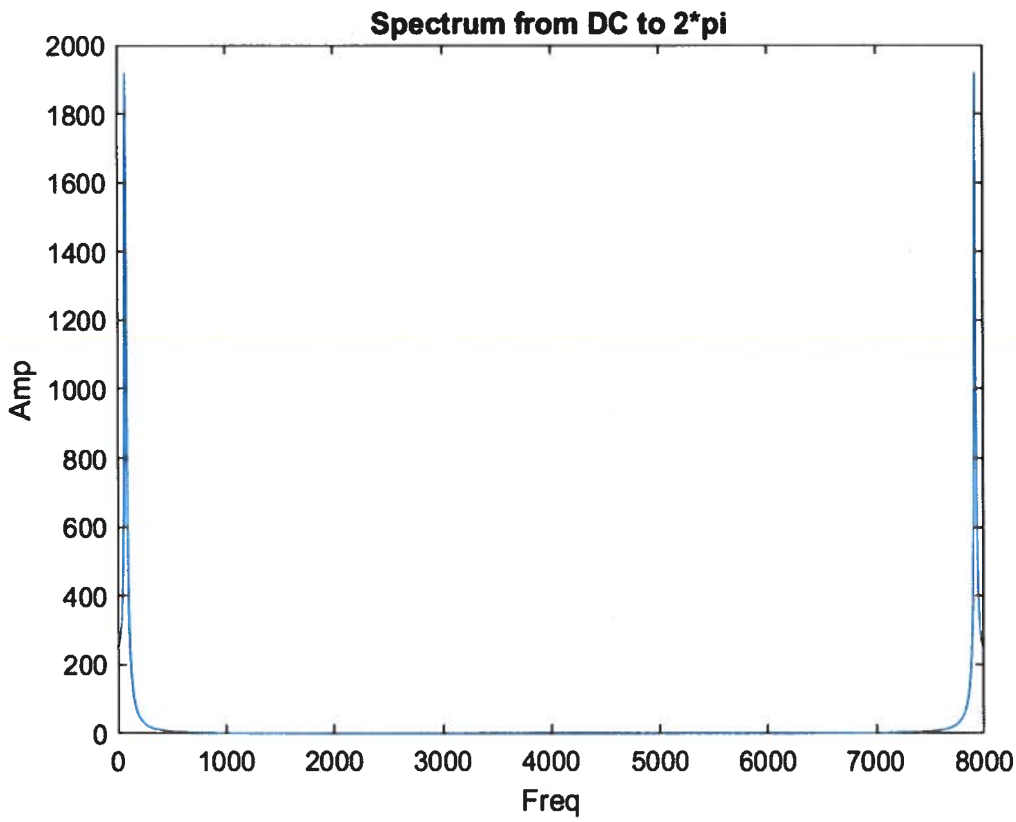
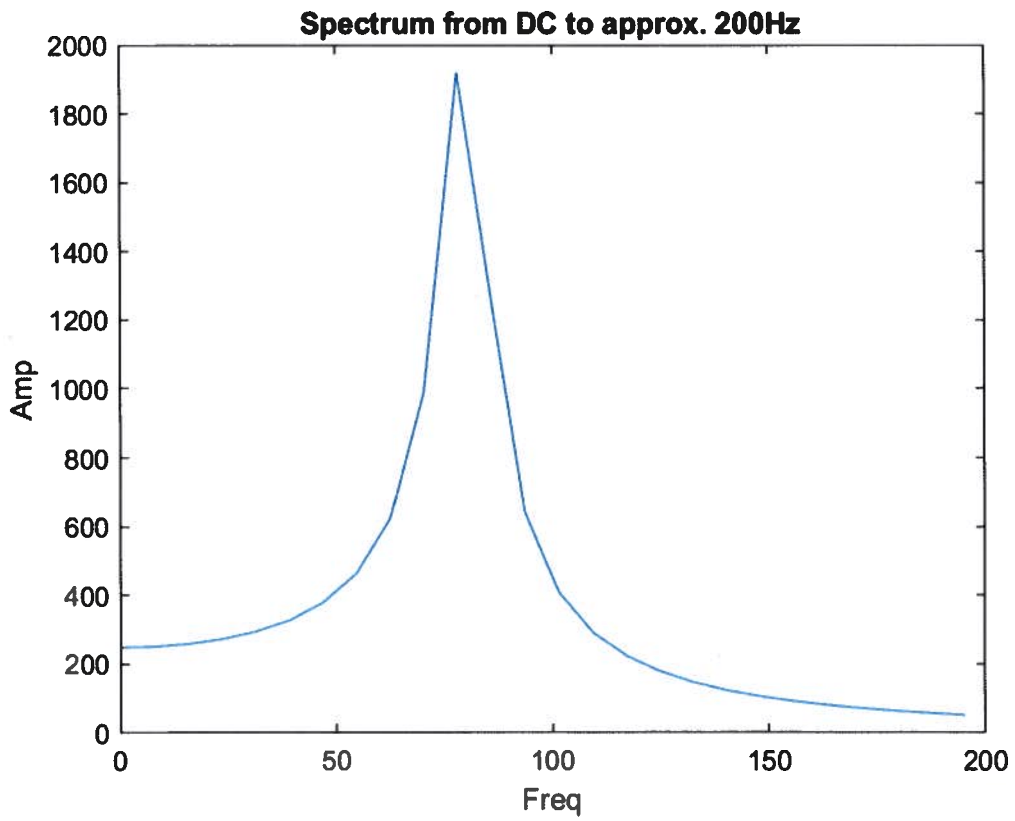
The spectrum of the damped sinusoid calculated using a 1024-point FFT



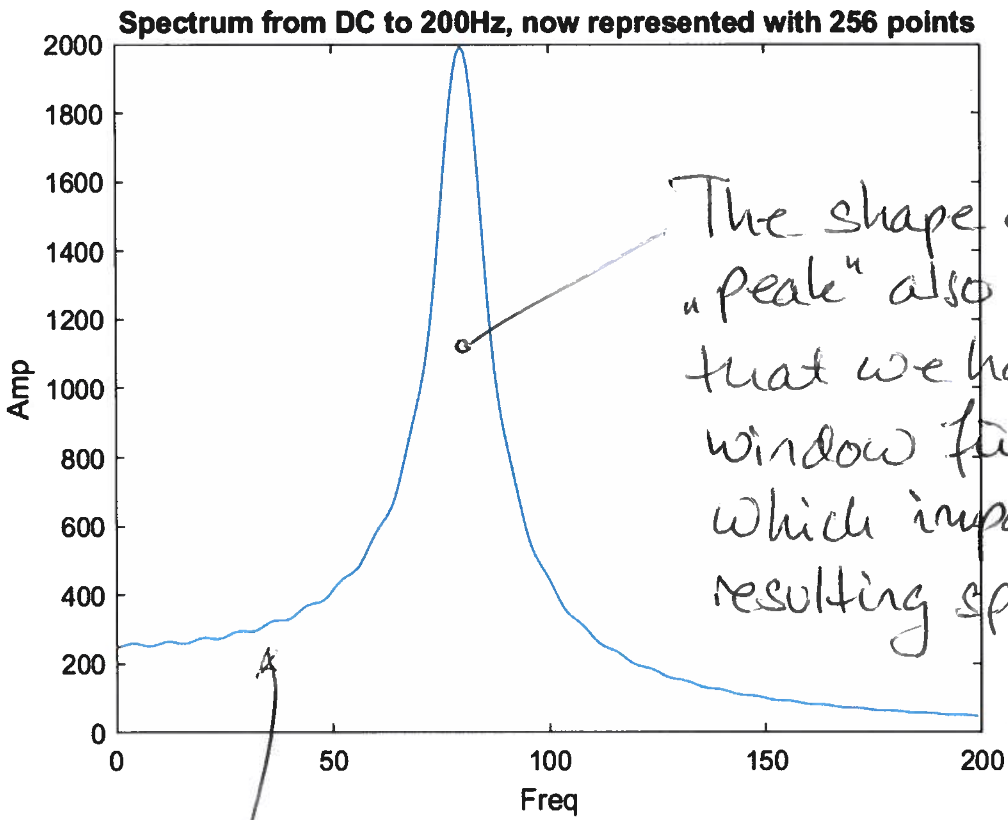
(2)

Here we have zoomed into the freq.-interval DC to ~200 Hz. We clearly see the 80 Hz sinus but we also see the damping in terms of information close to DC. The damping is a decreasing exponential, i.e., a very slowly varying signal ~ DC.



Now, since we have only 26 points in this freq. interval, there is no pin located in $f = 80$ Hz (exactly). The peak i located i $f = 78{,}125$ Hz

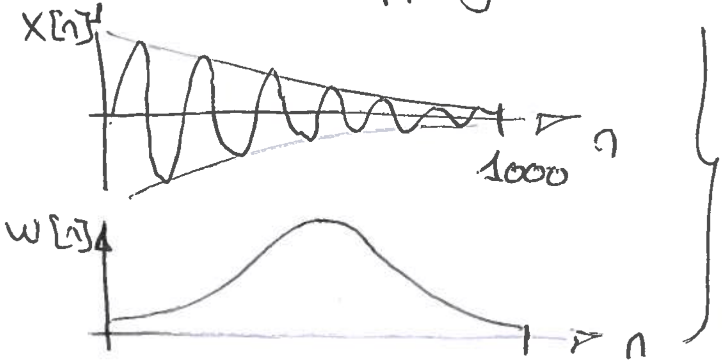
Increasing the number of points with af factor of 10 (to 256) we now a pin located in f = 79,7 Hz — „much" closer to the actual peak. For that reason we can also see that the peak has increased in height



The shape of the „peak" also indicates that we have a window function which impacts the resulting spectrum.

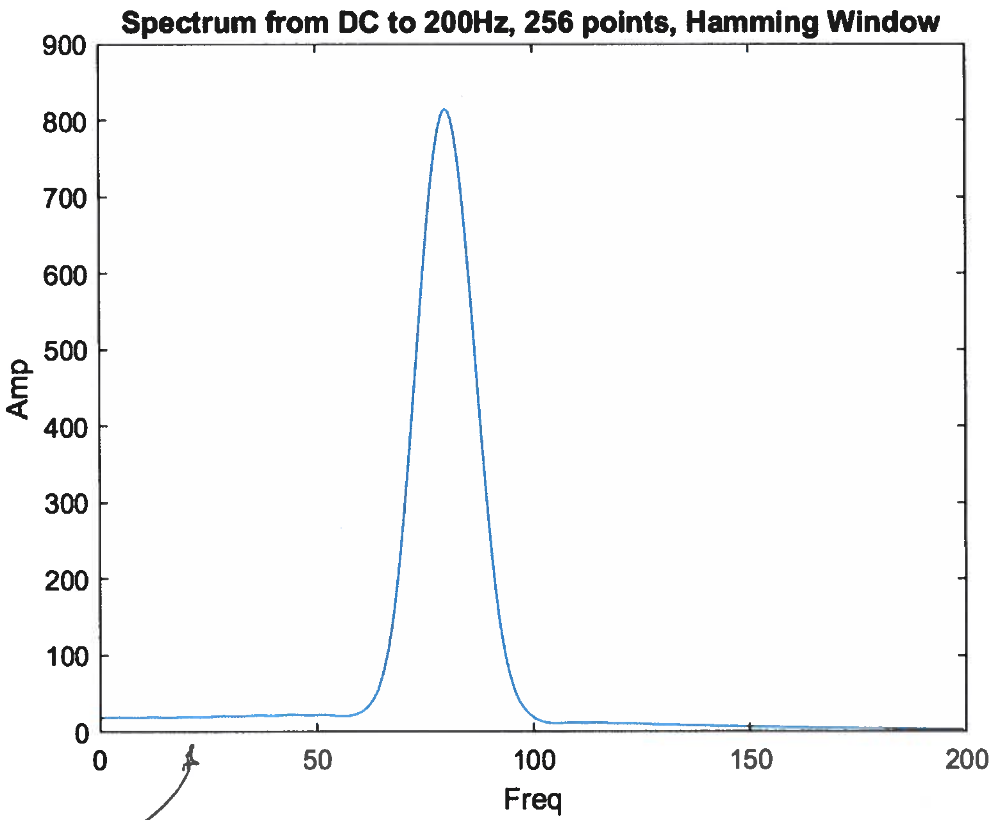
You should also note these little ripples here which are due to the application of the Rectangular window (i.e. no window).

In order to reduce the side lopes we now apply the Hamming window



$s[n] = x[n] \cdot w[n]$

After multiplication we zero-pad to 10240.



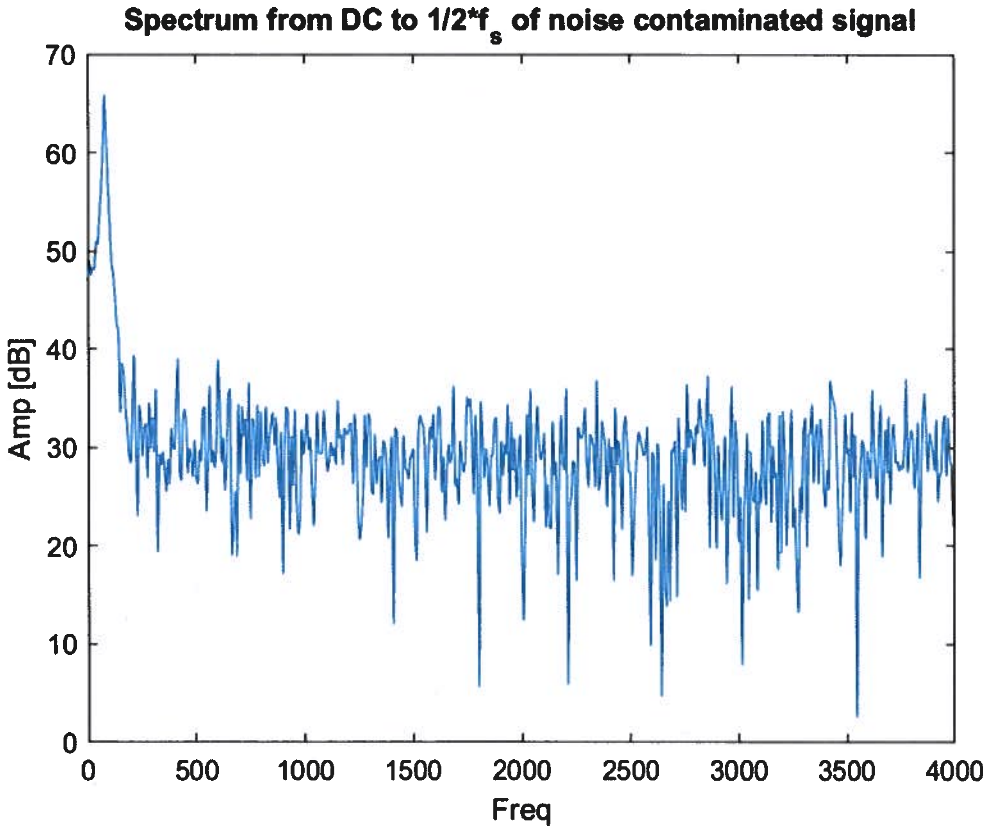
Note that we still have some low-freq. content in the signal — but the ripples have decreased significantly.

The shape of the peak is mainly influenced by the mainlope of the Hamming window.

5

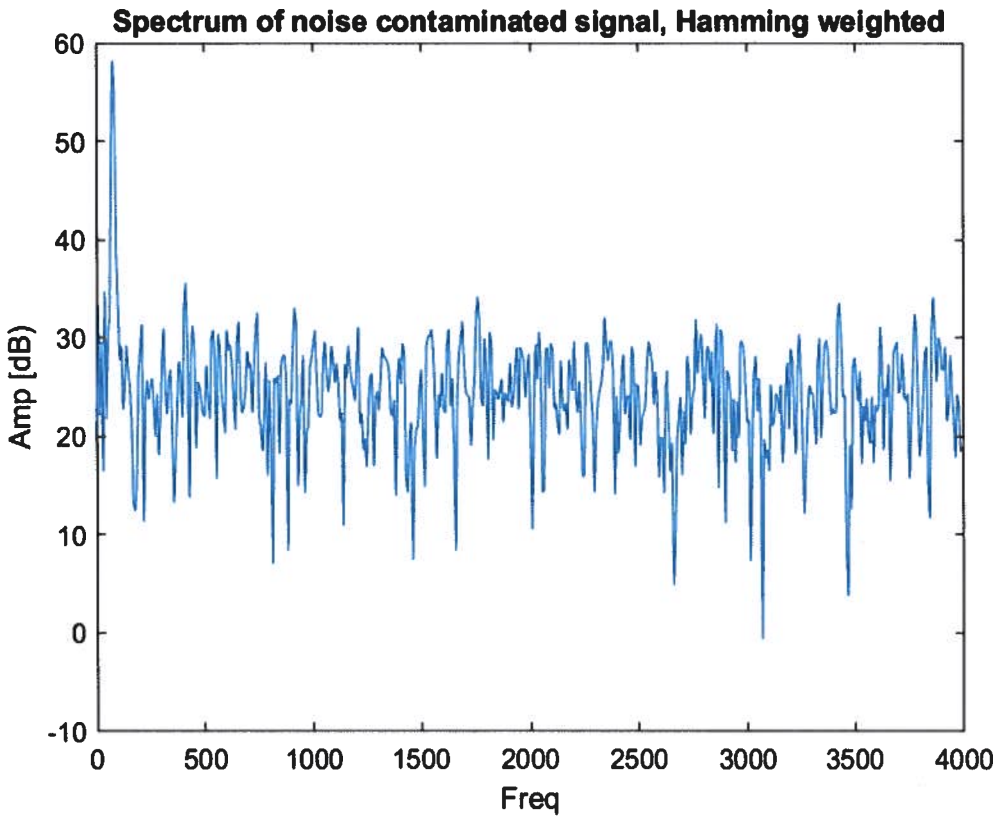
The noise overlaying the signal is a white signal — this is also clear from the spectrum where we see that the noise spectrum is „flat".

A reasonable estimate is that the amp. of the noise is 30 dB, and the signal is approx 65 dB.



So, the noise is approx. 35 dB (x 56) lower than the signal — this is a quite good signal-to-noise ratio.

Here we have applied the Hamming window to the noise contaminated signal and next conducted spectral analysis (1024-point FFT). We see that the noise is still approx. 35 dB lower than the signal — consistent with rectangular window.



Similarly, we see that the noise spectrum is „flat" ~ white noise (at least in the interval investigated).