Assignment - 4
Frequency Response of
Linear Time-Invariant Systems

February 24, 2018

Task 1

Let

$$h[n] = a^n(u[n] - u[n-30]),$$

where $a \in \{1, 0.9, 0.5, 0.1\}$.

Questions

1. Calculate Fourier transform $H(e^{j\omega})$ of $h[n]$ on paper for all values of a. What is the system called when $a = 1$. For which value of a, $h[n]$ has the fastest decay?
2. Plot Fourier transform $H(e^{j\omega})$ of $h[n]$ using MATLAB. Since ω is continuous, MATLAB cannot simulate it as it is. You can discretize ω axis, calculate $H(e^{j\omega})$ on these discrete values and then use `plot` command to join them to give you a "continous" look of the Fourier transform. Plot Fourier transform from -2π to 2π. Do you see any repetition of Fourier transform?
3. For what values of a, Fourier transform has higher frequency components and why?

Task 2

Let

$$h[n] = \left(a^n + j\left(\frac{a}{10}\right)^n\right)(u[n] - u[n-30]),$$

where $a \in \{1, 0.9, 0.5, 0.1\}$.

Questions

1. Plot Fourier transform of $h[n]$ using MATLAB. Is Fourier transform conjugate symmetric? Why or why not?

Task 3

Download the file almostcaught.wav from piazza. The file has the voice of the great Captain Jack Sparrow but perturbed by a tone.

Questions

1. Plot Fourier transform of the wave data using MATLAB. What is the frequency of the tone?