Introduction to Electronic Instruments Low Pass Filter

Results and Analysis

ENPH 253

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Results and Analysis

The transfer function (equation 4 in the lab book) was used to predict the relationship between frequency and the ratio of output voltage to input voltage. Then experimental data was taken to validate the correctness of the transfer function. Both methods are plotted in Figure 1 below. Also present in Figure 1 is the calculated cutoff frequency of the low pass filter; the point at which the output voltage is only half of the input voltage (3dB of loss).

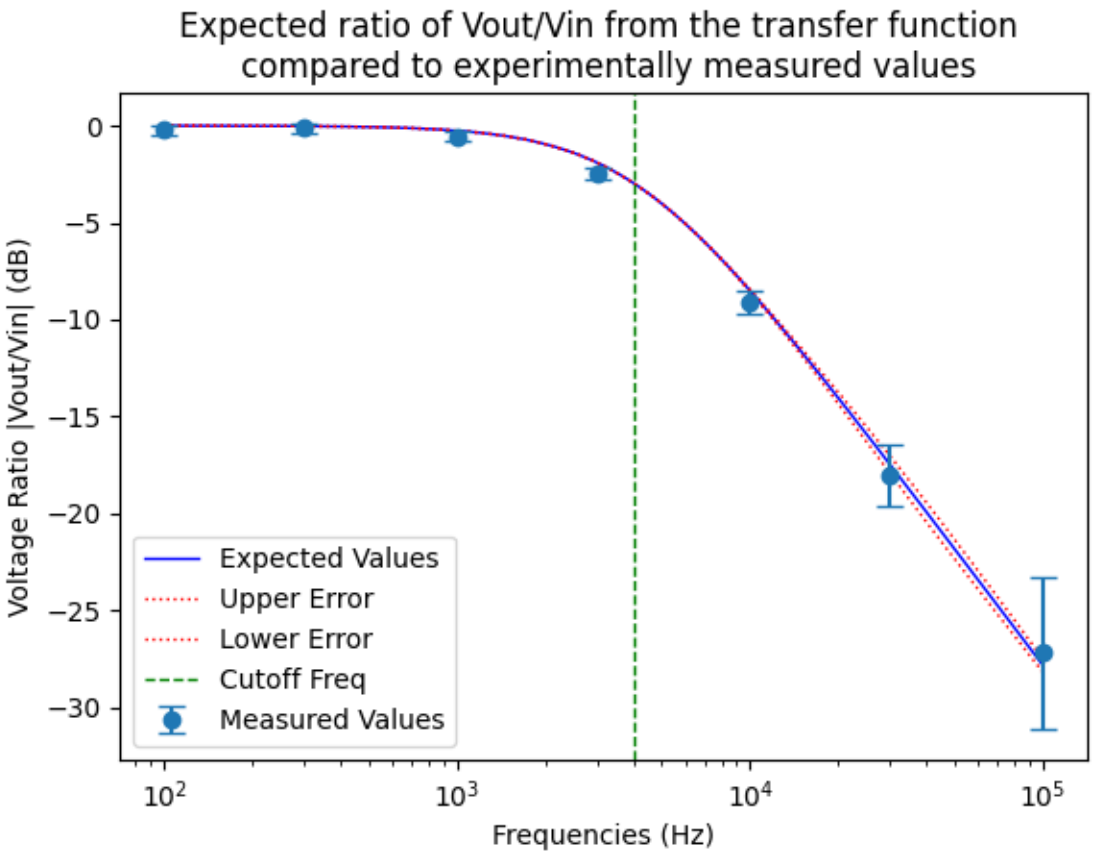

Figure 1: A plot containing experimental data compared to expected data for the ratio of output voltage to input voltage based on input signal frequency in a low pass filter

The error on the transfer function was determined using the standard partial differentiation method, whereas the error on each measured point was determined by adding each measurement error in quadrature. Based on Figure 1, the experimental data is very close to the expected values of the transfer function, with all but one of the error bars on the measured points overlapping the uncertainty range of the transfer function.

Similarly, the equation to determine the expected phase offset between output and input voltage was compared to experimentally observed data then plotted in Figure 2 below.

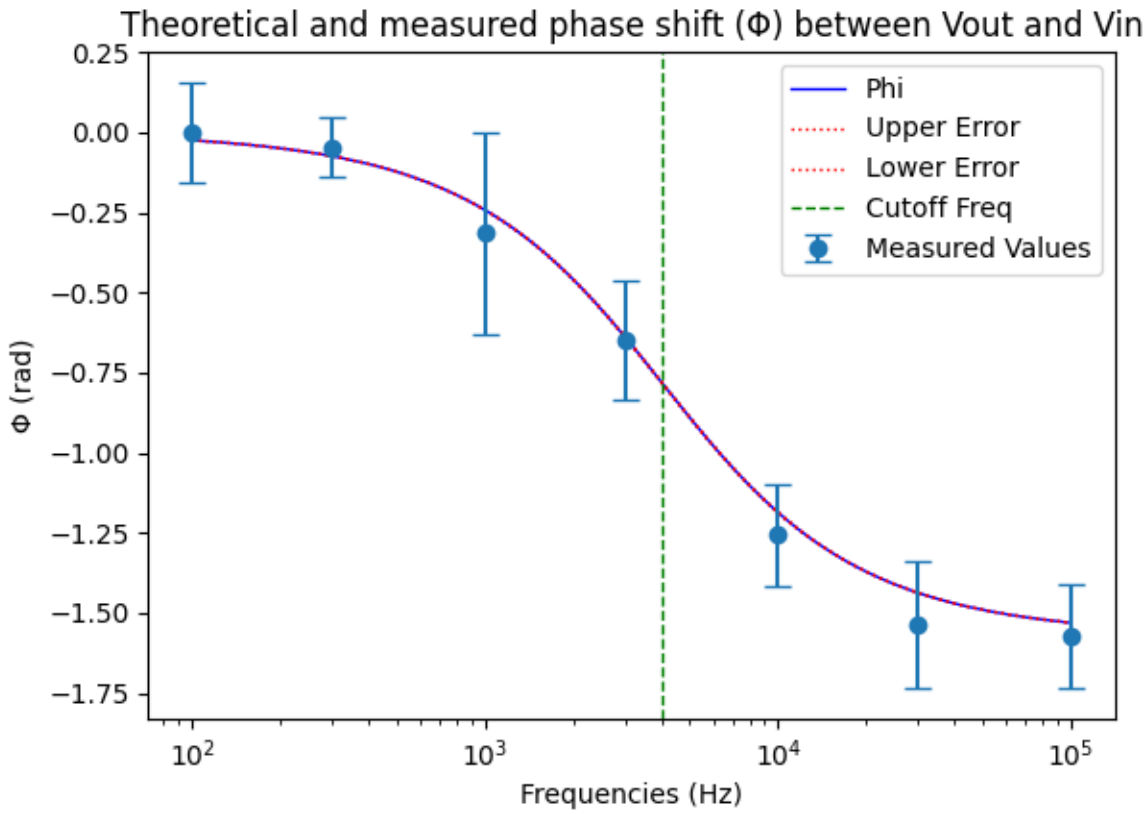

Figure 2: Plot comparing experimentally measured to expected phase offset between output and input voltage across a low pass filter

Once again, the error on the expected phase function was determined using the partial differentiation method, however the error is very small and not noticeably visible in Figure 2. The individual errors on each point were determined by adding the errors of each measurement in quadrature. The expected function passes through all the error bars of each measured value, indicating a good fit for the data. The error bars are a bit larger than desired however so changing the data collection system to use a system that is not based on simply “eyeballing” the amount of divisions covered by the wave function on the oscilloscope should be considered if this experiment is to be repeated.