Lab P8 - Digital Images: A/D and D/A

(Matthew Lowery, Timothy Felt)

3.1 Detecting aliasing in a downsampled lighthouse image

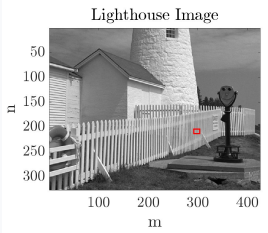

Figure 1

In images, it is visually intuitive when aliasing has occurred, e.g. blurring, rough edges (see figure 2; figure 3).

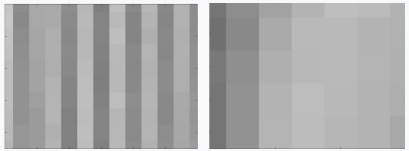

Figure 2. (Left) Zoomed in region of the red box of Figure 1 and (Right) same region in the downsampled image.

We detect it using DSP if we show there is frequency content in the original image higher than the Nyquist frequency of the downsampled image.

Thus, the downsampled image can not represent it.

3.2 Signal reconstruction of the downsampled lighthouse image

Different methods for reconstruction result in different qualitative results (figure 3), i.e.
– A *zero-order hold* method produced higher contrast edges
– *bilinear interpolation* softens the edges

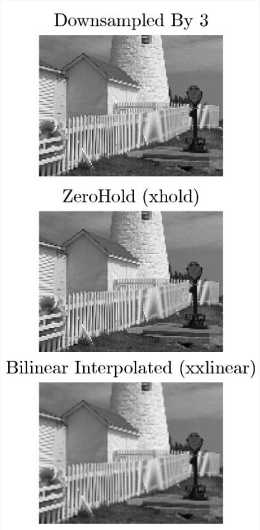

Figure 3

Nonetheless, we can not undo the aliasing. The original higher frequency is lost in downsampling and permanently conflated with lower frequencies.

Lab S8 - Spectrograms: Harmonic Lines & Chirp Aliasing

(Joshua Palter, Ryan Zarekarizi, Jordy Larrea Rodriguez)

2.1 Using a spectrogram to detect aliasing in a chirp signal

Here we observe consequences of sampling a signal of up to 11k Hz at 4k Hz for a spectrogram.

Data is lost for two reasons:
– the Nyquist Theorem: we lose values above/below +- (the sampling rate)/2
– Spectrograms only "see" the magnitude of a signal (how much energy it has in a point in time), i.e. they lose negative values

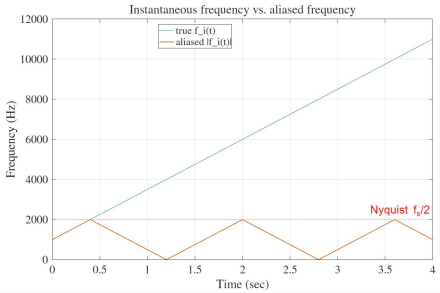

Figure 4

This means that for a relatively large range of frequencies we only end up seeing a range of [0, (the sampling rate/2)], or [0, 2000] Hz in this case (figure 4).

2.2 Understanding the Harmonic Line Spectrum of a Periodic Triangle Wave via different Spectrogram amplitude scales

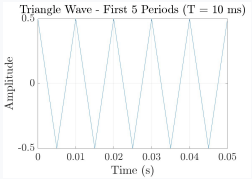

Figure 5

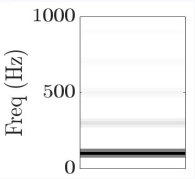

Figure 6

Periodic signals, such as the triangular signal (fig 5) contain harmonics. These harmonics can be observed when going from the time-domain (fig 5) to the frequency-domain (fig 6).

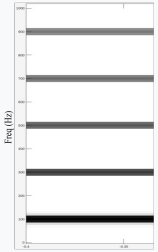

Figure 7

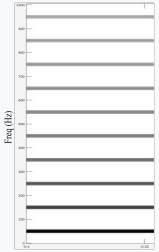

Figure 8

Spectrogram in dB of a 10 msec (fig 7) and a 20 msec (fig 8) triangular periodic.