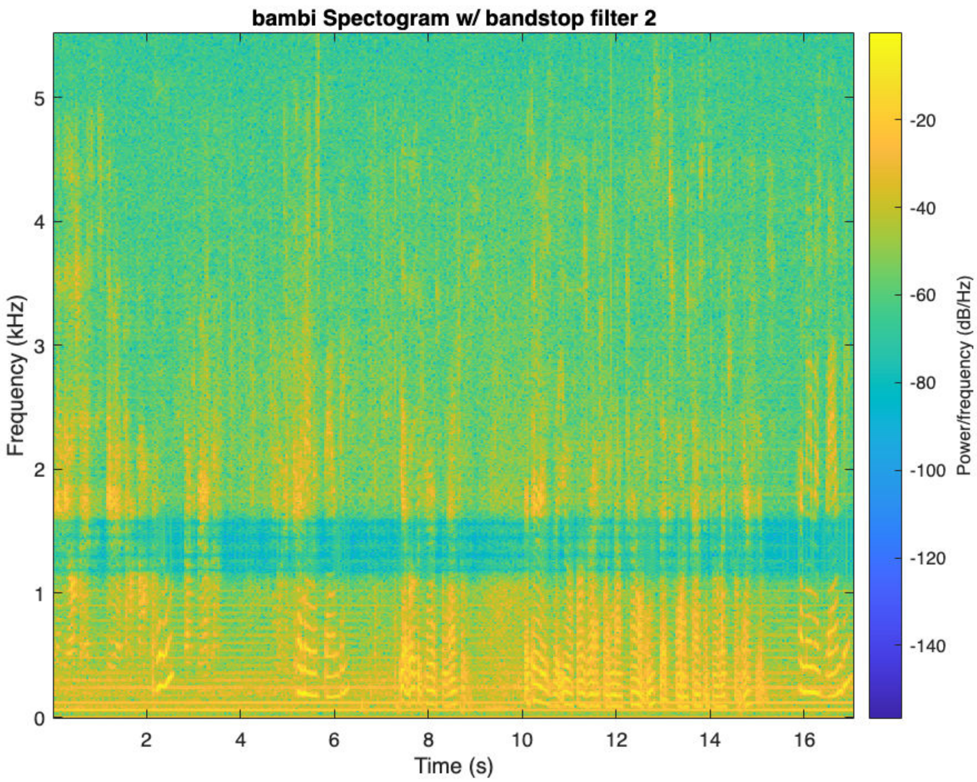



```
% For the speech signal, the filtered output has much more noise, but the
% overall shape appears to be the same.

% For the freqsweep, it appears to be the same as before, but its not as
% smooth with more ripples.
```

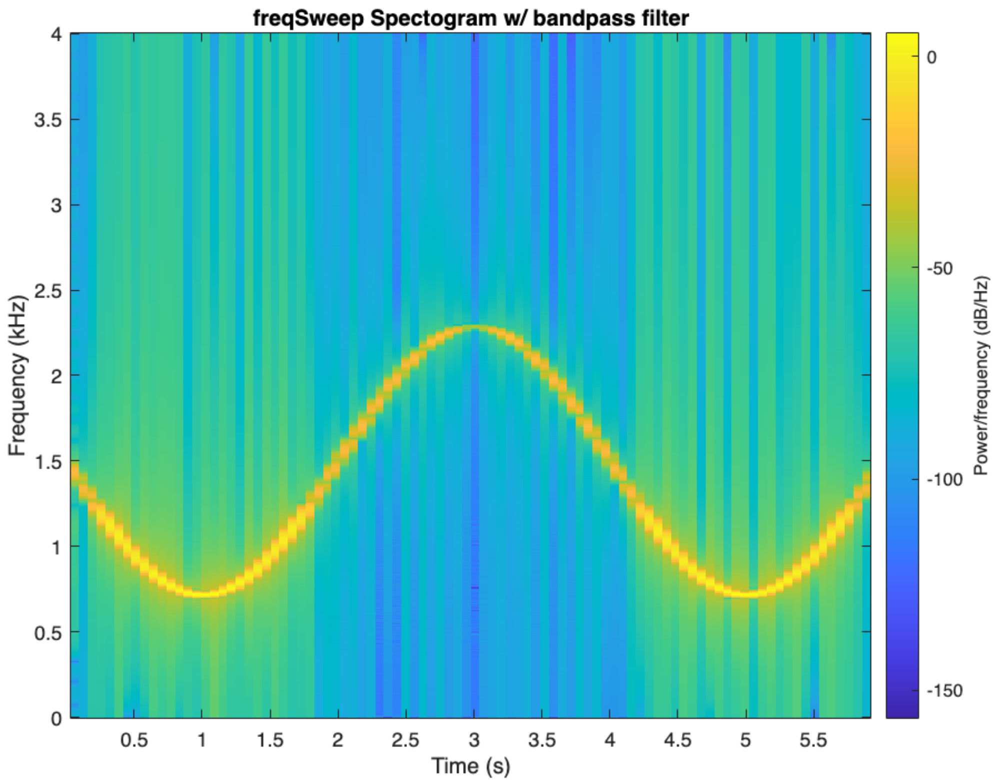
```
% Spectogram of filtered bambi signal
sp_win = 1024;
sp_ovr = 512;
sp_fftN = 1024;

figure;
spectrogram(y1_pm1, sp_win, sp_ovr, sp_fftN, fs1, 'yaxis')
title('bambi Spectogram w/ bandpass filter')
```



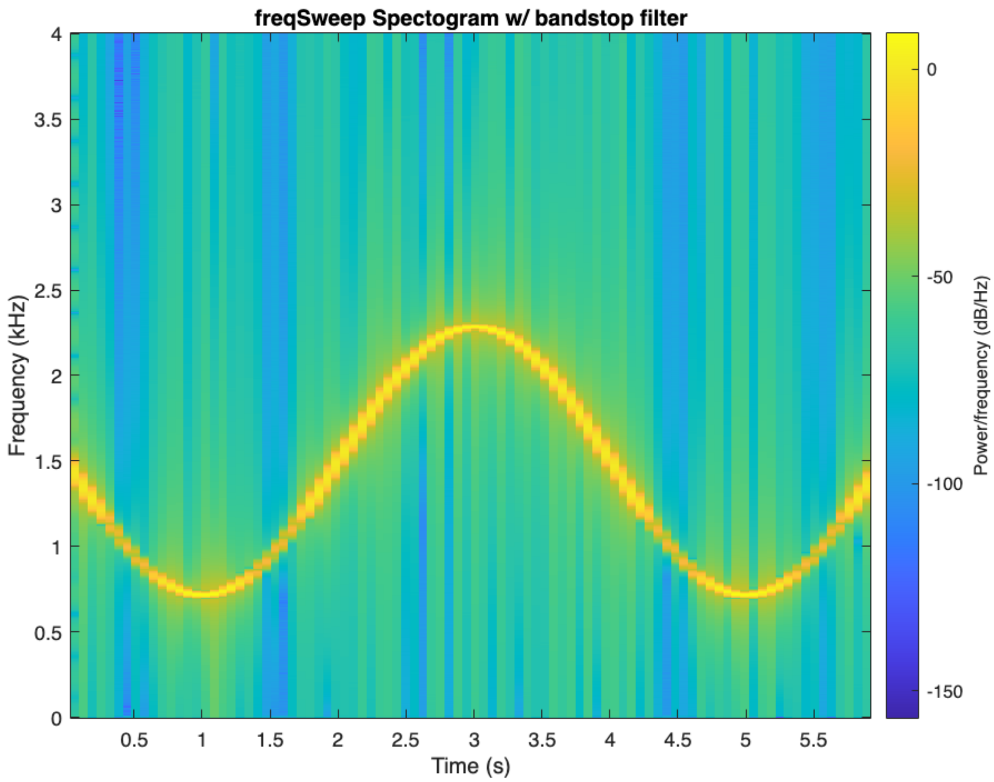

```
figure;
spectrogram(y1_pm2, sp_win, sp_ovr, sp_fftN, fs1, 'yaxis')
title('bambi Spectogram w/ bandstop filter 2')
```



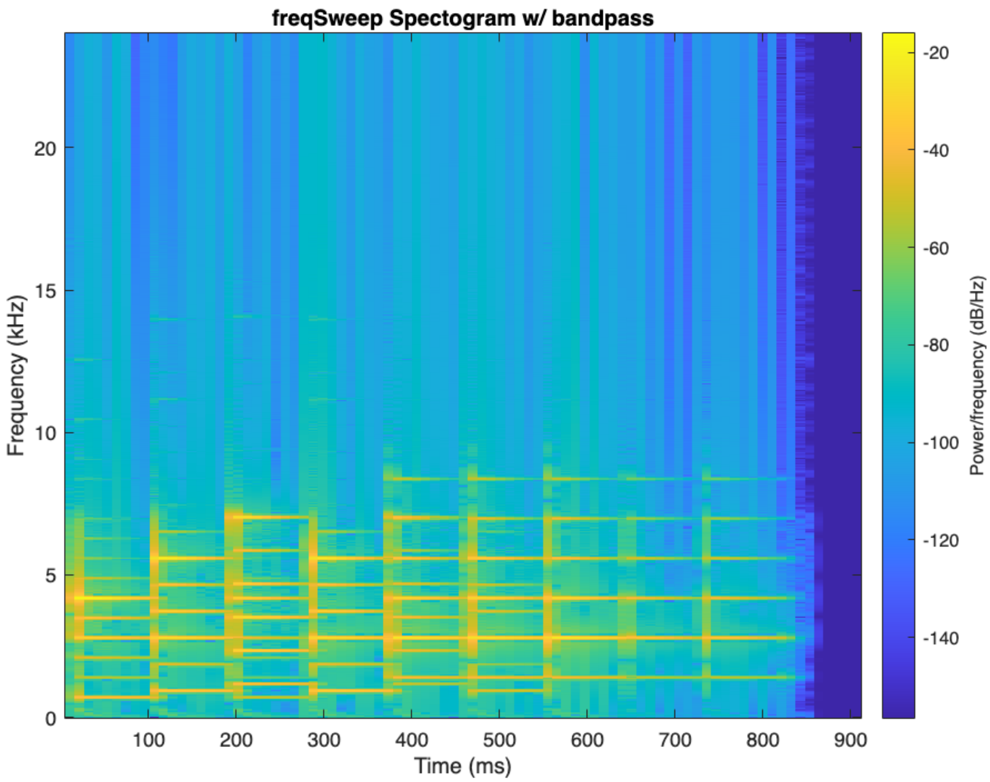

```
% Spectogram of filtered freqSweep signal
sp_win = 1024;
sp_ovr = 512;
sp_fftN = 1024;

figure;
spectrogram(y2_pm1, sp_win, sp_ovr, sp_fftN, fs2, 'yaxis')
title('freqSweep Spectogram w/ bandpass filter')
```



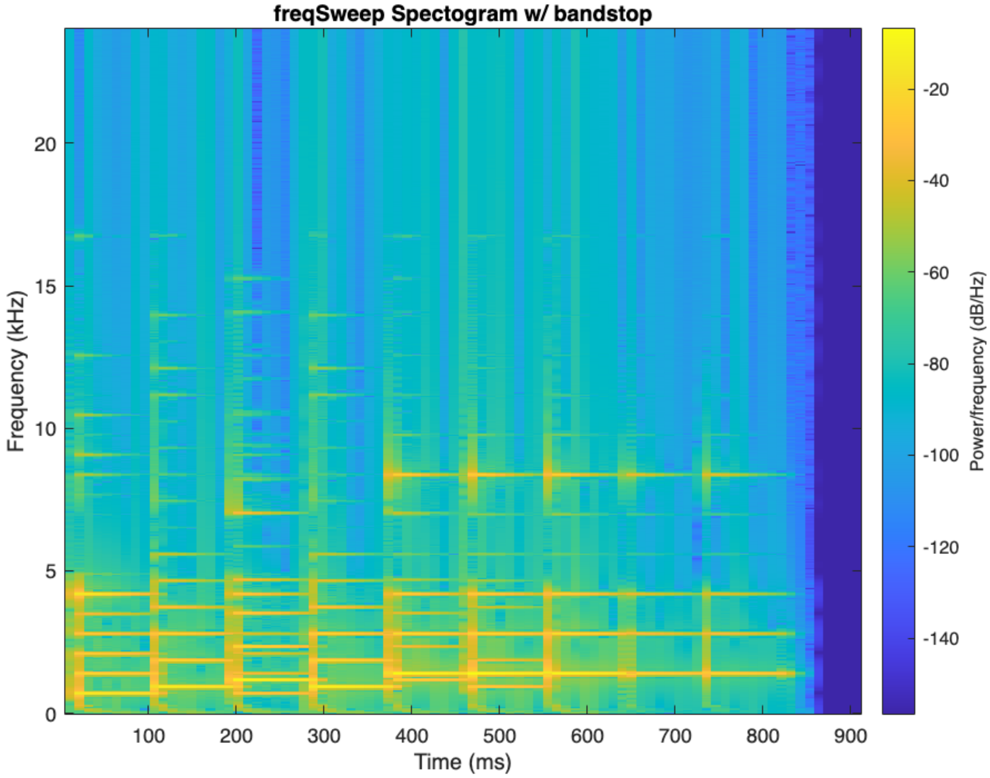

```
figure;
spectrogram(y2_pm2, sp_win, sp_ovr, sp_fftN, fs2, 'yaxis')
title('freqSweep Spectogram w/ bandstop filter')
```




```
% Spectogram of filtered alarm signal
sp_win = 1024;
sp_ovr = 512;
sp_fftN = 1024;

figure;
spectrogram(y3_pm1, sp_win, sp_ovr, sp_fftN, fs3, 'yaxis')
title('freqSweep Spectogram w/ bandpass')
```



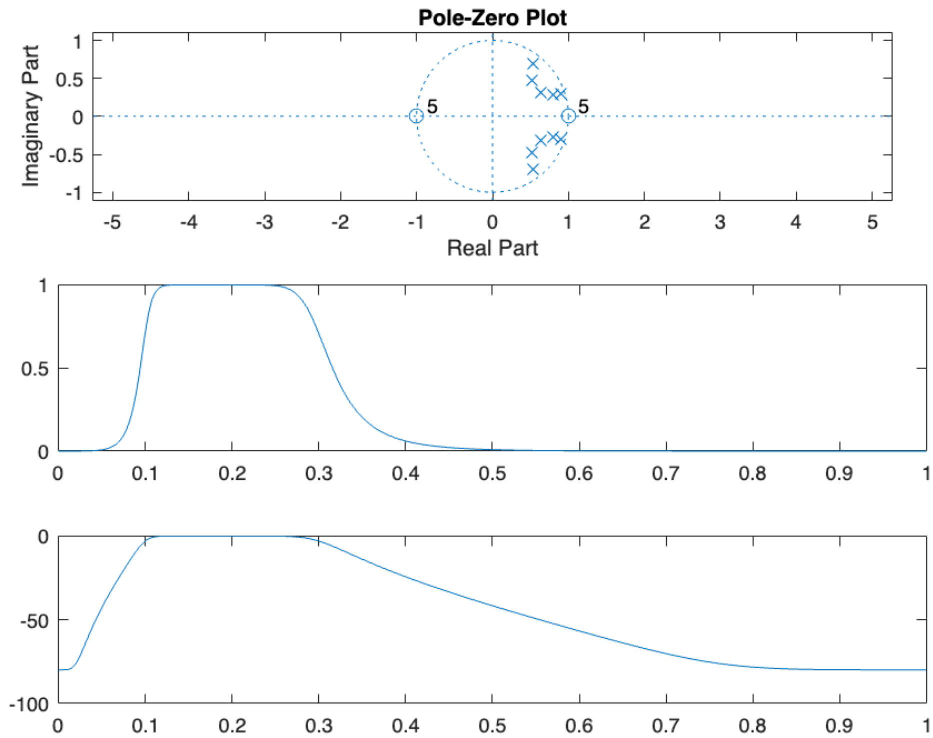

```
figure;
spectrogram(y3_pm2, sp_win, sp_ovr, sp_fftN, fs3, 'yaxis')
title('freqSweep Spectogram w/ bandstop')
```



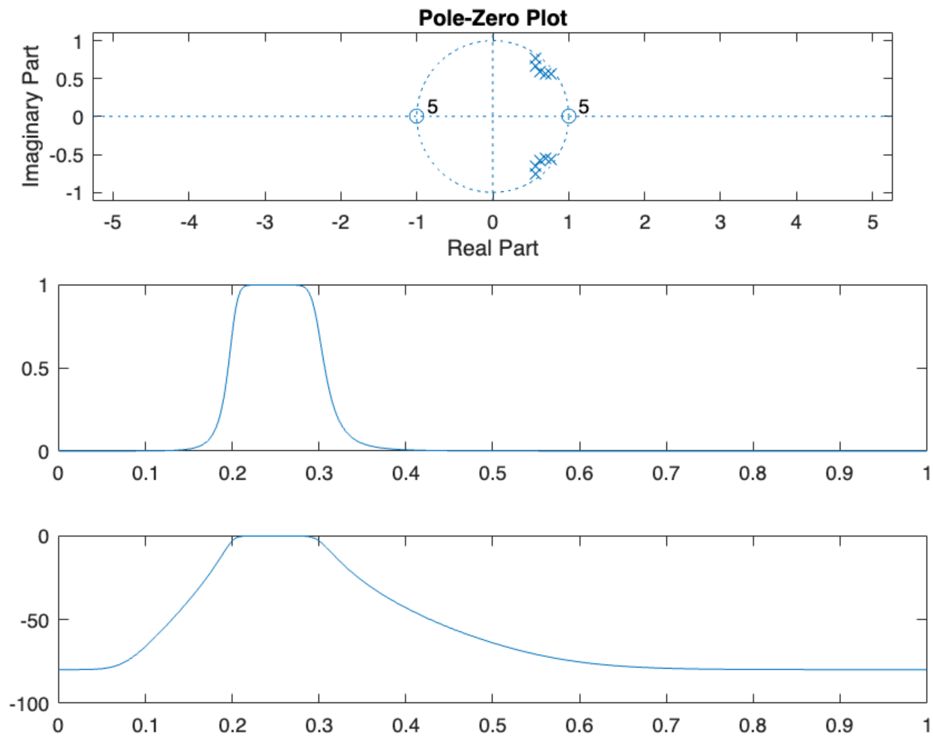

```
% The spectograms display the correct frequencies that are attneuated
% throughout both filters.
```

```
% Part 4
```

```
% Bandpass filter w/ f1 = 400 and f2 = 1200
fs = 8000;
f1 = 400;
f2 = 1200;

w1 = 2*f1/fs;
w2 = 2*f2/fs;
[b1,a1] = butter(5, [w1,w2],'BANDPASS');
figure;
subplot(3,1,1);
zplane(b1,a1);

subplot(3,1,2)
[h, w] = freqz(b1,a1, 2048);
plot(w/pi, abs(h))

subplot(3,1,3);
plot(w/pi, 20*log10(abs(h)+0.0001))
```




```
% Bandpass filter w/ f1 = 800 and f2 = 1200
fs = 8000;
f1 = 800;
f2 = 1200;

w1 = 2*f1/fs;
w2 = 2*f2/fs;

[b2,a2] = butter(5, [w1,w2],'BANDPASS');
figure;
subplot(3,1,1);
zplane(b2,a2);

subplot(3,1,2)
[h, w] = freqz(b2,a2, 2048);
plot(w/pi, abs(h))

subplot(3,1,3);
plot(w/pi, 20*log10(abs(h)+0.0001))
```




```
% Bambi sound w/ bandpass filter 1
y1_bt1 = filter(b2,a2,y1);
sound(y1_bt1,fs1);
```

```
% Bambi sound w/ bandpass filter 2
y1_bt2 = filter(b2,a2,y1);
sound(y1_bt2,fs1);
```

```
% freqSweep sound w/ bandpass filter 1
y2_bt1 = filter(b1, a1, y2);
sound(y2_bt1,fs2);
```

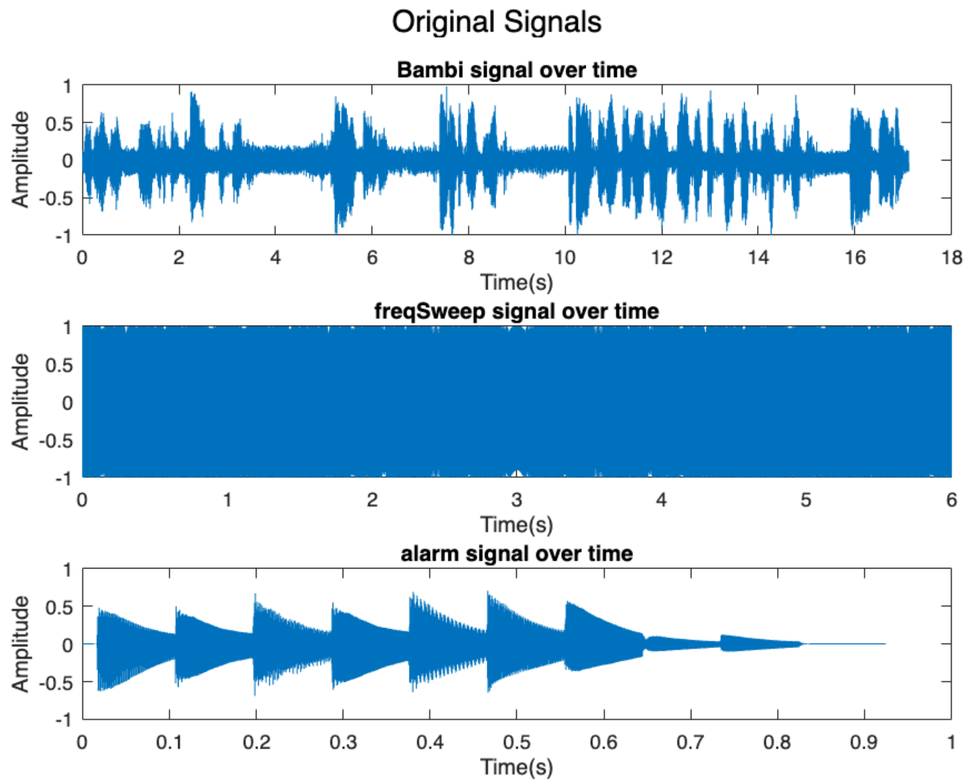
```
% freqSweep sound w/ bandpass filter 2
y2_bt2 = filter(b2, a2, y2);
sound(y2_bt2,fs2);
```

```
% alarm sound w/ bandpass filter 1
y3_bt1 = filter(b1, a1, y3);
sound(y3_bt1,fs3);
```

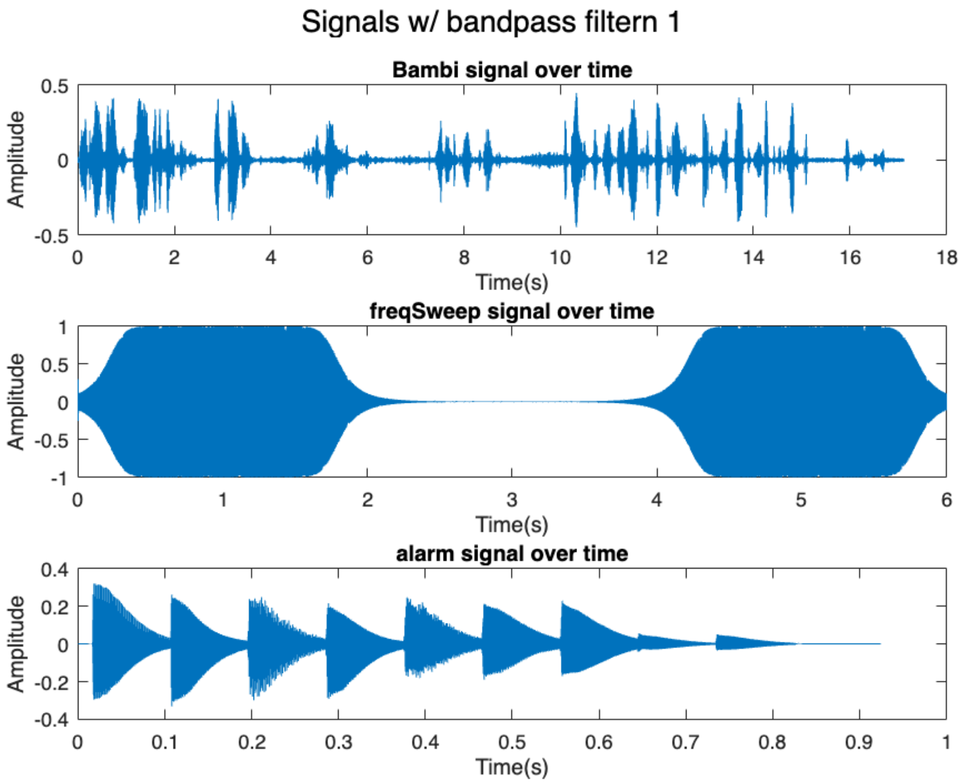
```
% alarm sound w/ bandpass filter 2
```

```
y3_bt2 = filter(b2, a2, y3);
sound(y3_bt2,fs3);
```

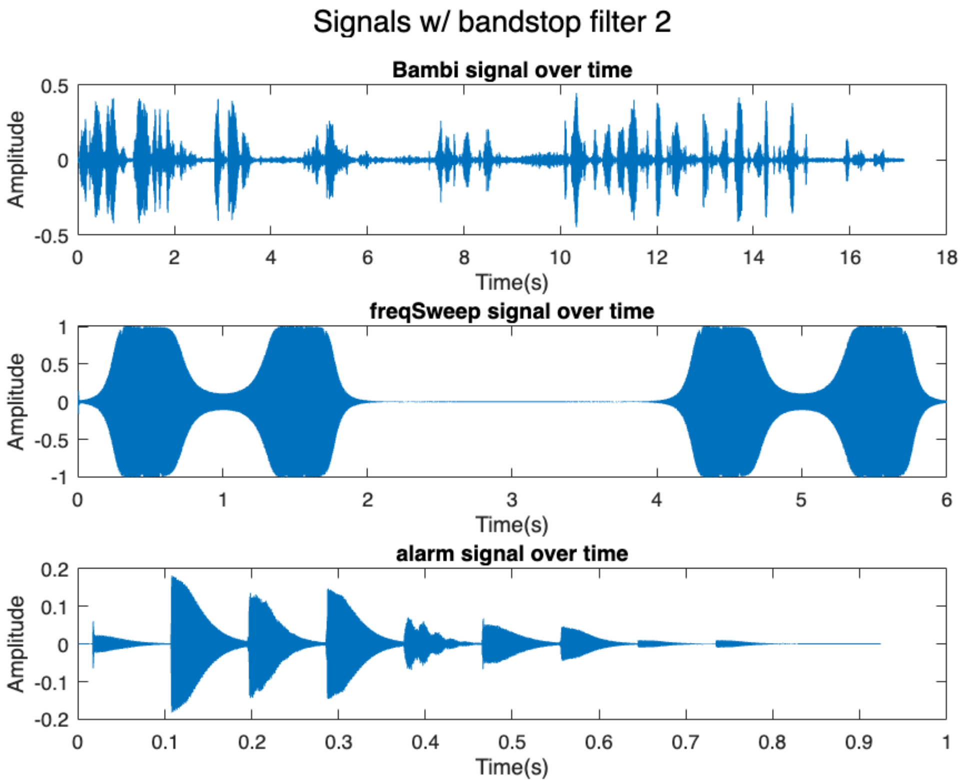
```
% Output signals

t1 = 0:1/fs1:1/fs1*(length(y1)-1);
t2 = 0:1/fs2:1/fs2*(length(y2)-1);
t3 = 0:1/fs3:1/fs3*(length(y3)-1);

figure;
sgtitle('Original Signals')
subplot(3, 1, 1);
plot(t1, y1);
title("Bambi signal over time");
xlabel("Time(s)");
ylabel("Amplitude");

subplot(3, 1, 2);
plot(t2, y2);
title("freqSweep signal over time");
xlabel("Time(s)");
ylabel("Amplitude");

subplot(3, 1, 3);
plot(t3, y3);
title("alarm signal over time");
xlabel("Time(s)");
ylabel("Amplitude");
```




```
figure;
sgtitle('Signals w/ bandpass filtern 1')
subplot(3, 1, 1);
plot(t1, y1_bt1);
title("Bambi signal over time");
xlabel("Time(s)");
ylabel("Amplitude");

subplot(3, 1, 2);
plot(t2, y2_bt1);
title("freqSweep signal over time");
xlabel("Time(s)");
ylabel("Amplitude");

subplot(3, 1, 3);
plot(t3, y3_bt1);
title("alarm signal over time");
xlabel("Time(s)");
ylabel("Amplitude");
```

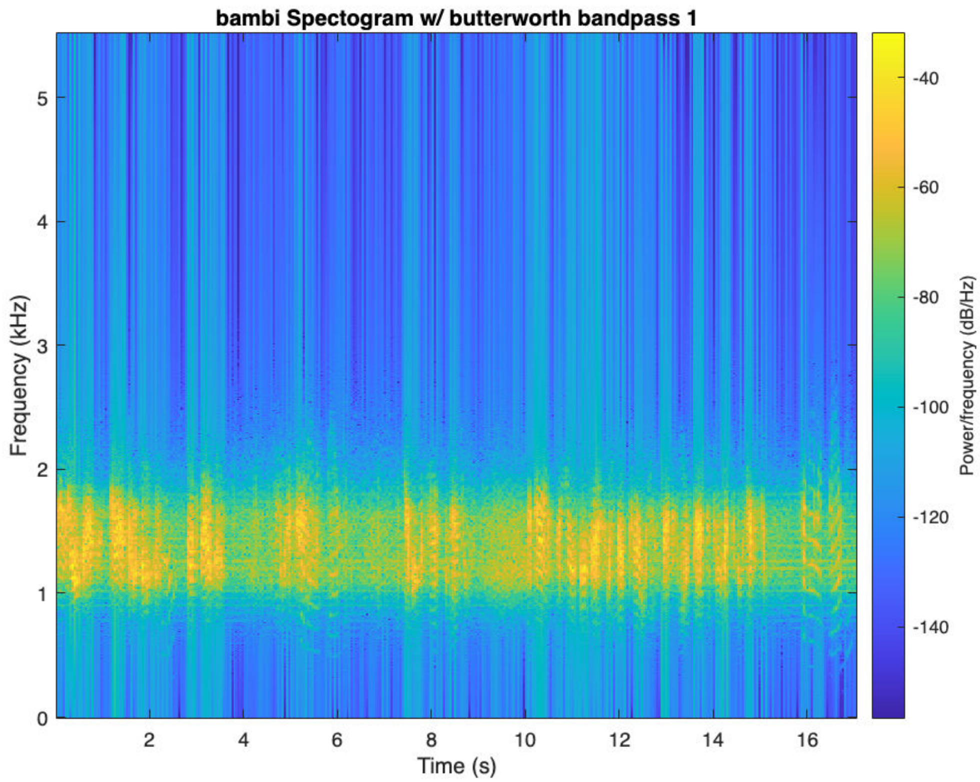



```
figure;
sgtitle('Signals w/ bandstop filter 2')
subplot(3, 1, 1);
plot(t1, y1_bt2);
title("Bambi signal over time");
xlabel("Time(s)");
ylabel("Amplitude");

subplot(3, 1, 2);
plot(t2, y2_bt2);
title("freqSweep signal over time");
xlabel("Time(s)");
ylabel("Amplitude");

subplot(3, 1, 3);
plot(t3, y3_bt2);
title("alarm signal over time");
xlabel("Time(s)");
ylabel("Amplitude");
```

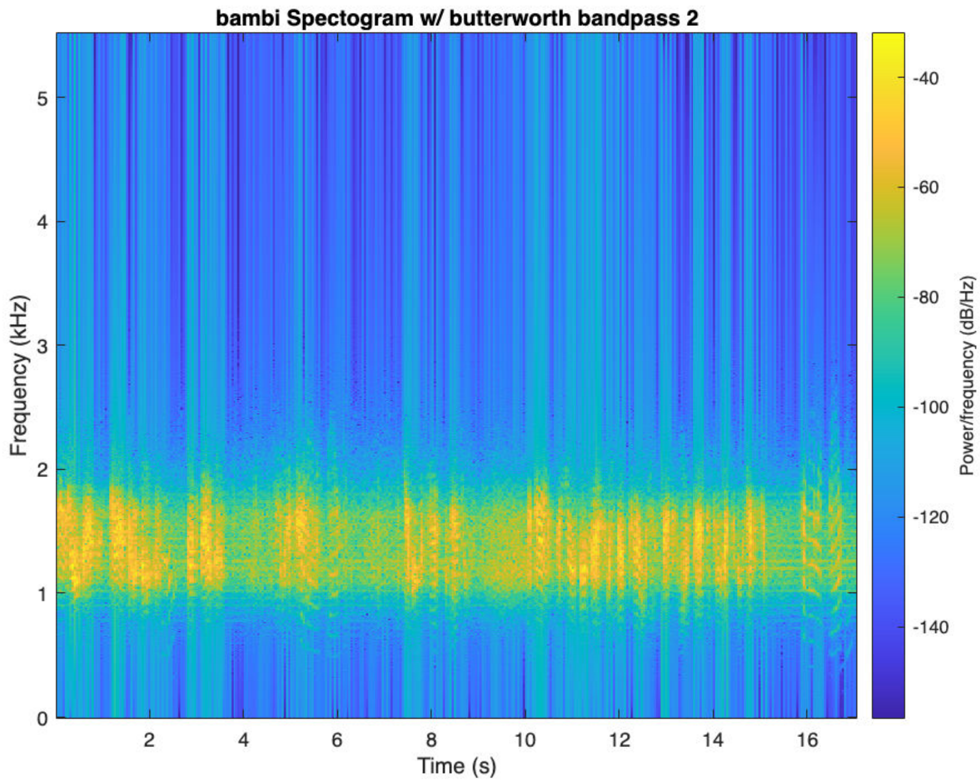



```
% The filtered speech signals look very different from the original signal.
% These differences are noticable when listening to the sound.

% The freqsweep filtered plots illustrate the correct frequencies being
% filtered out of the audio signal or both the bandpass and bandstop.
```

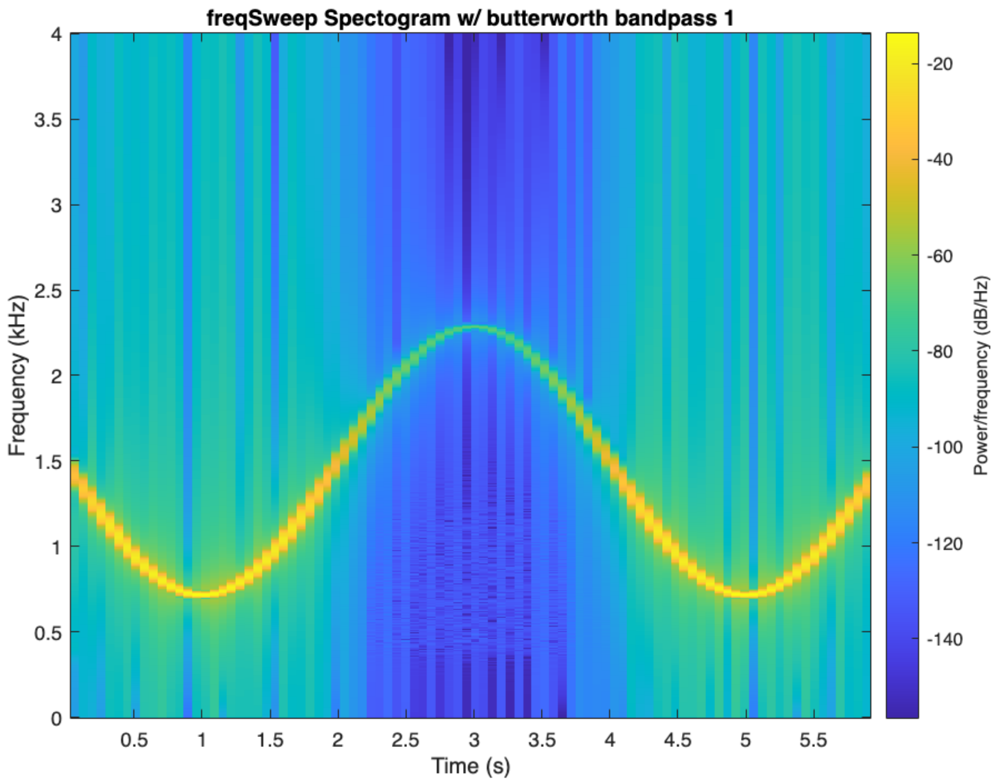
```
% Spectogram of filtered bambi signal
sp_win = 1024;
sp_ovr = 512;
sp_fftN = 1024;

figure;
spectrogram(y1_bt1, sp_win, sp_ovr, sp_fftN, fs1, 'yaxis')
title('bambi Spectogram w/ butterworth bandpass 1')
```



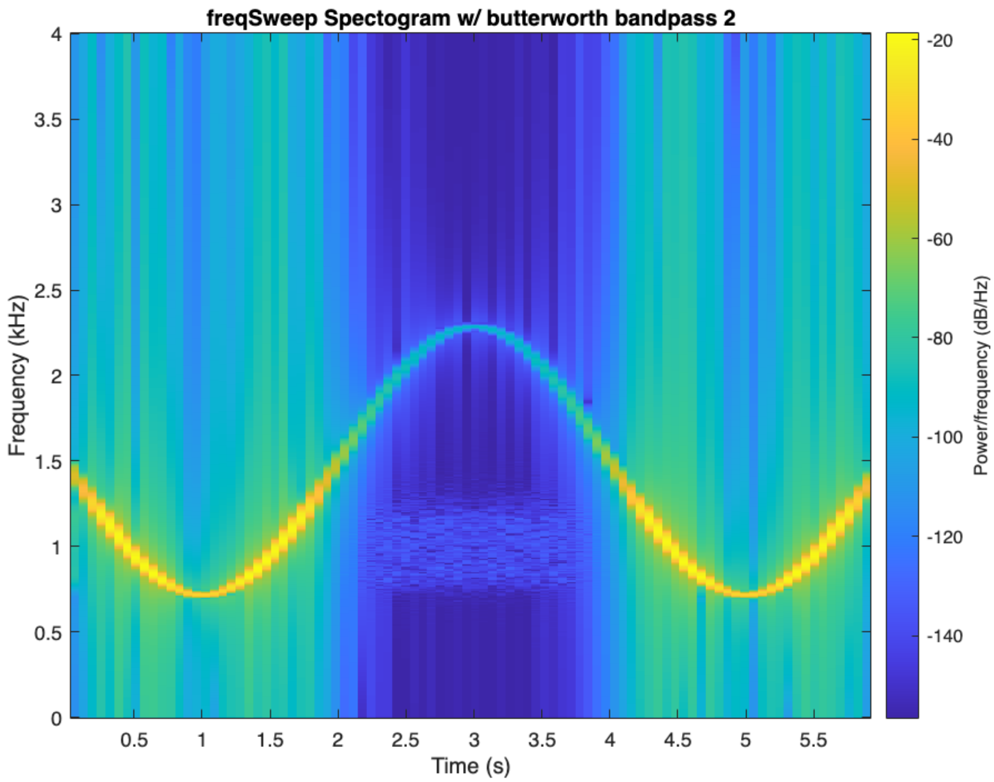

```
figure;
spectrogram(y1_bt2, sp_win, sp_ovr, sp_fftN, fs1, 'yaxis')
title('bambi Spectogram w/ butterworth bandpass 2')
```



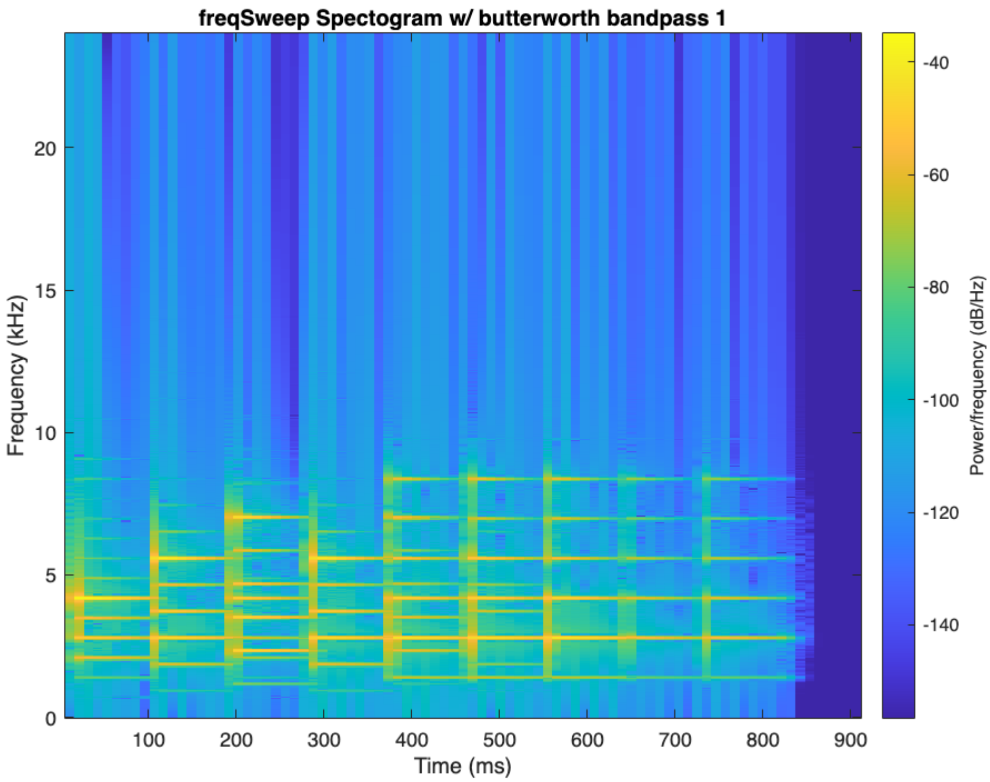

```
% Spectogram of filtered freqSweep signal
sp_win = 1024;
sp_ovr = 512;
sp_fftN = 1024;

figure;
spectrogram(y2_bt1, sp_win, sp_ovr, sp_fftN, fs2, 'yaxis')
title('freqSweep Spectogram w/ butterworth bandpass 1')
```



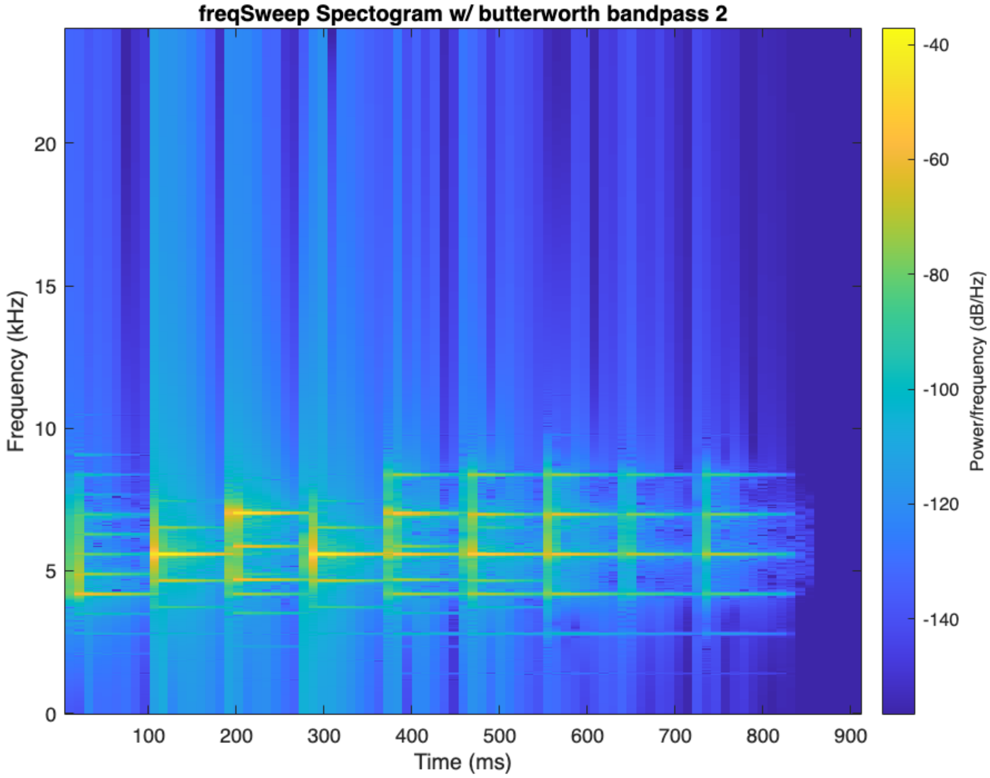

```
figure;
spectrogram(y2_bt2, sp_win, sp_ovr, sp_fftN, fs2, 'yaxis')
title('freqSweep Spectogram w/ butterworth bandpass 2')
```




```
% Spectogram of filtered alarm signal
sp_win = 1024;
sp_ovr = 512;
sp_fftN = 1024;

figure;
spectrogram(y3_bt1, sp_win, sp_ovr, sp_fftN, fs3, 'yaxis')
title('freqSweep Spectogram w/ butterworth bandpass 1')
```

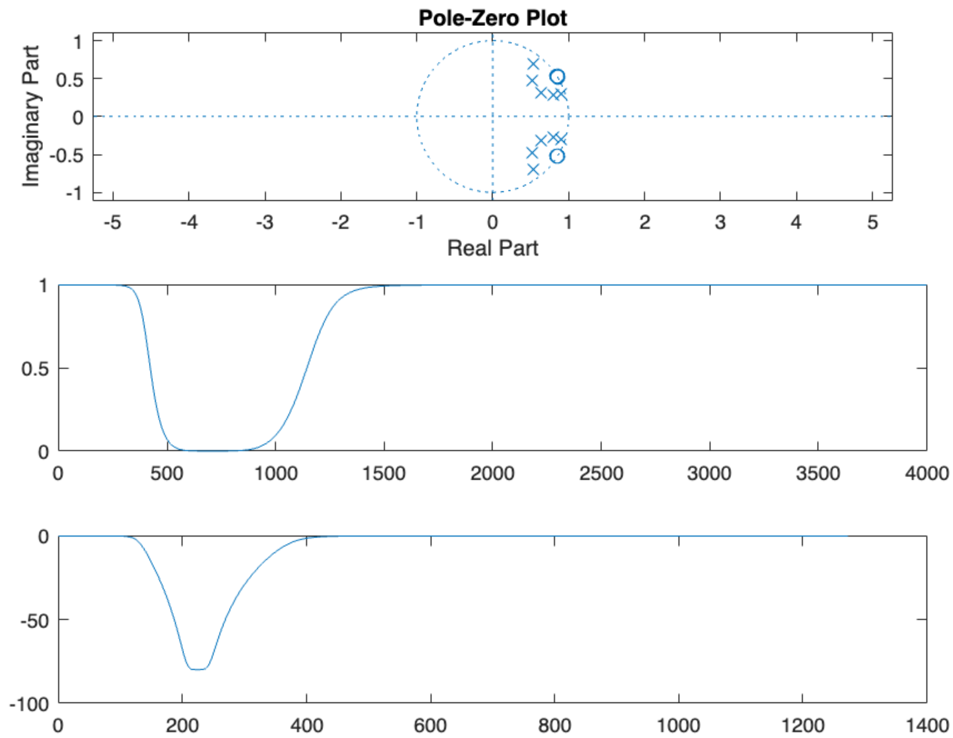



```
figure;
spectrogram(y3_bt2, sp_win, sp_ovr, sp_fftN, fs3, 'yaxis')
title('freqSweep Spectogram w/ butterworth bandpass 2')
```

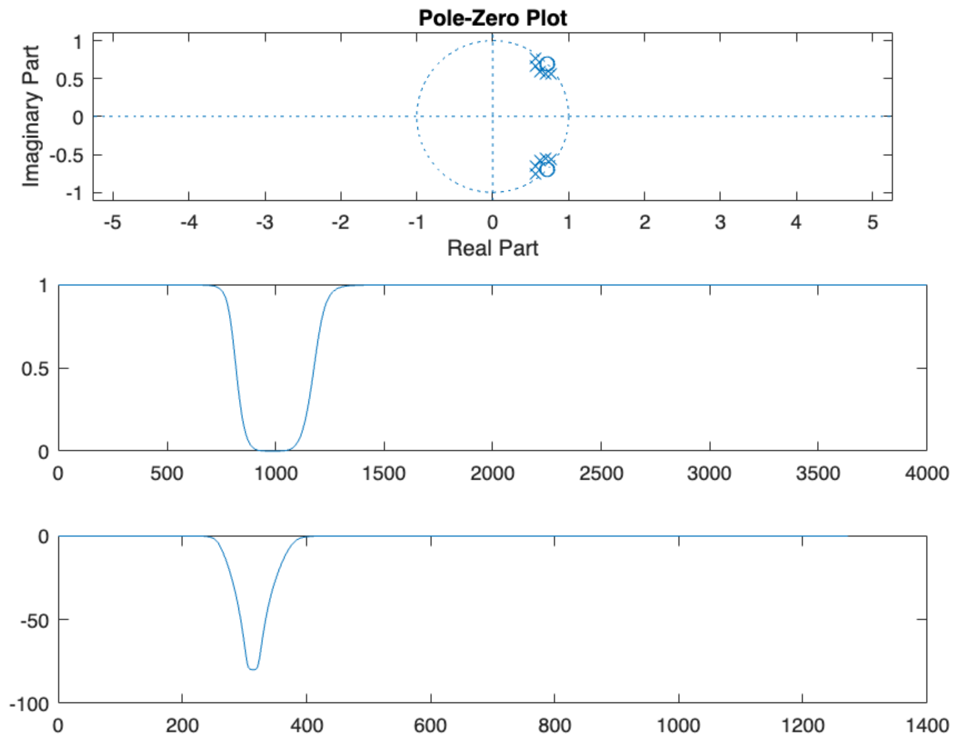



```
% As before, the spectogram displays the correct signals being filtered out
% by the bandpass and bandstop filters.
```

```
% Bandstop filter w/ f1 = 400 and f2 = 1200
fs = 8000;
f1 = 400;
f2 = 1200;

w1 = 2*f1/fs;
w2 = 2*f2/fs;
[b1,a1] = butter(5, [w1,w2],'stop');
figure;
subplot(3,1,1);
zplane(b1,a1);

subplot(3,1,2)
[h, w] = freqz(b1,a1, 2048, fs);
plot(w, abs(h))

subplot(3,1,3);
plot(w/pi, 20*log10(abs(h)+0.0001))
```




```
% Bandstop filter w/ f1 = 800 and f2 = 1200
fs = 8000;
f1 = 800;
f2 = 1200;

w1 = 2*f1/fs;
w2 = 2*f2/fs;

[b2,a2] = butter(5, [w1,w2],'stop');
figure;
subplot(3,1,1);
zplane(b2,a2);

subplot(3,1,2)
[h, w] = freqz(b2,a2, 2048, fs);
plot(w, abs(h))

subplot(3,1,3);
plot(w/pi, 20*log10(abs(h)+0.0001))
```




```
% Bambi sound w/ bandpass filter 1
y1_bts1 = filter(b2,a2,y1);
sound(y1_bts1,fs1);
```

```
% Bambi sound w/ bandpass filter 2
y1_bts2 = filter(b2,a2, y1);
sound(y1_bts2,fs1);
```

```
% freqSweep sound w/ bandpass filter 1
y2_bts1 = filter(b1, a1, y2);
sound(y2_bts1,fs2);
```

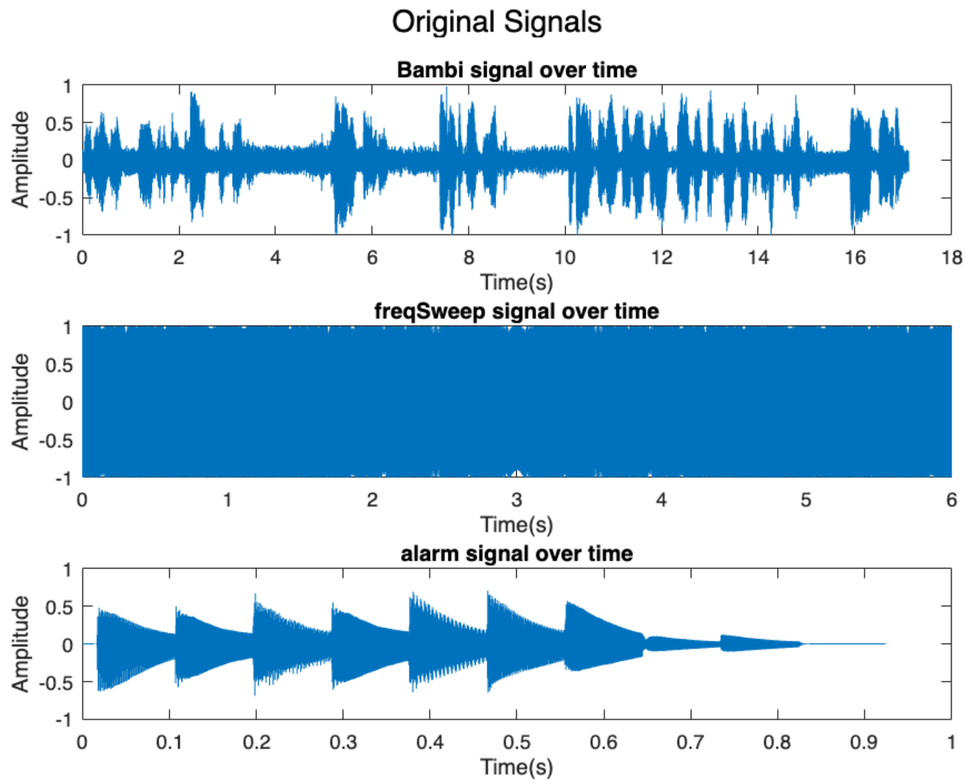
```
% freqSweep sound w/ bandpass filter 2
y2_bts2 = filter(b2, a2, y2);
sound(y2_bts2,fs2);
```

```
% alarm sound w/ bandpass filter 1
y3_bts1 = filter(b1, a1, y3);
sound(y3_bts1,fs3);
```

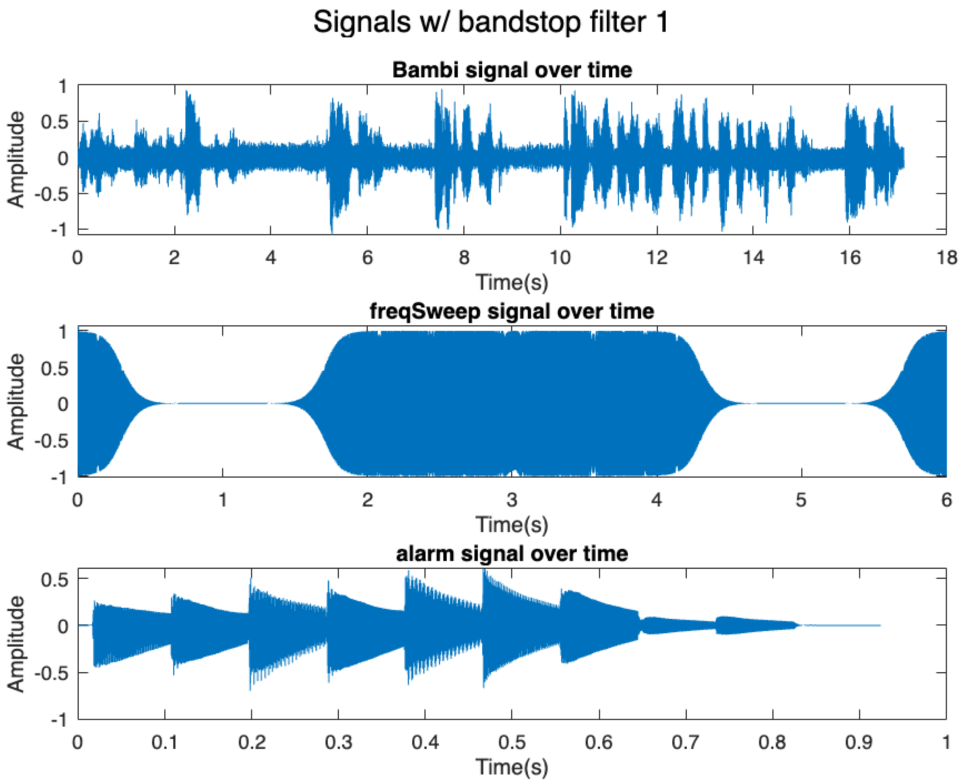
```
% alarm sound w/ bandpass filter 2
```

```
y3_bts2 = filter(b2, a2, y3);
sound(y3_bts2,fs3);
```

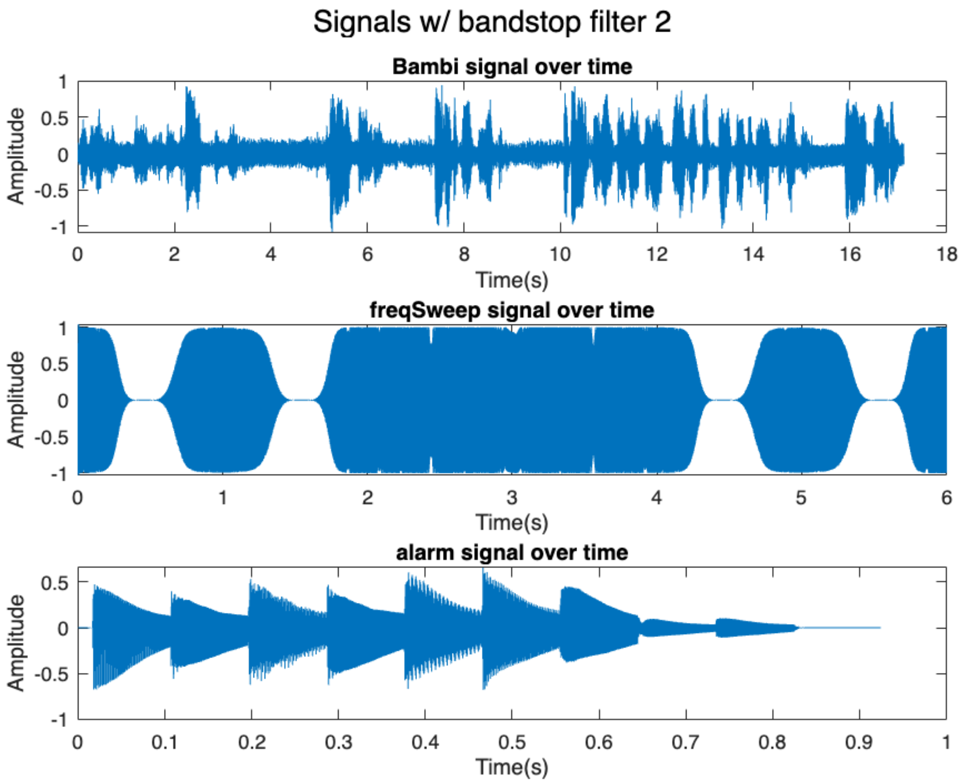
```
% Output signals

t1 = 0:1/fs1:1/fs1*(length(y1)-1);
t2 = 0:1/fs2:1/fs2*(length(y2)-1);
t3 = 0:1/fs3:1/fs3*(length(y3)-1);

figure;
sgtitle('Original Signals')
subplot(3, 1, 1);
plot(t1, y1);
title("Bambi signal over time");
xlabel("Time(s)");
ylabel("Amplitude");

subplot(3, 1, 2);
plot(t2, y2);
title("freqSweep signal over time");
xlabel("Time(s)");
ylabel("Amplitude");

subplot(3, 1, 3);
plot(t3, y3);
title("alarm signal over time");
xlabel("Time(s)");
ylabel("Amplitude");
```



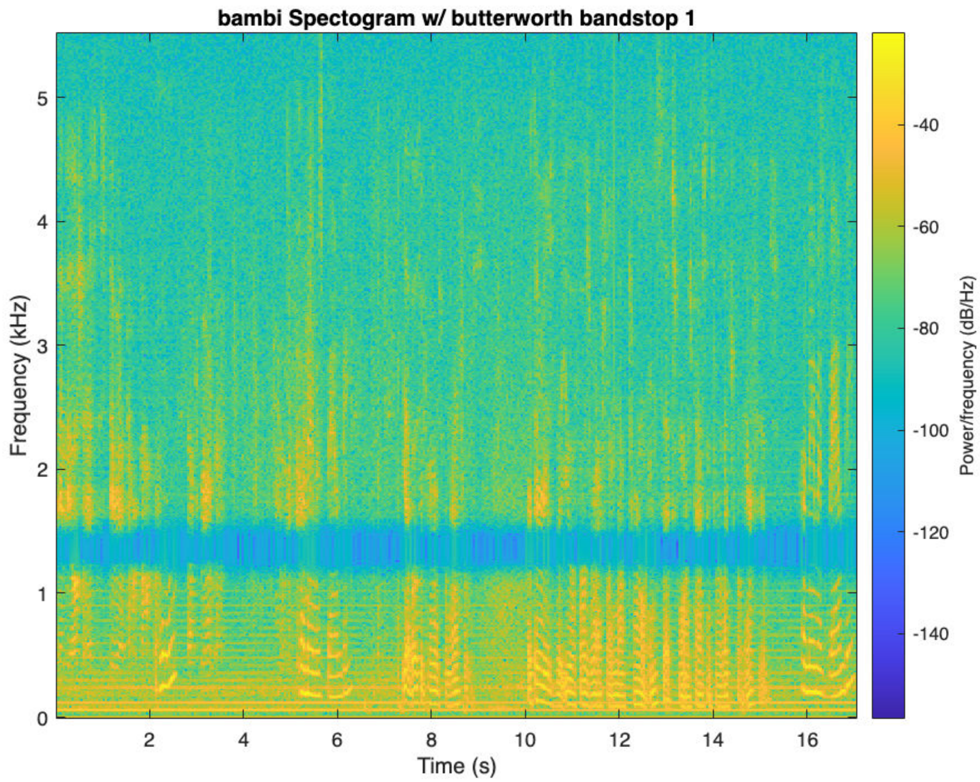

```
figure;
sgtitle('Signals w/ bandstop filter 1')
subplot(3, 1, 1);
plot(t1, y1_bts1);
title("Bambi signal over time");
xlabel("Time(s)");
ylabel("Amplitude");

subplot(3, 1, 2);
plot(t2, y2_bts1);
title("freqSweep signal over time");
xlabel("Time(s)");
ylabel("Amplitude");

subplot(3, 1, 3);
plot(t3, y3_bts1);
title("alarm signal over time");
xlabel("Time(s)");
ylabel("Amplitude");
```



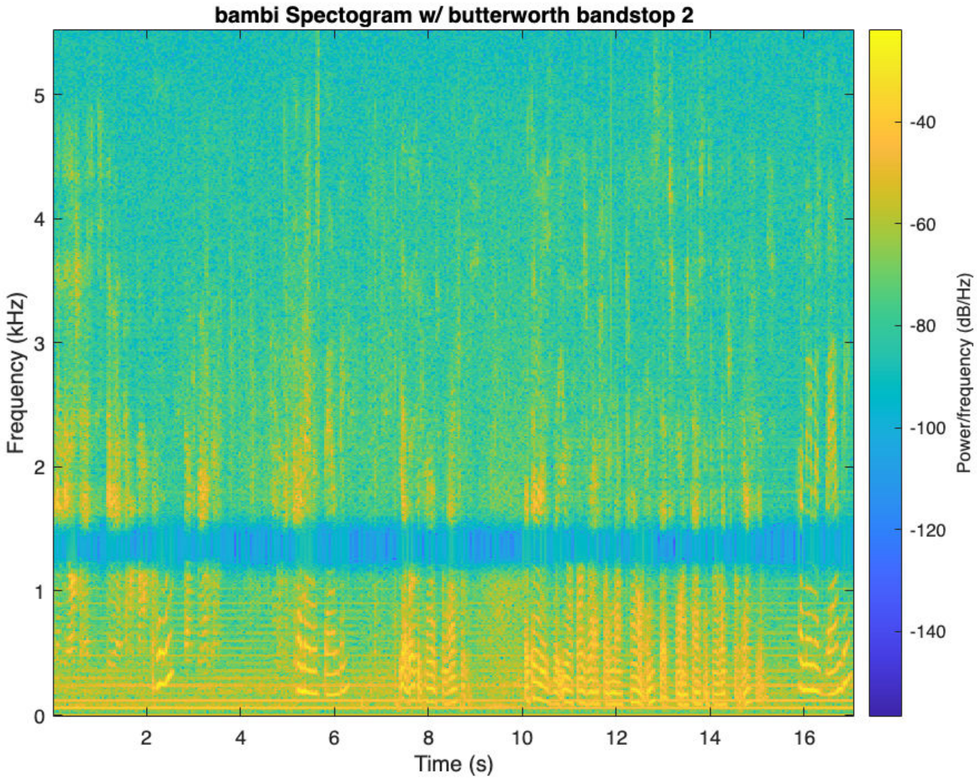

```
figure;
sgtitle('Signals w/ bandstop filter 2')
subplot(3, 1, 1);
plot(t1, y1_bts2);
title("Bambi signal over time");
xlabel("Time(s)");
ylabel("Amplitude");

subplot(3, 1, 2);
plot(t2, y2_bts2);
title("freqSweep signal over time");
xlabel("Time(s)");
ylabel("Amplitude");

subplot(3, 1, 3);
plot(t3, y3_bts2);
title("alarm signal over time");
xlabel("Time(s)");
ylabel("Amplitude");
```



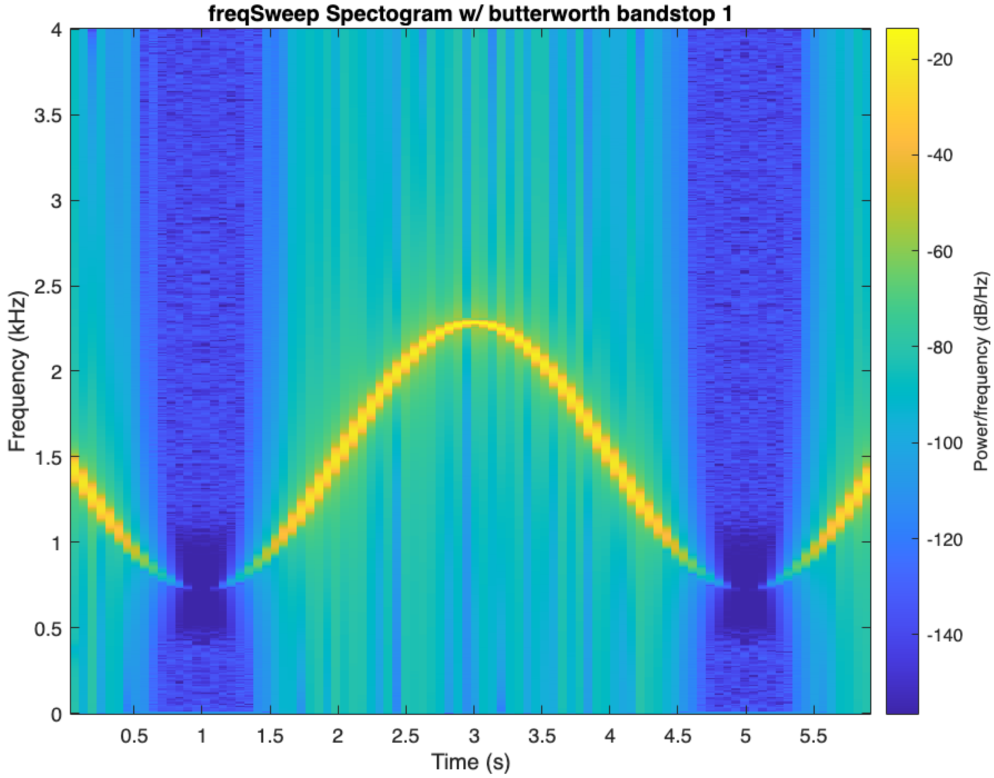

```
% Spectogram of filtered bambi signal
sp_win = 1024;
sp_ovr = 512;
sp_fftN = 1024;

figure;
spectrogram(y1_bts1, sp_win, sp_ovr, sp_fftN, fs1, 'yaxis')
title('bambi Spectogram w/ butterworth bandstop 1')
```



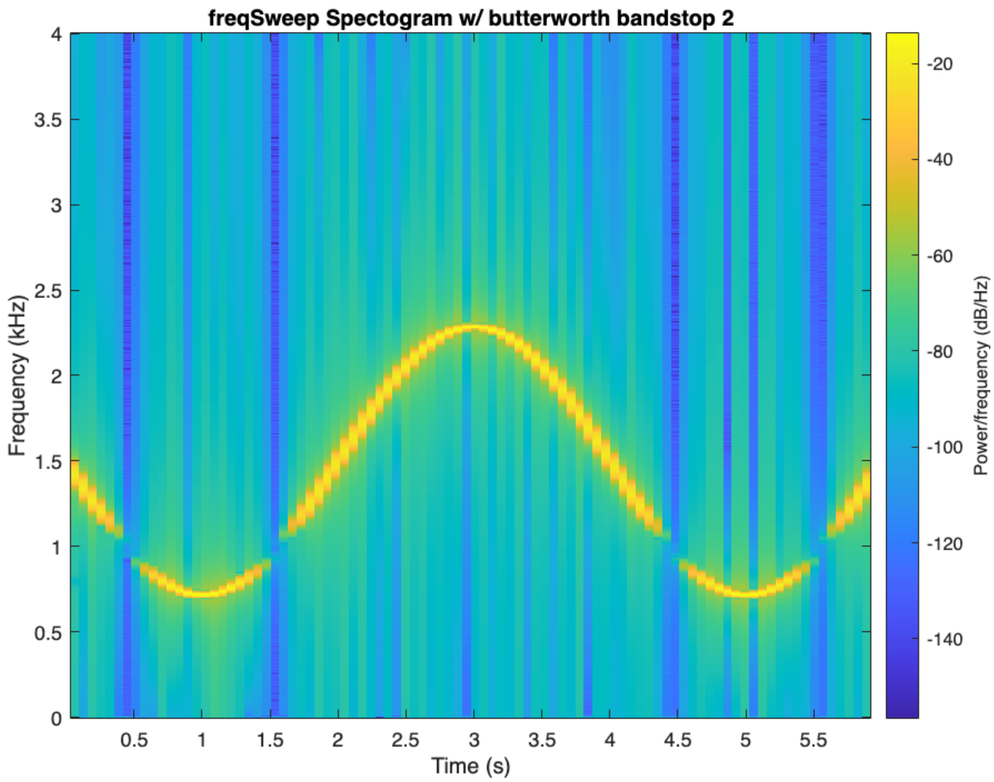

```
figure;
spectrogram(y1_bts2, sp_win, sp_ovr, sp_fftN, fs1, 'yaxis')
title('bambi Spectogram w/ butterworth bandstop 2')
```



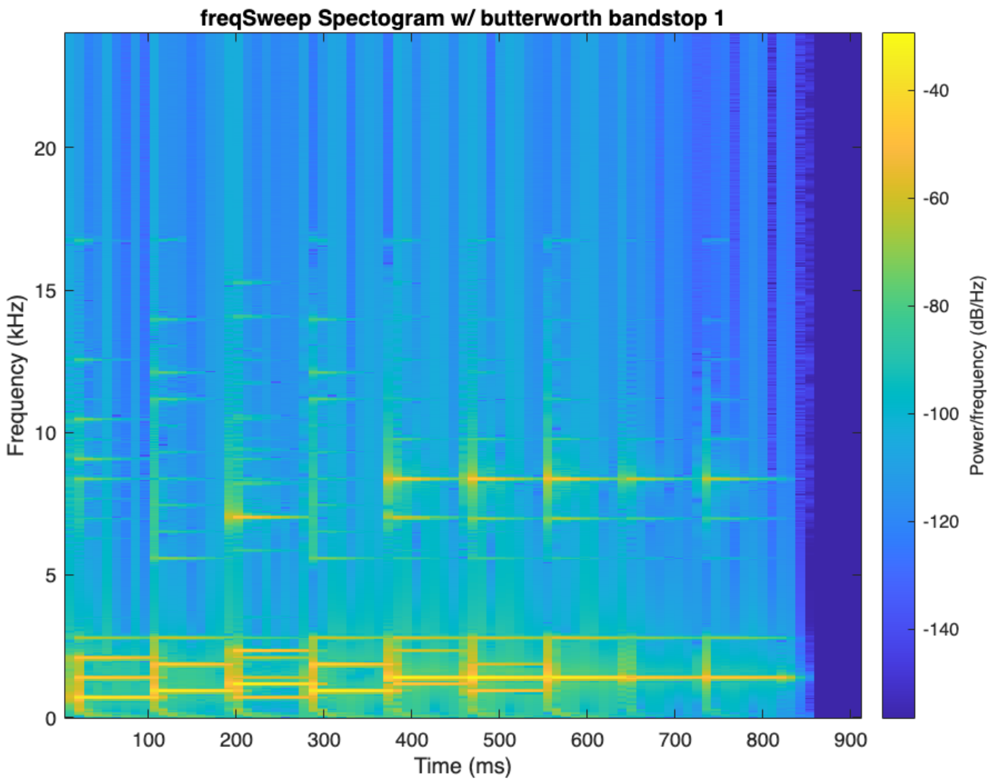

```
% Spectogram of filtered freqSweep signal
sp_win = 1024;
sp_ovr = 512;
sp_fftN = 1024;

figure;
spectrogram(y2_bts1, sp_win, sp_ovr, sp_fftN, fs2, 'yaxis')
title('freqSweep Spectogram w/ butterworth bandstop 1')
```



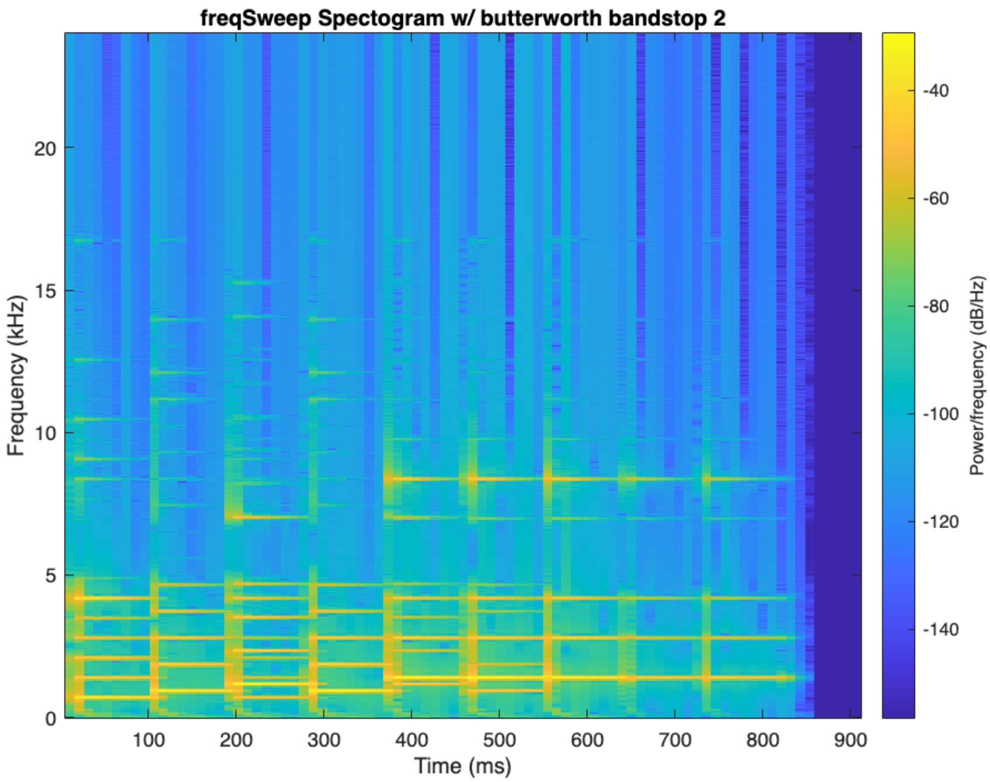

```
figure;
spectrogram(y2_bts2, sp_win, sp_ovr, sp_fftN, fs2, 'yaxis')
title('freqSweep Spectogram w/ butterworth bandstop 2')
```




```
% Spectogram of filtered alarm signal
sp_win = 1024;
sp_ovr = 512;
sp_fftN = 1024;

figure;
spectrogram(y3_bts1, sp_win, sp_ovr, sp_fftN, fs3, 'yaxis')
title('freqSweep Spectogram w/ butterworth bandstop 1')
```




```
figure;
spectrogram(y3_bts2, sp_win, sp_ovr, sp_fftN, fs3, 'yaxis')
title('freqSweep Spectogram w/ butterworth bandstop 2')
```




```
% The 64th order filters do a better job at filtering the desired
% frequencies compared to the 10th order filters.

% From the spectograms, the desired frequencies are more heavily attenuated
% compared to the spectograms of the 10th order filters.
```