Electrical and Computer Engineering Department
University of Puerto Rico at Mayagüez

COMMUNICATION THEORY I
MATLAB CLASSWORK 03
DSB-SC Communications System
and
Speech & DTMF Signal Transmissions

For
Prof. Domingo Antonio Rodríguez
Electrical and Computer Engineering Department
University of Puerto Rico at Mayagüez
domingo.rodriguez1@upr.edu

<Date>

HW03 – Due: Friday, Oct. 29, before 11:50 PM

Speech & DTMF Signal Transmissions

The objective of this homework is to model a double sideband suppressed carrier (**DSB-SC**) communications system for the transmission and reception of **speech signals** as well as voice-like (**DTMF**) signals in an **underwater medium**.

The **maximum frequency content** of all transmitted signals is assumed to be equal to $F_V = 4000Hz$ and the "**one-sided**" **channel bandwidth** is said to be equal to $B = 16000Hz$. For the proper reception of the transmitted signal, a receiver must be designed to recover such signal: $x_r(t) \approx s(t)$ (see ***Fig. 3***).

The channel itself is modeled as a composition of two basic systems, an **ideal**, **linear phase**, **low-pass filter** T_C, with ***cut-off frequency*** $\boldsymbol{f = F_L}$, and a signal **summing system**, T_N, where the channel **underwater noise signal**, $n(t)$, is added to the output of the linear phase filter T_C. This DSB-SC communications channel is given the name $T_{CN} = T_{AM}$. Thus, it is given by cascading T_C and T_N (see ***Fig. 2***).

The sampling frequency of the **DSB-SC communications** system must be set to more than twice the maximum frequency (**Nyquist-Shannon sampling theorem**) content of the output of the demodulator at the receiver side. That is, $F_S > 2(2f_c + F_V)$, where f_c is the carrier frequency of the modulator (demodulator) and must be $8000 < f_c < 12000$.

The input signal $x_m(t)$ to the modulator is the sum of a "**wanted**" speech signal $s(t)$ and an "**unwanted**" **interference signal** $g(t)$. After the demodulator, an ideal, linear phase, low-pass filter, T_L is used, with cut-off frequency $F_M = 4000Hz$, to recover "**wanted**" **speech or voice signal** $s(t)$ (see ***Fig. 1***).

Tasks to Perform

Task 01.- (10 points): Proceed to modify the given MATLAB m-script located in the course main webpage under the heading **DSBSC_Draft** in the by adding instructions in order to plot the modulating signal in the time-domain. For this task, you must also load the speech signal "**Star_Story**." Rename this file hw03gpzzt01.m where zz is group number.

Task 02.- (10 points): Proceed to modify the given MATLAB m-script located in the course main webpage under the heading **DSBSC_Draft** in the by adding instructions in order to plot the magnitude of the spectrum of the modulating signal in the time-domain. For this task, you must also load the speech signal "**Star_Story**" and rename this file hw03gpzzt02.m where zz is group number.

Task 03.- (10 points): Proceed to modify the given MATLAB m-script located in the course main webpage under the heading **DSBSC_Draft** in the by adding instructions in order to plot the interfering signal in the time-domain. For this task, you must also load the speech signal "**Star_Story**" and rename this file hw03gpzzt03.m where zz is group number.

Task 04.- (10 points): Proceed to modify the given MATLAB m-script located in the course main webpage under the heading **DSBSC_Draft** in the by adding instructions in order to plot the magnitude of the spectrum of the interfering signal in the time-domain. You must also load the speech signal "**Star_Story**" and rename this file hw03gpzzt04.m where zz is group number.

Tasks 05 to 08 (15 points each): Proceed to repeat **Tasks 01** to **04** by changing the input signal to a **DTMF voice-like** signal. Rename, from hw03gpzzt05.m to hw03gpzzt08.m, the resulting m-scripts, accordingly. Use hw03gpzzt05.wav to hw03gpzzt08.wav to name your **DTMF** files in **.wav** format.

REMARKS:

A.- This homework does not require a written report. All that is required is for each group to send a **.zip** folder with the requested eight (8) m-script files, with the required TAT document in **.PDF** format, as well as this document, both, in **.DOCX** and **.PDF** formats. A total of **11 documents**, nothing else, should be sent inside the **.zip** folder.

B.- Name of **.zip** folder and the name of the **e-mail subject**:

INEL4301_MCW03_SXXX_GPYY

E-mail to: domingo.rodriguez1@upr.edu

STANDARD TABLE FOR DEMERITS

01.- Script file does NOT execute well	**-05 pts.**
02.- Correct script file NOT included	**-05 pts.**
03.- Task assignment table NOT included	**-05 pts.**
04.- Unzipped folder does NOT have same name	**-05 pts.**
05.- Missing INEL4301_MCW03_SXXX_GPYY.docx	**-03 pts.**
06.- Missing INEL4301_MCW03_SXXX_GPYY.pdf	**-03 pts.**
07.- Missing class section number sxxx	**-03 pts.**
08.- Missing student's group number gpyy	**-03 pts.**
09.- Missing script or program number pgzz	**-03 pts.**
10.- Missing or incorrect e-mail subject name	**-03 pts.**