Lab 7: Fourier Series

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TLDR

Each problem goes in its own function

Submit for your printed lab report the code you did

Submit for your printed lab report the answers to the individual questions

Email me three animated GIFS corresponding to each Fourier Series

Meme Policy: Don't you dare put a meme on the gif and then get the problem wrong.

Introduction

The point of this lab is to get you guys to compute the fourier series of various waveforms. I want you to graphically see how series of sinusoids can combine to approximate different functions.

" Get this guy off the stage!!"

That's what I think when I can't integrate in front of the class but anyways we showed in a few classes ago that the Sawtooth wave function

$$s(t) = \frac{t}{\pi} \tag{1}$$

on the interval from $[\pi, \pi]$ could be approximated by:

$$S_N(t) = \frac{-2}{\pi} \sum_{n=1}^{N} \frac{\cos(n\pi)\sin(nt)}{n} \tag{2}$$

Problem 1

Using a similar code as last week, animate the fourier series of the sawtooth wave, each frame, increment "N". So the first frame is just $N = 1$, second frame is with $N = 2$ etc, **up to 10 frames**

Problem 2

We'll do the same idea but on a different series, animate the fourier series up to $N = 20$. We'll have the same number of frames as in the first animation, because we skip the even numbered integers. If you do not know how to skip every other number in python, I want you to read the docs about the `range()` function, then if you can't figure it out, we'll get you there. **you get to pick your own value for L, as long as I can see in your gif that the output is periodic**

$$f(x) = \frac{4}{\pi} \sum_{n=1,3,5...}^{N} \frac{1}{n} \sin(\frac{n\pi x}{L}) \tag{3}$$

2.1

What waveform was generated?

Problem 3

Animate the first 10 nonzero frames of...

$$f(x) = \frac{8}{\pi^2} \sum_{n=1,3,5,..,}^{\infty} \frac{(-1)^{(n-1)/2}}{n^2} \sin(\frac{n\pi x}{L}) \tag{4}$$

You read that as "negative one raised to n minus one over two"

3.1

What waveform was generated?

Problem 4

In general we saw in this assignment that the different functions from the function generator can be approximated by the finite sum of sinusoids.

4.1

Two of our fourier series had some innacuracies. Which two waves were represented, but had some problems?

4.2

Where did these innacuracies occur? In other words, what points, relative to the continuous time function which may be outputting from our function generator were not accurately modeled by the Fourier series?

4.3

If I increase the value of "N" say $N = 50$, does the inaccuracy get reduced? What is the qualitative effect?

4.4

Find out the name of this phenomenon, then tell me why the triangle wave does not exhibit the phenomenon.