Stochastic Signal Processing

Lesson 6 – experiment:

Discrete-Time Processes 1: Time domain analysis

Weize Sun

Discrete-Time Processes (Page 384 of text book)

- A discrete-time process is a sequence X_n of r.vs.
- We use $X[n]$, where n is an integer, to represent this process.
- The autocorrelation and autocovariance are:

$$R[n_1, n_2] = E\{X[n_1]X^*[n_2]\},$$
$$C[n_1, n_2] = R[n_1, n_2] - m_X[n_1]m_X^*[n_2]$$

Where $m_X[n]$ is the mean of $X[n]$.

- A process is WSS if

$$m_X[n] = m_X$$
$$R[n+m, n] = E\{X[n+m]X^*[n]\} = R[m] \qquad \text{(e6-1)}$$

- The cross-correlation and cross-covariance of two processes $X[n]$ and $Y[n]$ is:

$$R_{XY}[n_1, n_2] = E\{X[n_1]Y^*[n_2]\},$$
$$C_{XY}[n_1, n_2] = R_{XY}[n_1, n_2] - m_X[n_1]m_Y^*[n_2]$$

- In our experiment, we will tackle the discrete-time processes only.

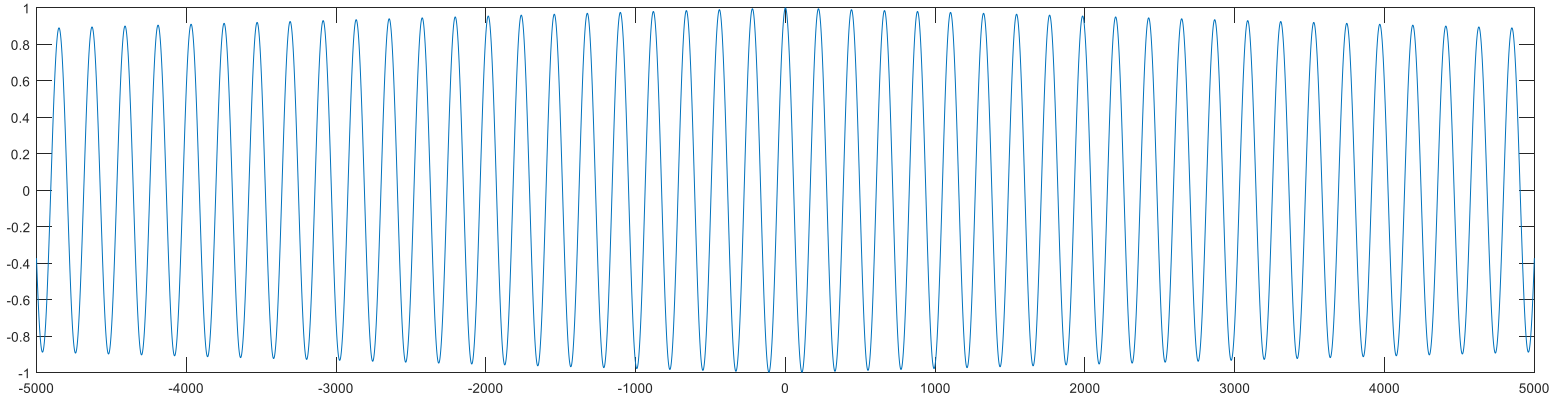
A short example of autocorrelation

- Generate a sin wave and display the autocorrelation

```
clear
clc

Fs = 44100; % The sampling frequency is 44.1kHz
T = 1;      % The duration time of the signal
n = Fs*T;   % No. of sampling
f = 200;    % The frequency of the sin wave
x = sin(2*pi*f*T*linspace(0,1,n+1));
% %% displaying the sound
% sound(x,Fs);
% %% figuring
% figure(1)
% plot(x)
% xlim([0, 2000])
```

```
%% find the autocorrelation of the signal x
R_x = xcorr(x, 'coeff');    % calculate the autocorrelation
% R_x = xcorr(x, 'unbiased');
% R_x = R_x/R_x(n+1);   % note that, the R_x(n+1) is R_x(0) as the R_x range from -4410
%% figuring
figure(2)
plot(-n:n,R_x)
xlim([-5000, 5000]) % plot m=-5000:1:5000, where m is in equation (e6-1) in the slides
```



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```

请先自行百度两者的差别，下节课开始讲experiment 2