# Lab I Signal Expressing and Sampling Theorem

Fall 2019

**Objectives**

1. Basic functions and commands of signal operations in MATLAB.
2. Sampling and reconstruction of a pure harmonic signal.
3. Aliasing phenomenon in the sampling process.

**Ex. 1.1**

Generate two digital signals  and , which both over the interval . Show the curves of the two signals in one axis and add legend. Do following operations with the two signals to generate one plot with four subplots. Add necessary legends, labels and titles for these plots.

1. 
2. 
3. 
4. 

**Ex. 1.2**

Consider a discrete-time signal *x*(*nT*) is obtained by sampling a sinusoidal signal  where *T* is the sampling interval, *f*0 is the oscillation frequency of the signal, and the sampling frequency *fs* equals to 1/*T*.

The sampling frequency is fixed at *fs* = 8000.

1. Assume *f*0 = 300, plot 3 periods of *x*(*t*) and *x*(*nT*) in one axis, ; And plot 3 periods of *x*[*n*] using **stem**. Use subplot to put these two axes in one figure.
2. Repeat a) for the sinusoidal frequencies *f*0 = 3000, *f*0 = 4000, *f*0 = 5000.
3. Play *x*(*t*) in terms of *f*0 from 500 to 12000 with the increment of 500 using **sound**. Indicate which frequencies you can hear are the highest pitch. Why?

**Ex. 1.3**

Consider a sinusoidal signal with the oscillation（fundmental） frequency Ω0. *x* (*t*) is sampled by a fixed sampling rate Ω*s*., where Ω*s* =, and then the corresponding discrete-time signal *x*[*n*] is produced.

1. Assume , show thefirst 100 samples of *x*[*n*] from *n* = 0.
2. Increase the oscillation frequency, i.e. ,,,,,.

Play the sampled signals with MATLAB function **sound(*x*[*n*],** Ω*s***/2*π* )**. Does the pitch of the tone that you hear continuously increase with the increase of Ω0? Please explain this phenomenon.

**Requirements of the report**

1. In the report cover, add your student number and other necessary information.
2. Each figure should be in good format and resolution, and include your student number in the title.
3. MATLAB code should be attached in the appendix.