FUNDAMENTALS OF COMMUNICATION

PRACTICAL 1 –2023
AMPLITUDE MODULATION USING MATLAB

Objectives

The objectives of this practical are:

- To get familiar, at a high level, with the various amplitude modulation and demodulation techniques.
- To observe the time domain and frequency domain characteristics of various amplitude modulation systems.

Requirements

- This practical requires some preparation, in terms of theoretical background as well as the use of the tools (Matlab, the m-files, etc. . .).
- To observe the time domain and frequency domain characteristics of various amplitude modulation systems.
- You are required to do all the preparation needed to implement the algorithms.
- You can discuss the practical with others students in the class, but you are required to undertake the Matlab simulation on your own and submit your own report.
- The report should be uploaded to the course website and it should include the following information:
  - Your name and student number.
  - All the m-files used in the simulation.
  - Results and discussion.

Exercises

1. **DSB-FC and SSB modulation**

The message $m(t) = 4\cos(100\pi t) + 3\sin(200\pi t) + 3\sin(300\pi t)$

is fed into a modulator with a carrier frequency of 1 MHz.

(a) If the modulator is DSB-FC with a modulation index of 0.70, simulate the system in Matlab and plot the modulated time domain waveform and its spectrum. Calculate the period and frequency of the envelope of the modulated signal.

(b) If the modulator is SSB producing the lower sideband, simulate this system in Matlab and plot the output modulated signal and its spectrum.

2. **DSB-SC modulation**

The signal $x(t)$ is passed through a lowpass filter with a frequency response $H(f)$ to produce the signal $m(t)$ at the output of the lowpass filter. The signal $m(t)$ is then modulated using DSB-SC modulation to yield the modulated signal $u(t)$. Assume that $x(t)$ and $H(f)$ are given by:

$$x(t) = \begin{cases} e^{-(t-0.5)} & t \geq \frac{1}{2}, \\ 0 & t < \frac{1}{2}, \end{cases}$$

$$H(f) = \begin{cases} \cos\left(\frac{\pi f}{3}\right) & |f| \leq 1.5\text{Hz}, \\ 0 & \text{otherwise}\,. \end{cases}$$

(a) Use Matlab to determine and plot the magnitude and phase spectra of $m(t)$.

(b) Use Matlab to compute and plot $u(t)$ and its Fourier transform $U(f)$.

Submission Deadline: 18 August 2023