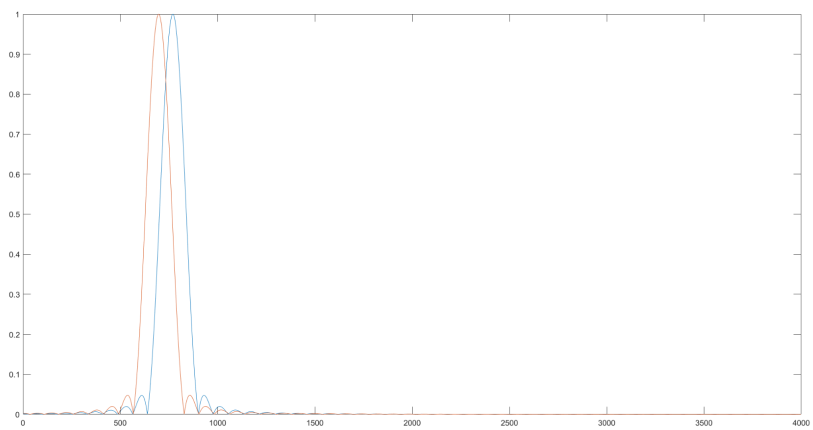
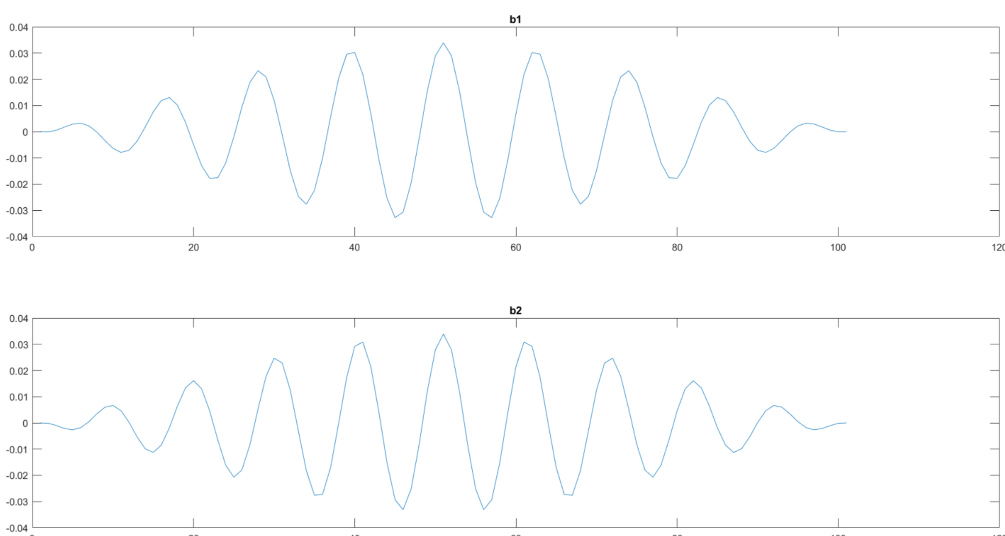
ECEN 133
Jack Landers
Henry Fang

Lab Report 4

Step 1



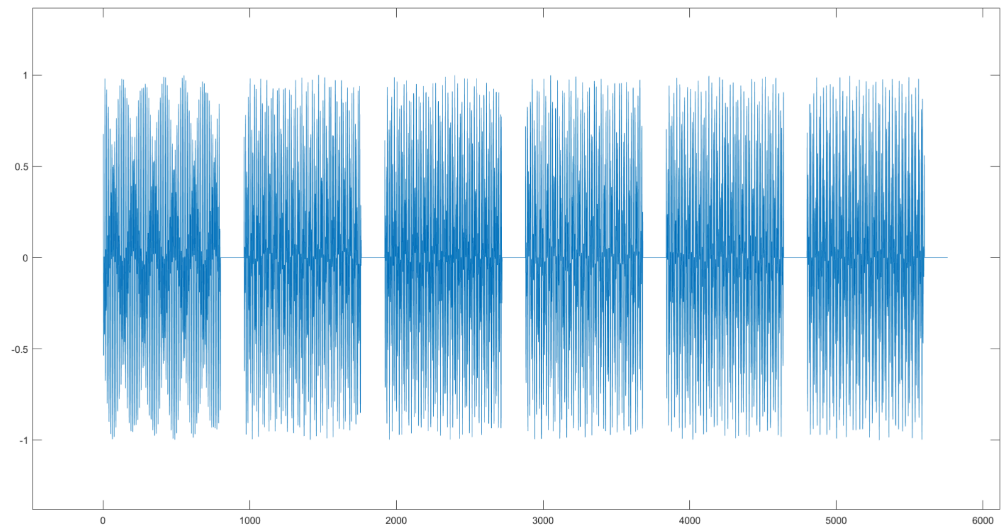
Step 2



B1 has 9 positive peaks and 8 negative peaks.
B2 has 9 positive peaks and 10 negative peaks.
I'm not sure how this relates to the center frequency.

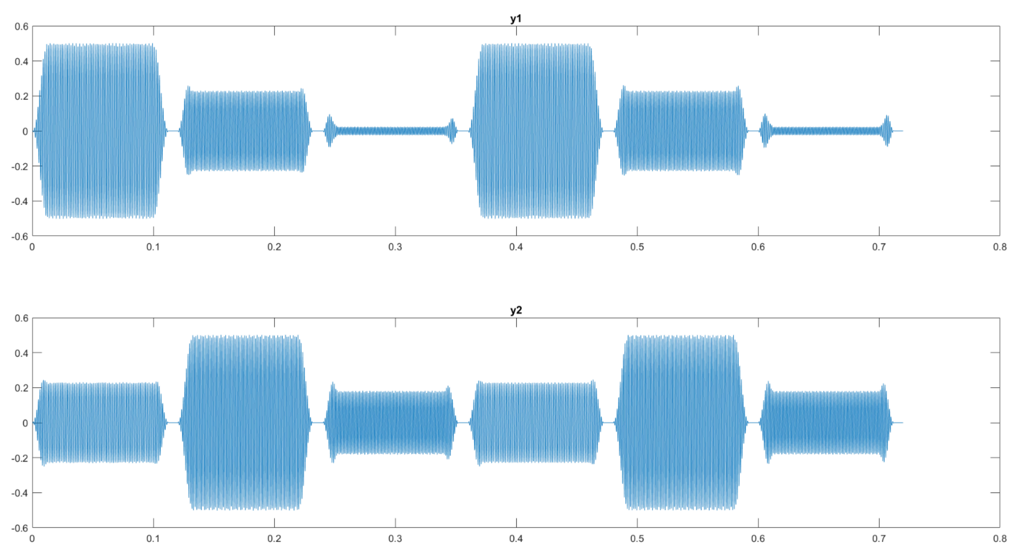
B1 0.03/0.003~=10
B2 0.03/-0.003~=-5

Step 3



Very good sound

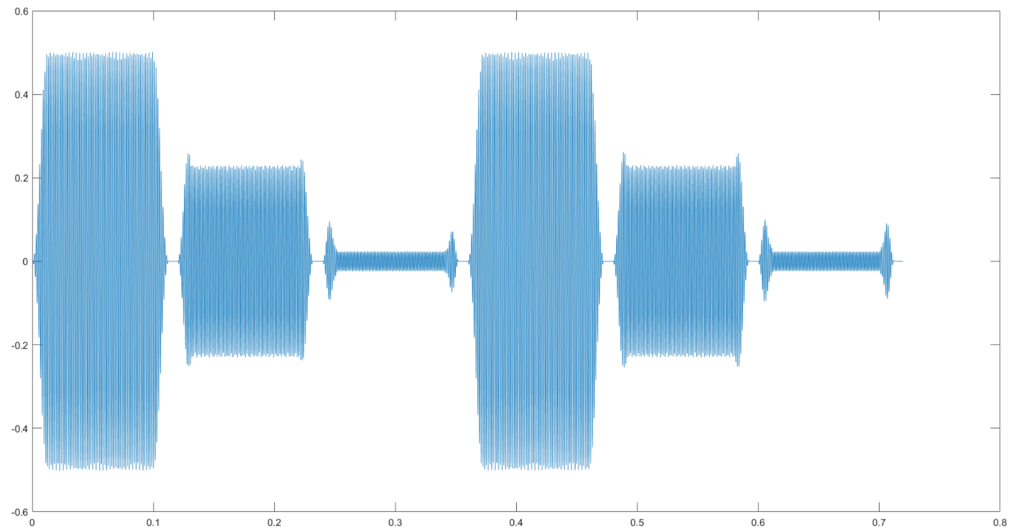
Step 4



The maximum amplitude is 0.5 for b1 and 0.5 for b2. There is no difference in the maximum amplitude between b1 and b2.

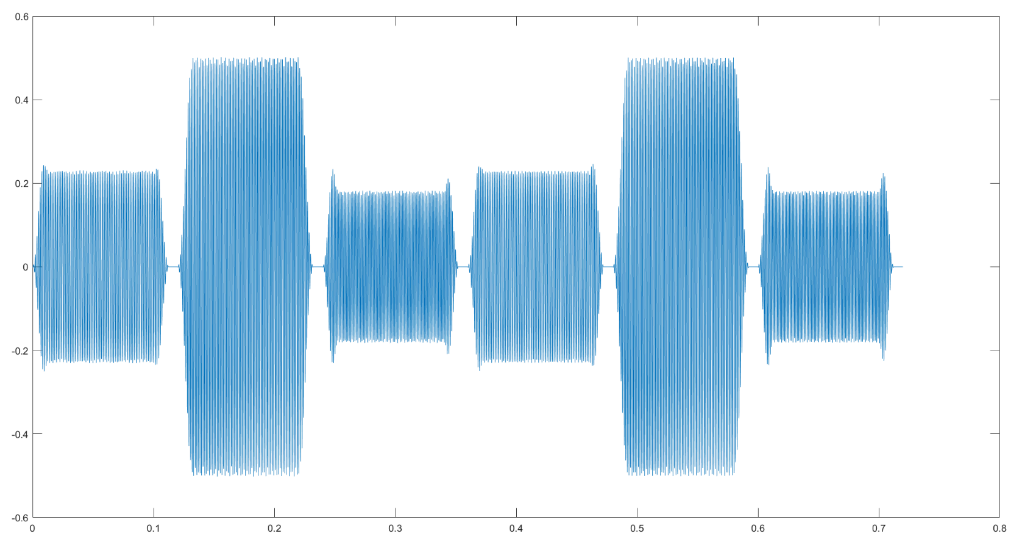
y1

The max amplitude is buttons 1 and 3, showing that it is a low pass filter bandwidth



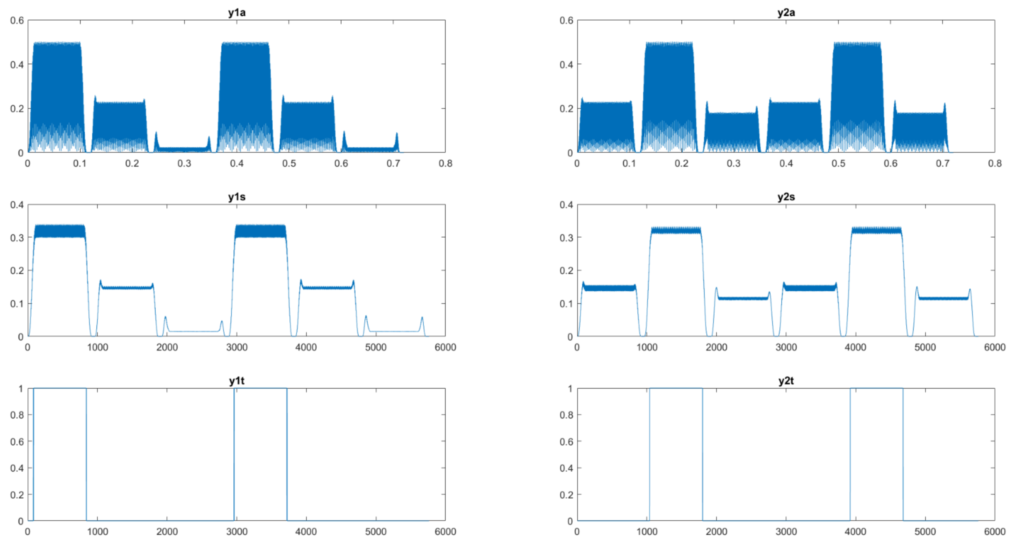
y2

Buttons 4 and 6 are amplified, showing that it is acting as a band pass filter where only frequencies in their range are amplified

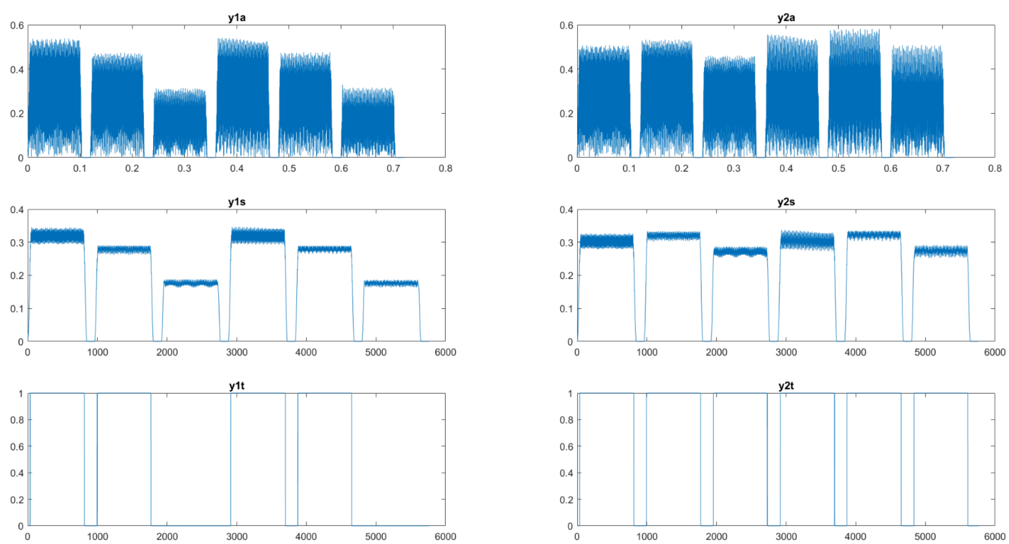


Step 5

F1 is in 697Hz, sample frequency is 8000 Hz, Ts=1/8000, 20 frames* 1/8000 s=0.0025s, 0.0025s*697/s=1.7425 cycles.

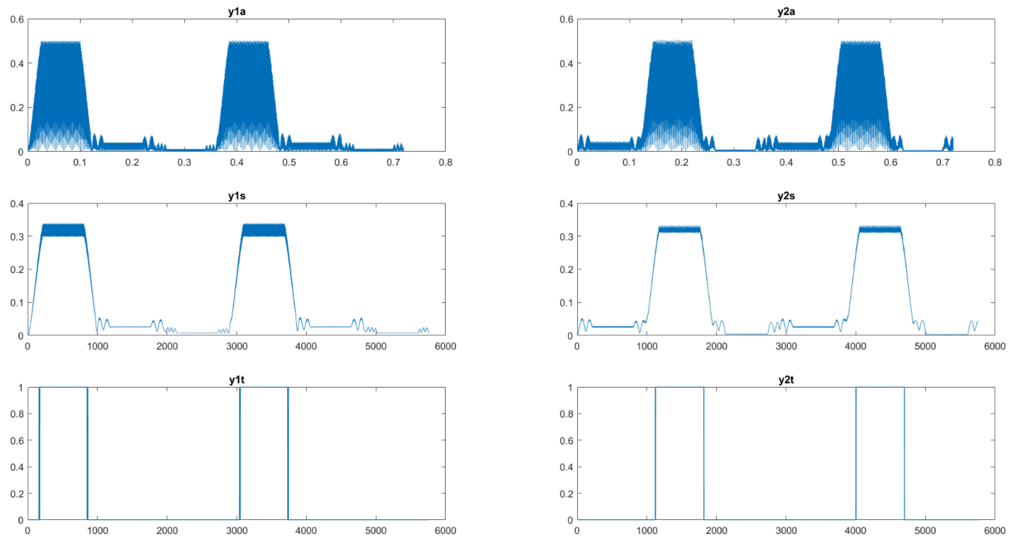


Step 6



M=26

With M=26, we need a more fine-tuned threshold for the filter because the difference between different frequencies is not amplified as significantly.

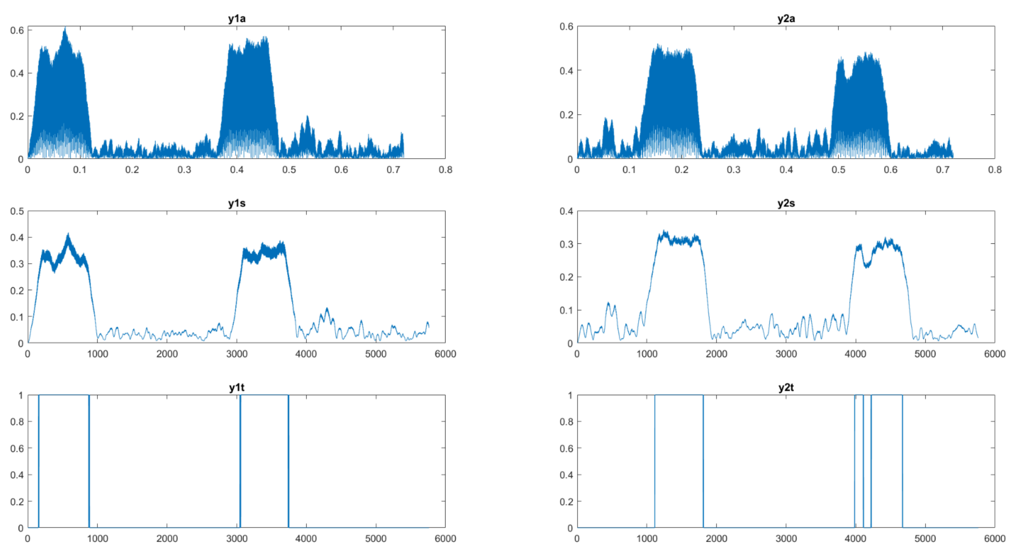


M=200

With M=200 and BW=20, the filter amplifies specific frequencies to a much stronger signal. Our possible threshold limit range is now much greater with such a recognizable difference between the amplified frequencies. We should increase the threshold because the ripples are now higher with a more selective bandwidth.

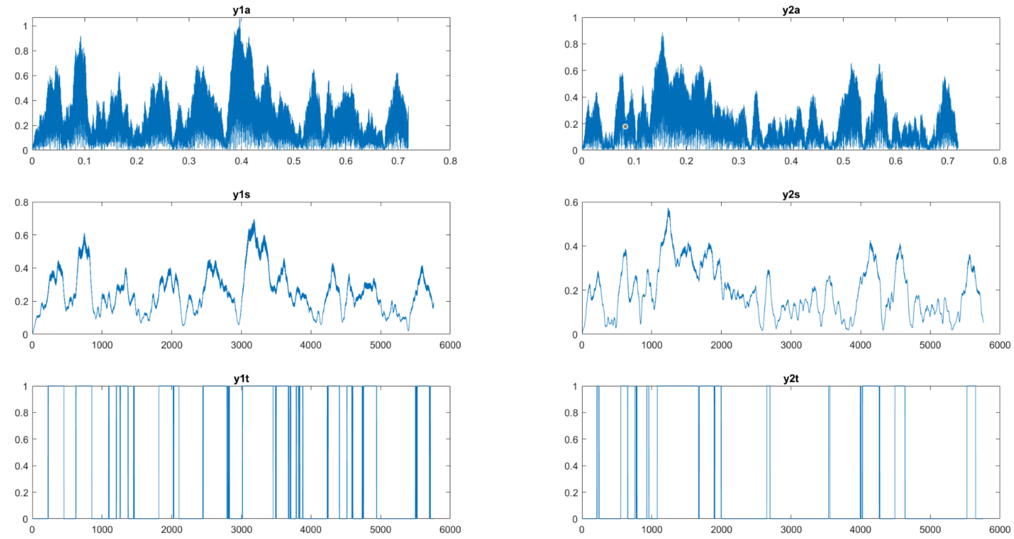
Step 7

aa=0.5



Increasing the aa value introduces more noise to the signal, making the tones more difficult to filter out and less clear. The threshold value should have a tighter limit so that less noise can pass through with the signal.

aa=2



List all the parameters used in making your filter/rectifier detector. What is the effect of changing M? bw? smoothLength?

The M is the order of the filter. A Higher M will have a better attenuation effect on undesired frequencies, making the desired frequency stand out from other frequencies.

The bw is the filter's bandwidth. Greater BW allows more adjacent frequencies to sneak in while looking for the desired frequency, making it harder to distinguish desired frequencies from surrounding frequencies. Narrow BW will decrease the number of adjacent frequencies that sneak in, but the trade-off is more ripples around the desired frequency. Many narrow BW channels will build up the ripples to cover the frequencies in cross-talks and noises.

The SmoothLength is the MA period of absolute frequency responses. A greater SmoothLength makes the smoothed signal more stable or “smooth.” This makes the filter easier to distinguish on and off. But the price we paid is the duration on the plateau, making the filter less time to catch logic high.

In the design process for this lab, we tried to suppress nearby row and column frequencies by a large factor. However, your detector might still work reliably with less attenuation of nearby DTMF frequencies. Considering the tests you did in this lab, how much attenuation of nearby DTMF frequencies is needed for reliable operation in a noise-free environment? What is the impact of added noise?

In a noise-free environment, theoretically, if SmoothLength is equal to the duration of the dial time and the computer is fast enough, we have a tip to trigger the logic function. The difference between the tip and surrounding is distinguishable by an extremely small difference. Any small attenuation will make DTMF frequencies work reliably.
When noise impacts, we must ensure the logic function is not mis-triggered.
For that, we need to increase the logic function's threshold. Then, we must make the gap between the two frequencies' responses bigger. Finally, we need M to be bigger to increase the attenuation.