Assignment 2

Part 1.

Q1. Write an algorithm in MATLAB to detect the active (desirable) and non active (silence or undesirable) part (segment) for the given signal. Use the given signal 'dtmf_sound.wav' to test your algorithm. You may like to listen this DTMF audio file to define the desirable and undesirable part of the signal in this context.

Background:

One of the basic and initial operation in signal processing is to segment the signal into active(desirable) and non active part (undesirable). For example, Cell phone compress our speech signal through DSP algorithms before transfer it to the Base station. Now, when we communicate through phone, sometimes we do not speak (silence with background noise). Some of the speech/audio codec compress silence part of the signal as much lower rate compared to active part of the signal which altogether reduce the size of the data which needs to be transfer to the Base station. Here, we are looking for a very simple way to tackle this problem and move slowly to develop a complete basic DSP system design. In literature, you may find different more sophisticated method as per the signal context.

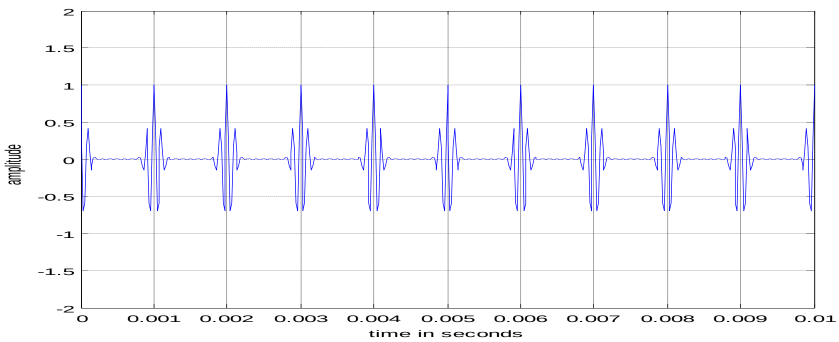
Sample code (readwav.m) to read the DTMF audio file in MATLAB is also given with this assignment.

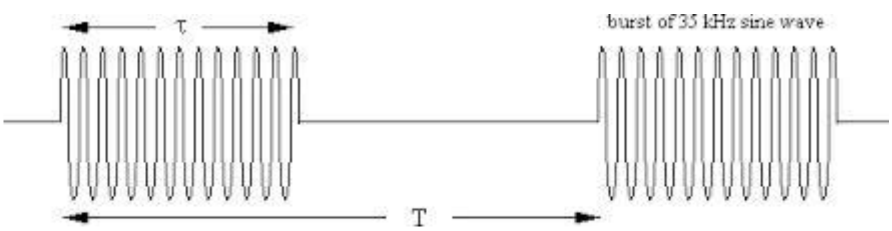
Part 2.

Q1. Write a MATLAB program to generate a sine wave signal for a Pulsed radar (The objective is to generate a pulsed sine wave).

Pulse repetitive Frequency (PRF) = 1 KHz
Sine wave frequency = 10 KHz
Choose suitable Sampling frequency and the On-time of the Pulse

Example schematic of pulsed sine wave





Q2. Write a MATLAB program to generate a linear frequency modulated Chirp signal for a pulsed radar.

Centre frequency (f_c) = 60 MHz;
Pulse width (On-Time) = 6.66 micro seconds
Bandwidth = 3 MHz

Equation of chirp :

$$x(t) = \sin(2\pi ft) \text{ where, } f = f_0 + 0.5kt$$

'k' is chirp slope

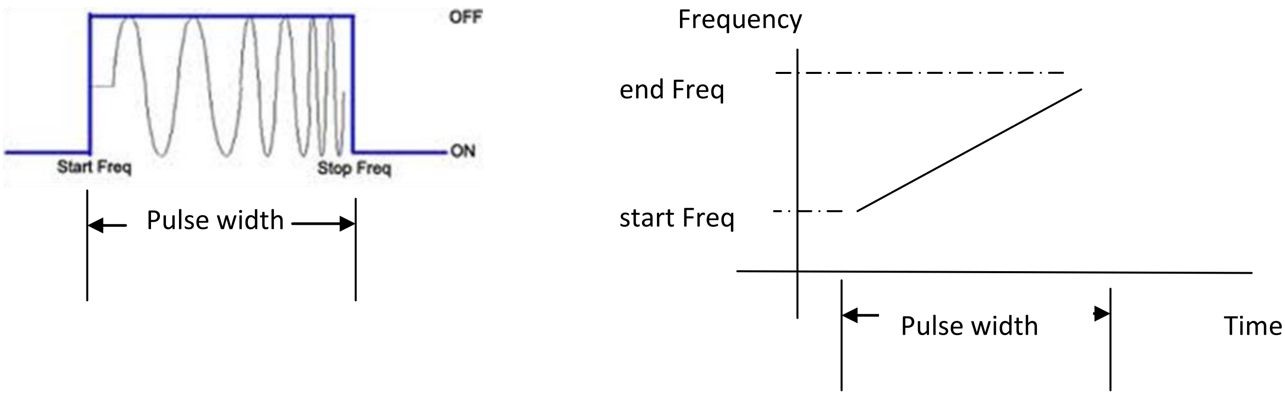
'f0' is start frequency

$f_0 = \{f_c - (0.5 * k * pulsewidth)\}$

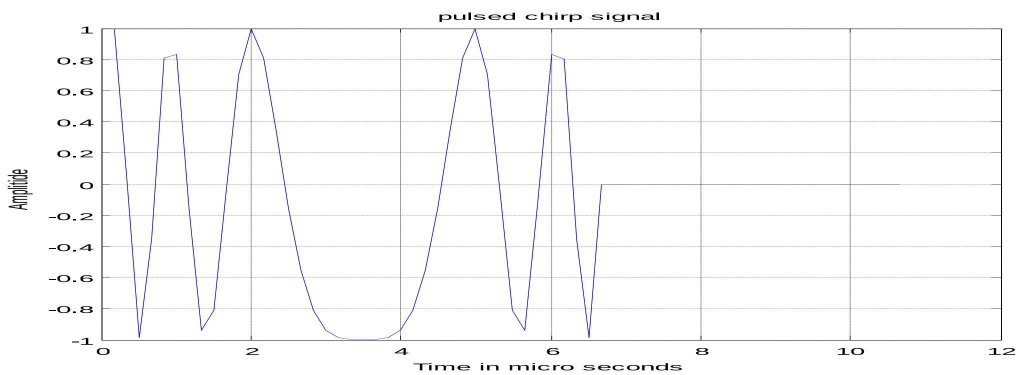
$k = bandwidth/pulsewidth$

Note : 'k' is chirp slope (Refer below diagram)

Example schematic of chirp signal for a pulsed radar



Note : Here bandwidth can be regarded as (BW = End freq - start freq)



Objective of part 2 (Radar Section) : To understand the signals transmitted by Pulsed radar.

Background :

Radar Signal Processing (RSP)

The word radar is an abbreviation for Radio Detection And Ranging. In general, radar systems use modulated waveforms and directive antennas to transmit electromagnetic energy into a specific volume in space to search for targets. Objects (targets) within a search volume will reflect portions of this energy (radar returns or echoes) back to the radar. These echoes are then processed by the radar receiver to extract target information such as range, velocity, angular position, and other target identifying characteristics.

Radars are most often classified by the types of waveforms they use, or by their operating frequency. Considering the waveforms first, radars can be Continuous Wave (CW) or Pulsed Radars (PR). CW radars are those that continuously emit electromagnetic energy, and use separate transmit and receive antennas. Un-modulated CW radars can accurately measure target radial velocity (Doppler shift) and angular position. Target range information cannot be extracted without utilizing some form of modulation. The primary use of un-modulated CW radars is in target velocity search and track, and in missile guidance. Pulsed radars use a train of pulsed waveforms (mainly with modulation). In this category, radar systems can be classified on the basis of the Pulse Repetition Frequency (PRF), as low PRF, medium PRF, and high PRF radars. Low PRF radars are primarily used for ranging where target velocity (Doppler shift) is not of interest. High PRF radars are mainly used to measure target velocity. Continuous wave as well as pulsed radars can measure both target range and radial velocity by utilizing different modulation schemes.

Radar signal Processing comprises of several techniques derived from digital signal processing concepts. Towards, understanding and appreciating the use of DSP in radar, the following assignments are designed.