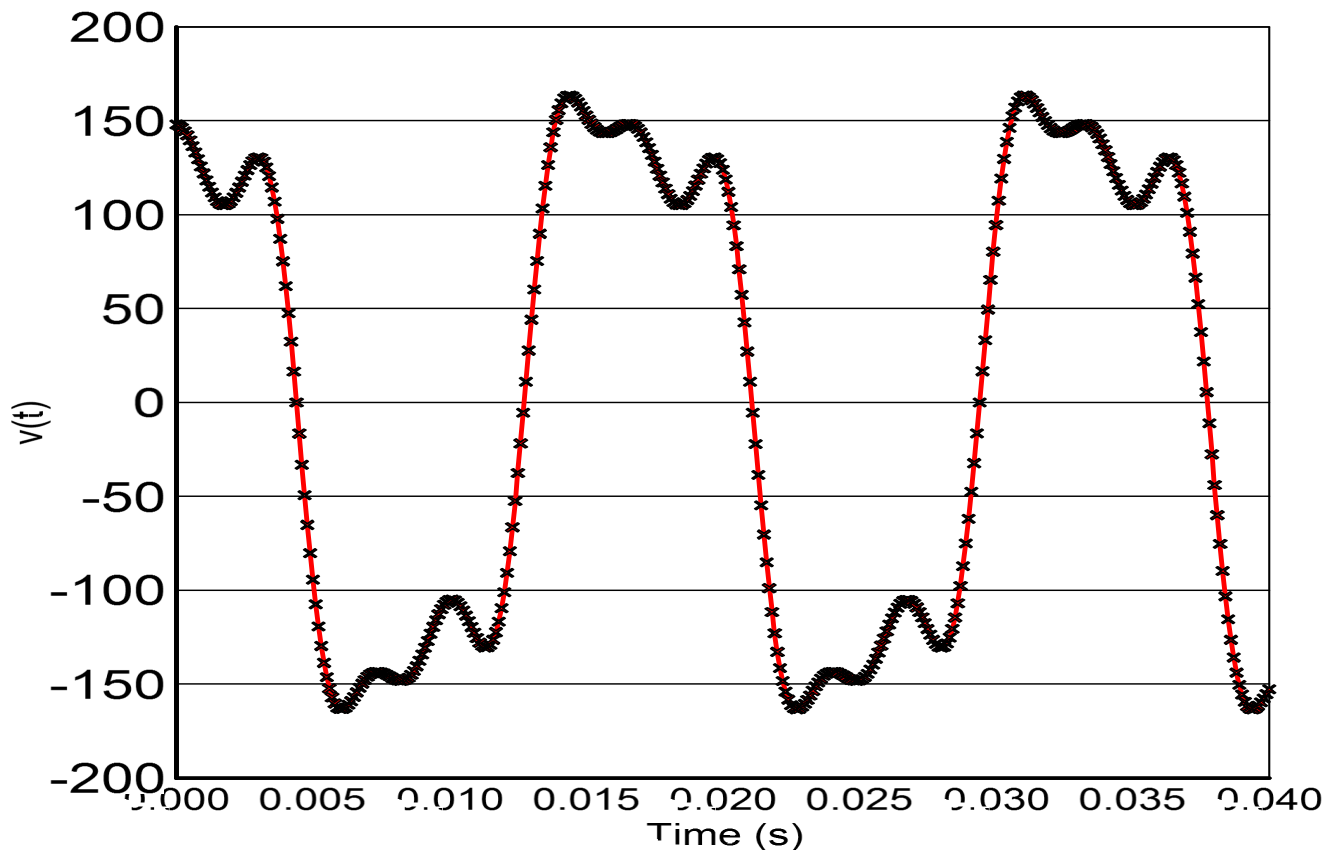


Objectives: Continued development of MatLab programming skills. Working with time series, intro to applied numerical integration methods. All code must be your original code. Goal: develop basic insights, review concepts, and work with sampled value (SV) data. Valuable for Smart Grid.

- 1) A power quality monitor has recorded a voltage waveform that has significant harmonic distortion. It is known that its fundamental frequency is 60 Hz. Sampled waveform data is provided in ASCII text file PQ_waveform.txt (click on "Data" link beside link to this assignment).
 - a) Open the file using fopen and appropriate file format and access options. Using low-level

Power Quality - Captured Waveform

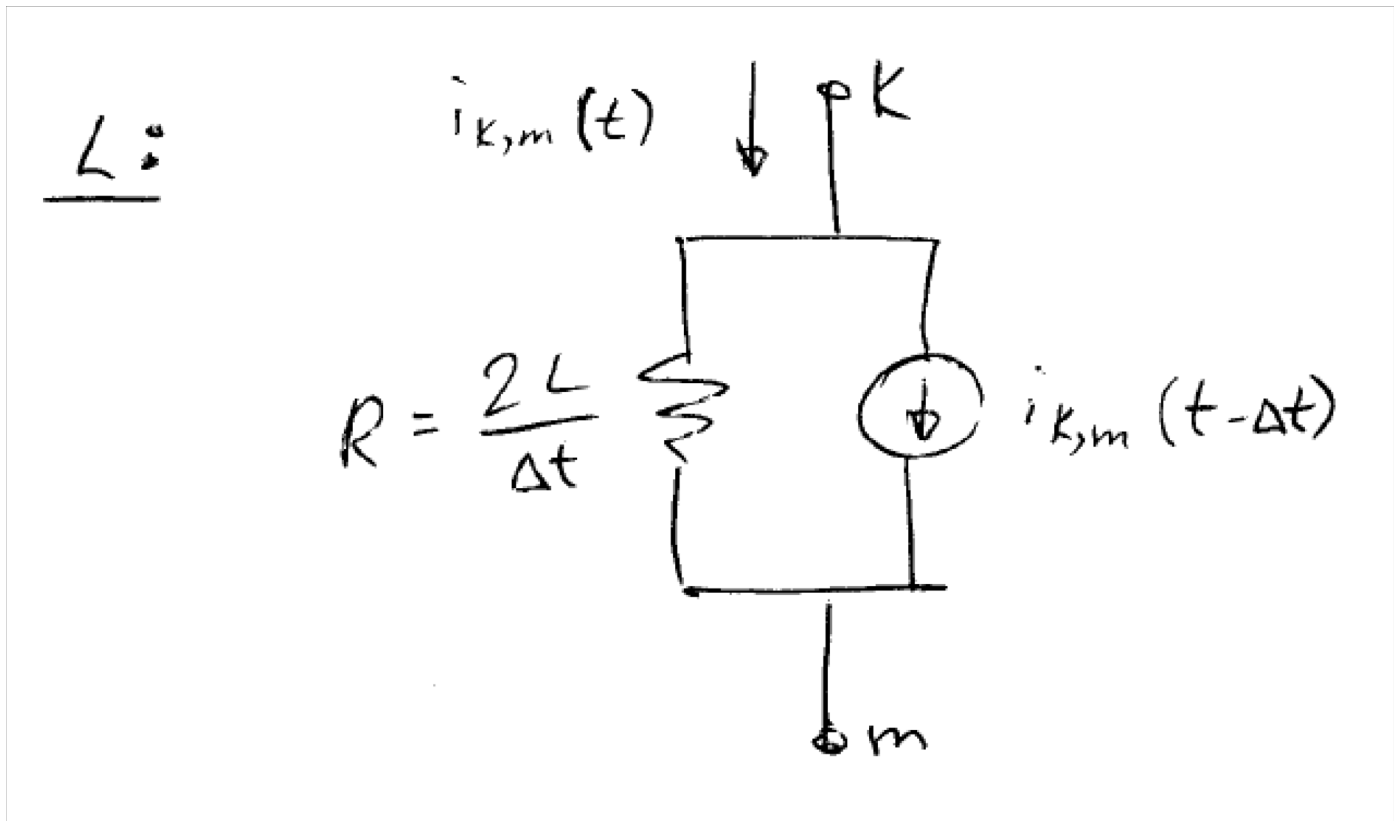


sscanf functions and appropriate formatting descriptors, i) read the t and v(t) data into storage vectors, and ii) display using matlab plot function. Confirm that you have correctly input the data. Next, you will use trapezoidal integration to quantify avg and rms...

- b) Now that you have this time series (sampled points on voltage waveform), write a **for** loop which steps through an integer number of fundamental frequency periods and calculates the average value of the waveform. What is it? _____ Volts
- c) Similarly, determine the true RMS value of the waveform. As an intermediate step, plot out the square of the voltage waveform. What is it? _____ Volts

As instructed on homework submission guidelines submit a printout of your .m code that include hand annotations. Provide comments in your code that would allow debugging or future modification.

2) As per lectures 14, 16, 19, as well as Dr. Paudyal's guest lectures 17 & 18, derive the trapezoidal approximation for the time domain solution of an inductor. Recall the companion circuit as:



- Base case to benchmark against: Use ATP to model a 120 Vrms 60-Hz voltage source supplying a 50 mH inductor. It may be useful to use the L model capable of initialization. With this ATP simulation, you can easily change timestep, peak voltage, inductance, and $i(0)$ of the inductor.
- Develop matlab code using trapezoidal integration which duplicates the base case above. Recall that the "history current" at $t=0$ is actually $i(0)$. Address the following 2 cases:
 - For a case with $i(0) = 0$. You can achieve this with $V_p \cos(\omega t + 0^\circ)$.
 - For a case with $i(0) \neq 0$.

In each case, overplot your solution with the ATP benchmark solution to verify that your code is working properly.

You're highly encouraged to share any questions you have on coding, writing data to output file, calculating line flows, etc. Please make use of e-mail list and my office hours.

Next: You and your partner will write code for solution of a small circuit (no more than a few nodes) which contains voltage and current sources and R_s , L_s , and C_s .