Frequency Modulation & Demodulation

Dr. B. Sainath

EEE Dept., BITS PILANI

Sep., 2017

Important Instructions

- Try to complete all tasks within 2 hours. After 2 hrs, evaluation starts.
- For each subtask, create mfiles (eg. CT_HT.m) and save them with suitable name.
- Prepare a word document naming your name and ID. In it, save all results including plots.
- In all plots, put x-label, y-label, legend, font 'Arial'(Size = 10), and, Width '2'.

Task 1: Plotting Bessel Functions

- Understand following library functions
  - besselj
  - bessely
  - besseli
- Questions:
  1. Plot Bessel function $J_\nu(\beta)$ of the first kind for $\nu = 0, 1, 2, 3, 4$. In the plot, provide x-label, y-label, title, and legend
  2. Plot Bessel functions of the second kind $K_\nu(\beta)$ for $\nu = 0, 1, 2, 3, 4$. In the plot, provide x-label, y-label, title, and legend
  - Determine zero crossings of $J_0(\beta)$
- Write a MATLAB code to prove the following property. Choose suitable 'N'. Assume modulation $\beta = 5$

$$\sum_{n=-N}^{N} \mathcal{J}_n^2(\beta) \approx 1$$

Task 2.(a): Frequency Modulation (FM)

- Consider single tone FM. Message signal
  $m(t) = 1.5\left(\exp\left(j2\pi \times 500t\right) + \exp\left(-j2\pi \times 500t\right)\right)$
- FM signal $s(t) = 10\cos(2\pi \times 10^4 t + 5\sin(2\pi \times 500t) - \frac{\pi}{2})$
- Questions:
  1. Write a program to plot message signal, carrier signal, and, modulated signal without using MATLAB library function. In other words, use FM signal expression directly. Give x-label, y-label, title etc. to all subplots. (Note: Use t=linspace(0,0.004,100000) in your code.)
  2. Determine modulation index, frequency deviation, transmit power P_t, and bandwidth.

Task 2. (b): Demodulation

- Understand following commands or functions
  - fmdemod
- Use the following
  - Same set of parameters in FM (plus)
  - Sampling frequency fs = 40000 Hz;
- Question:
  1. Write a program to plot demodulated signal. Use MATLAB library function **fmmod** and demodulated (an estimate of message signal) using MATLAB library function **fmdemod**
  2. Plot original message signal and demodulated signal. Give x-label, y-label, title etc. to all subplots

BITS Pilani