



Digital version

ENGS254 Signals and Systems Lab

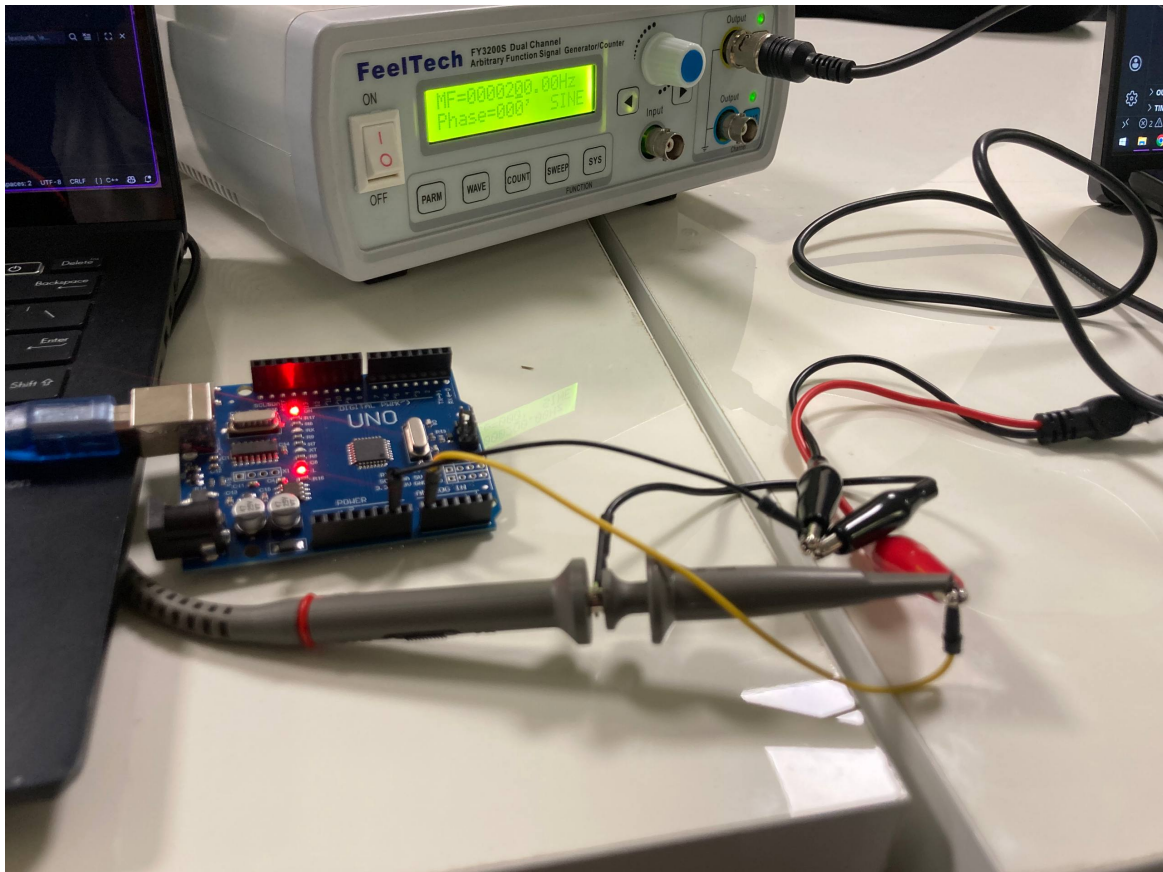
Sampling signals with an Arduino

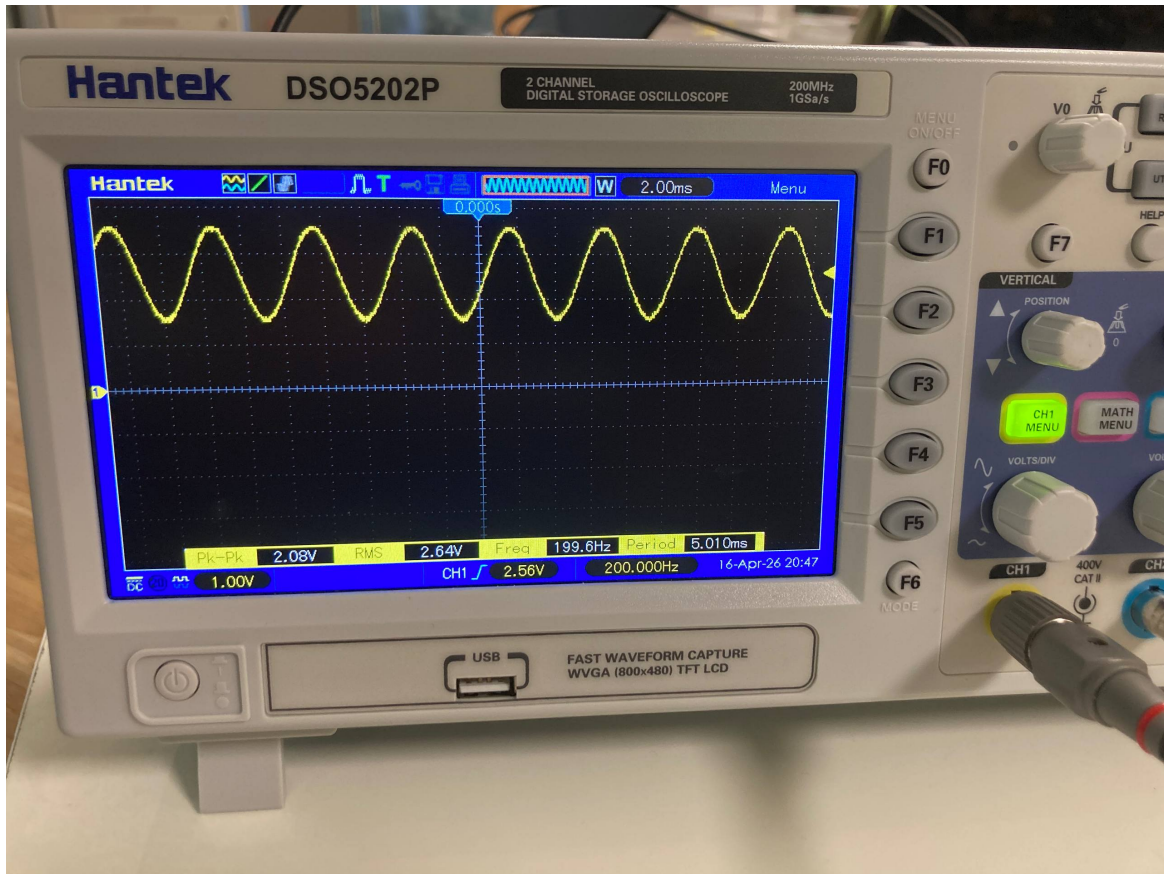
Mher Saribekyan A09210183

April 22, 2026

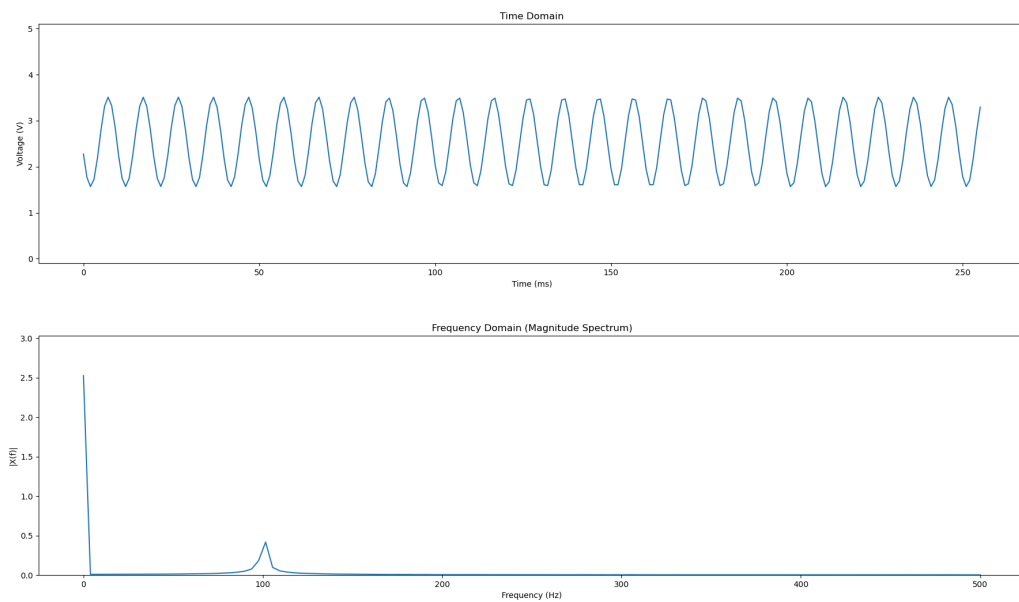
The lab

A signal generator was connected to an analog input (ADC) pin of an Arduino Uno. A signal generator was setup to output sine wave with amplitude of at 2 volts, and an offset of 2.5 volts.



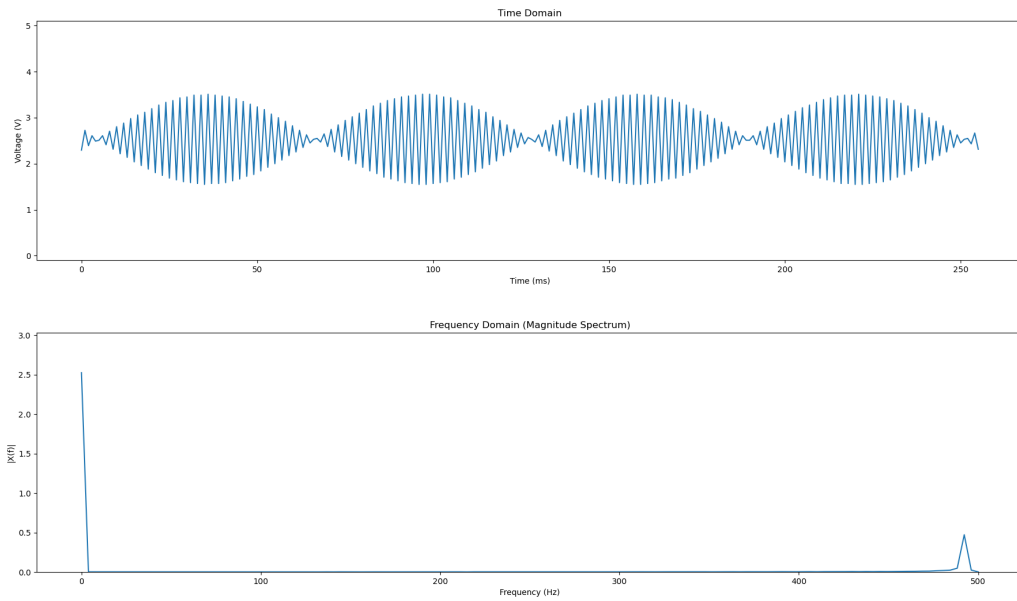


The signal was sampled at a 1000 Hz sampling rate, and groups of 256 samples were visualized on the computer. The FFT was calculated for the sampled data. Different frequencies were supplied and the sample was observed.



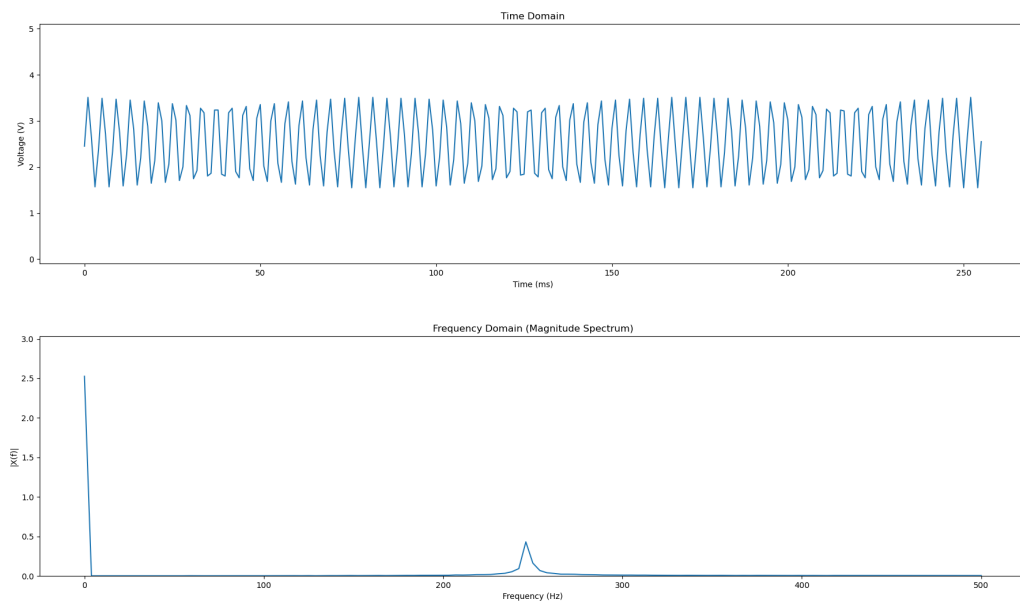
100Hz sine wave

The Nyquist limit for our sampling system is half the sampling rate, which becomes 500 Hz, which means that frequencies above that are lost while sampling. For the 100 Hz signal, we can clearly see the reconstructed sine wave.



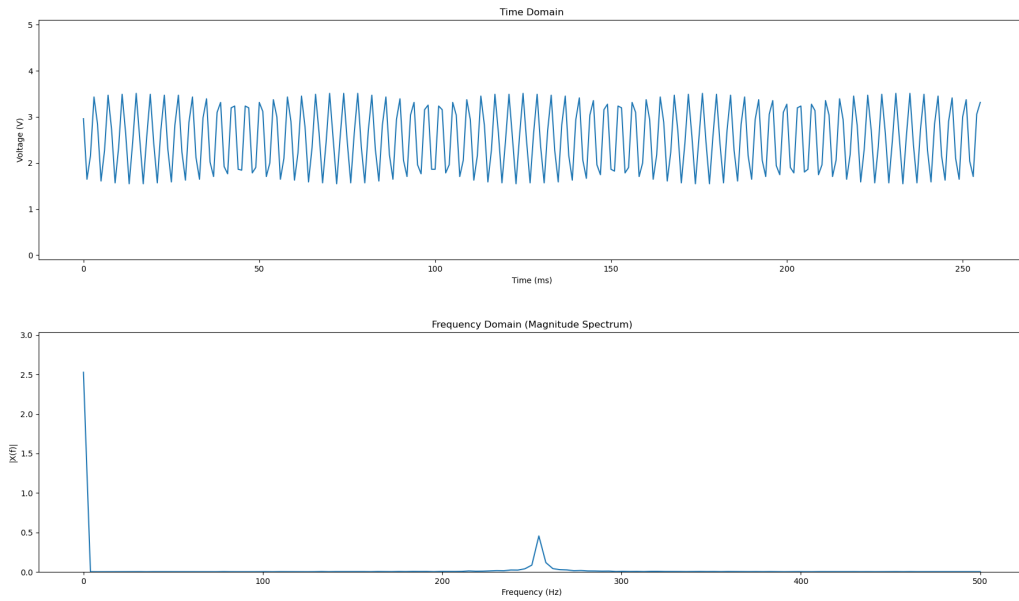
100Hz sine wave

At 490 Hz, we are very close to the Nyquist limit. The amplitudes and the shape do not represent a sine wave, however we can still see the clear 490 Hz mark on the FFT.



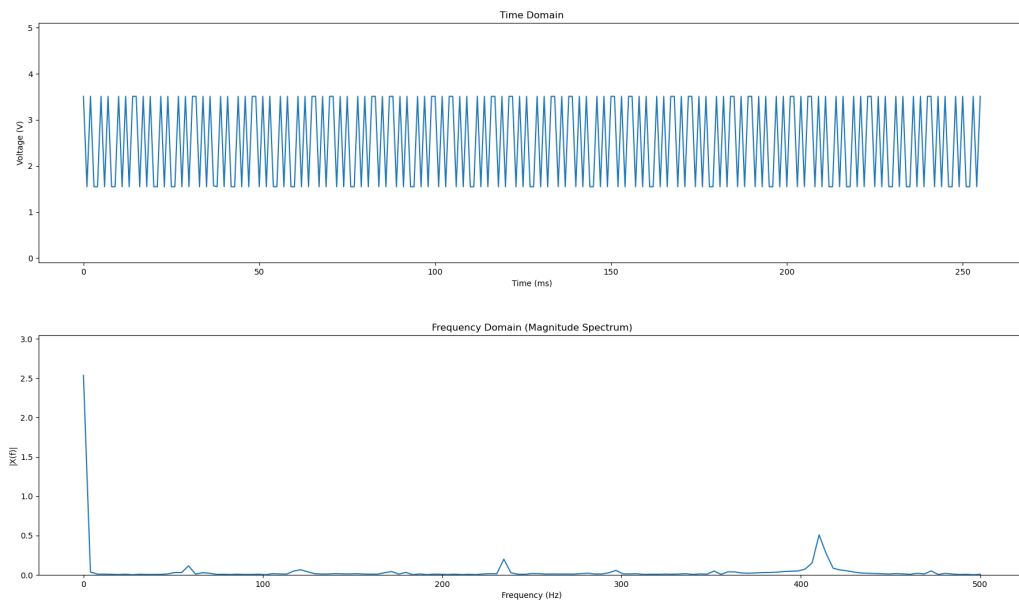
490Hz sine wave

At 750 Hz, which is above the 500 Hz Nyquist limit, the peak in the FFT is mirrored around the 500 Hz point onto 250 Hz. Our system recognizes a 750 Hz wave as a 250 Hz wave.



1250Hz sine wave

Similarly for the 1250 Hz, it is once mirrored at the 500 Hz mark, and once at the 1000 Hz mark, giving the same 250 Hz on the sampled signal. Here also, the 1250 Hz signal is lost, and instead we see a 250 Hz signal.



410Hz square wave

For the square wave of 410 Hz, we should be seeing peaks on the FFT at odd harmonics (410 Hz, 1230 Hz, 2050 Hz ...). But since we are limited to 500 Hz, those frequencies are aliased, and we see 410 Hz, 230 Hz and 50 Hz peaks on the FFT.

Conclusion

Sampling rate should be at least twice the frequency we are trying to measure. to prevent aliasing, an input low-pass filter around half of the sampling rate should be placed, to prevent high frequencies getting sampled and aliased into lower frequencies, destroying the digitized signal.