In the Name of God

Signals & Systems

Computer Assignment 2

Speech processing

1) Record an audio signal using your own voice in which you count from 0 to 9. Pronounce the digits clearly and with enough pauses between them (approximately one digit per second). The sampling rate is 8000 samples/sec and use 1 channel (mono) audio recording. Put the samples in a vector **speech1** (in Matlab) and listen to it to make sure that the signal is ok.

   Save the speech in file "speech1.wav" → report attachment

Hint : You can use "audiorecorder" in Matlab, or record it in other apps as a ".wav" file. You can use "wavread, wavwrite, and sound" functions in Matlab.

2) Write a Matlab function "find_digits" that inputs **speech1** and finds the intervals where each digit is pronounced. Use a fixed interval of 0.5 sec (4000 samples) for each digit, and the output is the selected samples for all 10 digits in a 4000x10 matrix, **digits**.

   Save the Matlab code in file "find_digits.m" → report attachment
   Plot all digits (each digit in a separate figure) → report

Hint: The energy of signal in **silent intervals** is very low.

3) Write a Matlab function "int2speech" that has two arguments : **digits** and N, where N is a positive integer, to generate speech signal that reads the digits of N one by one. The function generates a vector of speech data samples (**speech**) by using the digits of N sequentially (from the most significant digit to the least significant digit) with 0.25 sec pause between digits.

   Run your "int2speech" function using **N = your student ID #** and listen to the output voice.
   Save the Matlab code in file "int2speech.m" → report attachment
   Save the speech in file "speech2.wav" → report attachment

   Now add some noise to speech data samples and listen it again
   Save the noisy speech in file "speech3.wav" → report attachment

Hint: use "randn" function in Matlab to generate noise samples. Adjust the gain of noise samples such that the total energy of signal is 10 times the total energy of noise samples.

4) Write a Matlab function "speech2int" that has two arguments: **digits** and **speech**, that goes through the voice samples of **speech** and finds the sequence of digits pronounced in it, and outputs it as integer N.

   Save the Matlab code in file "speech2int.m" → report attachment

   Run your "speech2int" function using **speech3** samples and check if the output is your correct. Explain how your code works → report

Hint: use the magnitude of **correlation coefficient** of 2 signals to determine their **similarity**.

r = correlation coefficient (x,y) = $$\frac{\sum_{n=1}^{L} x[n]y[n]}{\sqrt{\sum_{n=1}^{L} x^2[n]}\sqrt{\sum_{n=1}^{L} y^2[n]}}$$

We know that 0 < |r| < 1, and larger values of |r| means more similarity.

Important notes:

1. Report MUST be in PDF format.
   Filename format: "CA2_surname_studentID.pdf"

2. For each part include the following (the same order) in your report:
   a) The Matlab codes (even the functions that are attached)
   b) The printed results and/or plots of Matlab
   c) Answers to the questions asked and any explanations or comments needed

3. Please be concise in your report. No need to explain the theory, your way of thinking, or …

4. Put all the attachments along with your report in a zip file, and submit it.
   Filename format: "CA2_surname_studentID.zip"
   It should have 7 files in total (one .pdf, 3 .m files, and 3 .wav files)