EE 513 HW3

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February 18, 2017

1 Problem 3.2a

The PSD of the recorded room noise is shown in Figure 1, the filter designed to match this noise is shown in Fig. 2. The resulting filtered white noise through this filter is shown in Fig. 3.

Having listened to the white noise before and after filtering, it is clear that some of the higher frequencies have been attenuated, removing some the 'hissing' sounds. However, the general sound of air traveling by your ears is the same, as the majority of the spectrum is not varied by much.

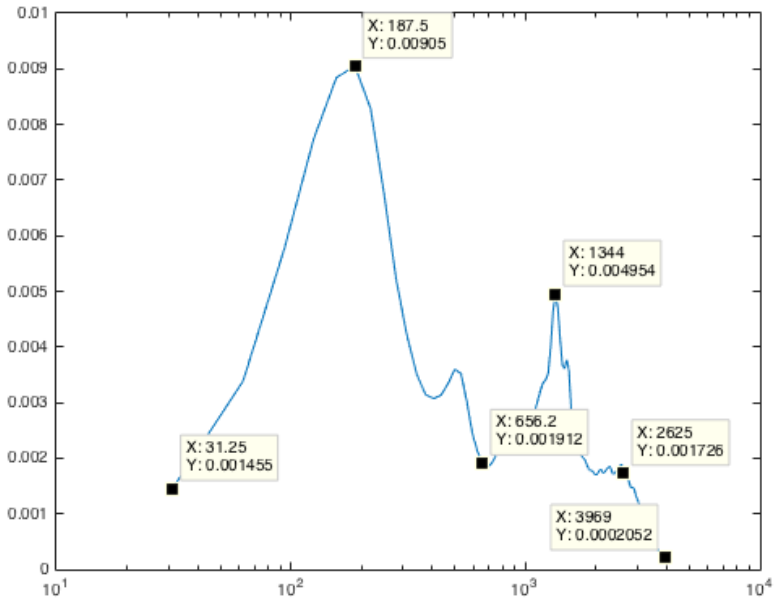

Figure 1: PSD of room noise, annotated with points used to create the FIR filter.

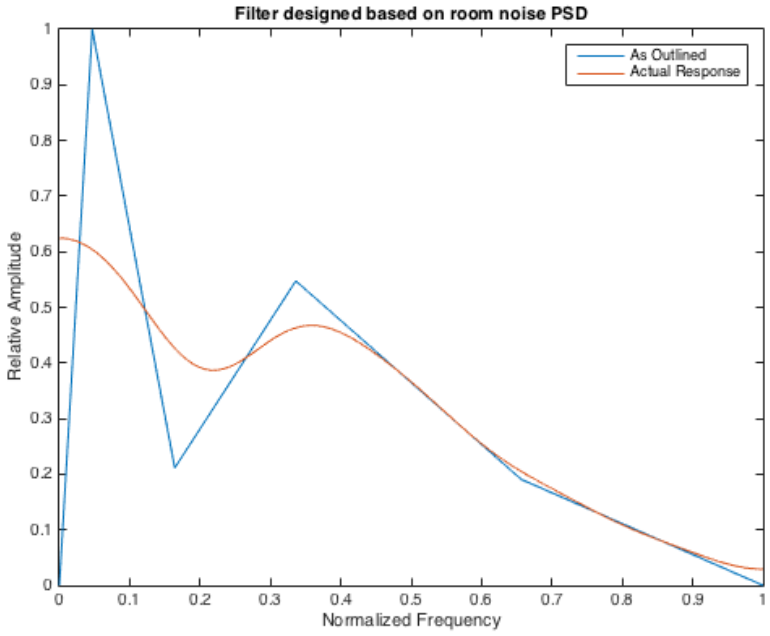

Figure 2: Filter designed on room noise.

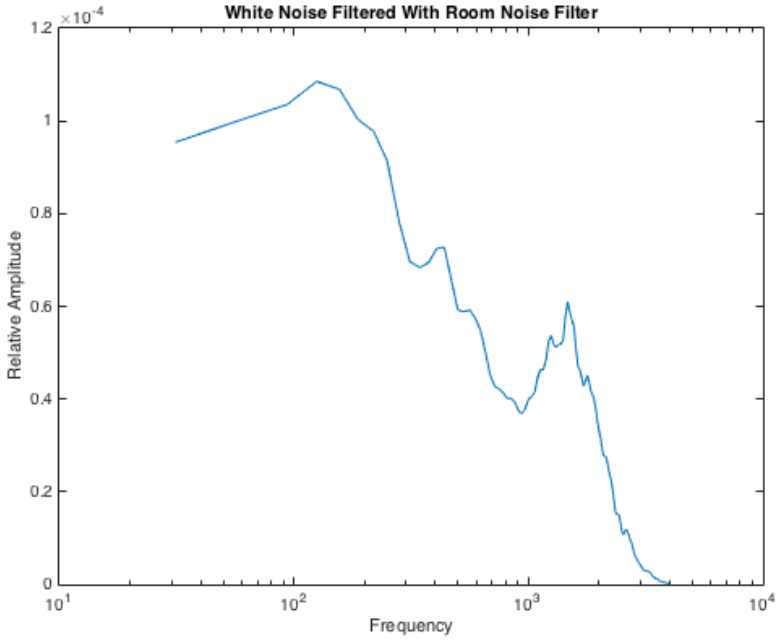

Figure 3: PSD of white noise through filter in Fig. 2.

2 Problem 3.2b

Most of the noise elimination that was able to be done on the recorded voice signal was the high frequency hissing.

The PSD of the voice recording with room noise is shown in Fig. 4. It is annotated with key frequencies and amplitudes indicating the voice portion of the signal. The fan harmonic peak is not included in the filter, eliminating much of the room noise. The filter designed to attenuate the noise is shown in Fig. 5, and the resulting PSD of the filtered voice signal with noise is shown in Fig. 6.

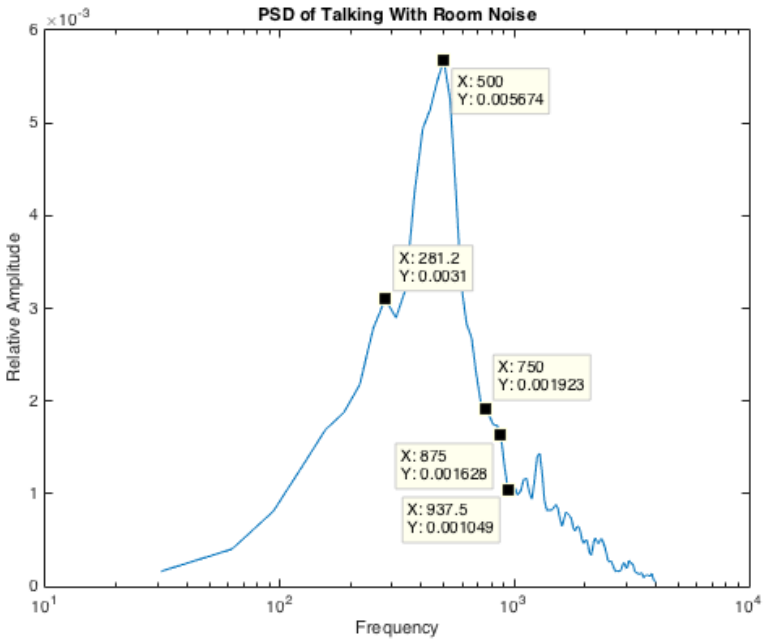

Figure 4: PSD of room noise with voice signal, annotated with points relevant to the design of the room-noise canceling filter.

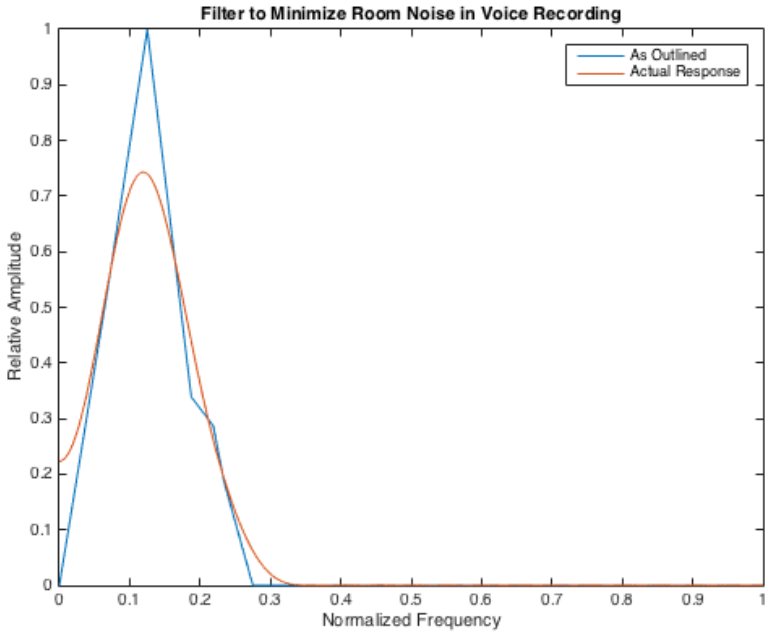

Figure 5: Filter designed on room noise.

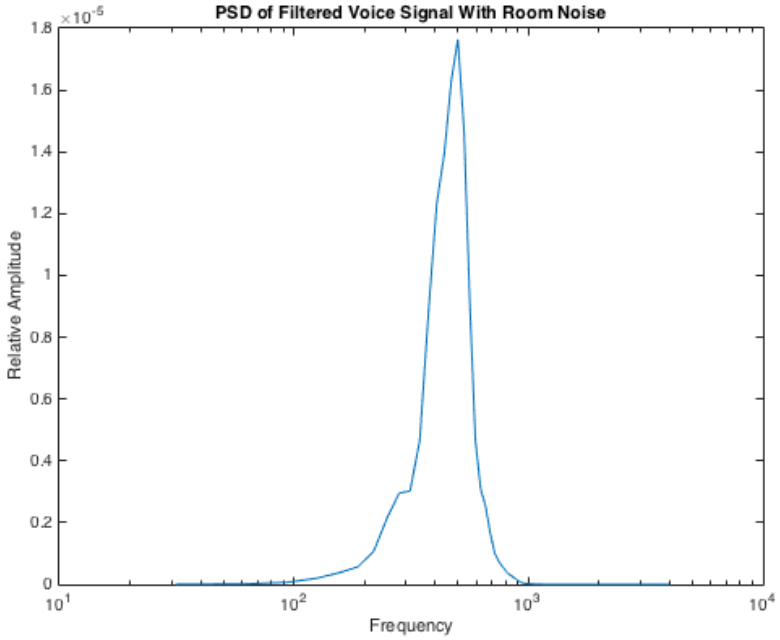

Figure 6: PSD of white noise through filter in Fig. 2.

3 Problem 3.3a

The solution to this question is included in the uploaded zip.

4 3.3b

A unit sinusoid was clipped at +/- 0.75, the two overlaid and shown in Fig. 7. The PSD of the unclipped sinusoid is shown in Fig. 8 and the PSD of the clipped sinusoid is shown in Fig. 9.

They are annotated to show the data points from which the THD was estimated.

Using the method of harmonic power ratios, the THD was calculated to be 55.3%. This is shown in Eg. 1.

$$THD = \frac{10^{5.9/10} + 10^{-12.1/10} + 10^{-22.7/10} + 10^{-32.7/10} + 10^{-32.11/10}}{10^{8.7/10}} = 55.3\% \quad (1)$$

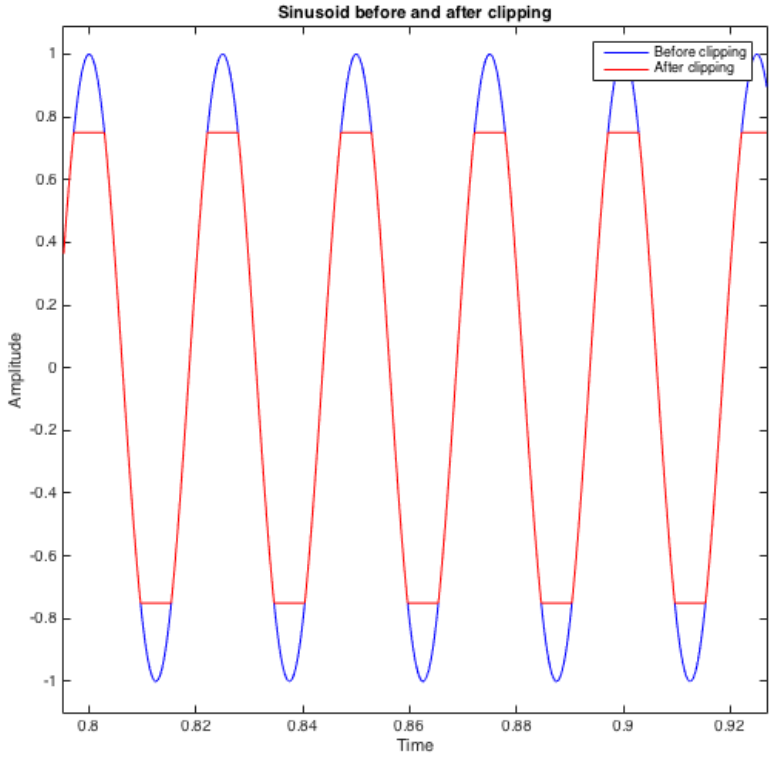

Figure 7: Time domain plot of input signal showing clipping occurring.

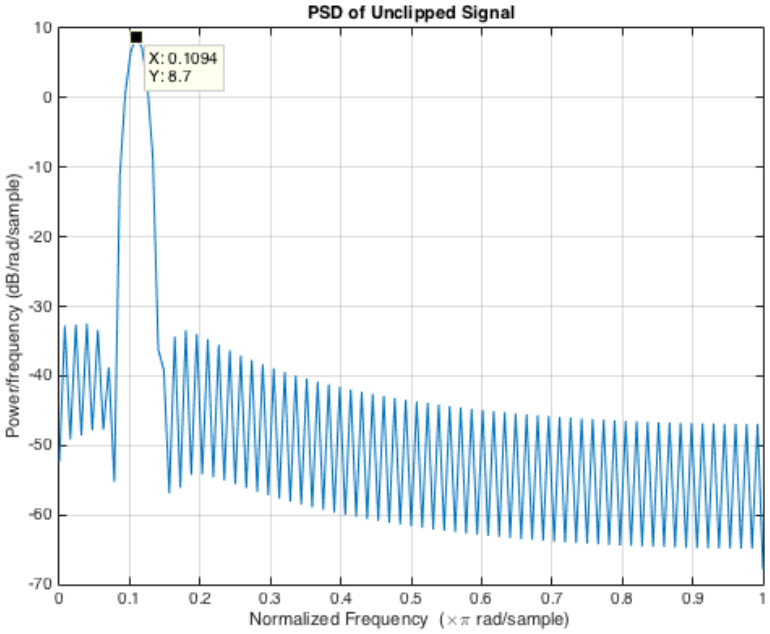

Figure 8: PSD of the unclipped signal; no harmonics.

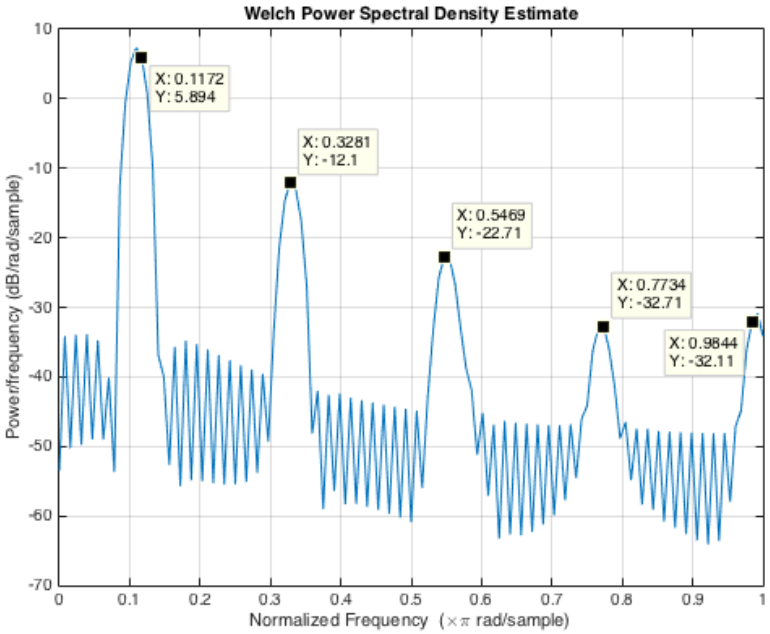

Figure 9: PDF of the clipped sinusoid, showing the introduced harmonics.