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%%%%Exercice 1%%
%EX1 tp3_5a%%

close all;
clear all;
f1= 10.5;

N=256;
Fe=512;
Te=1/Fe;
Tmax =(N-1)*Te;
t=0:Te:Tmax;

a=2;
x1=a*cos(2*pi*f1*t);

figure(1)
plot(t,x1);

xlabel('temps / s');
ylabel('x1 / V');
legend('x1');

%La fonction de corrélation x1
corr_x1=xcorr(x1);
corr_x1b=xcorr(x1,'biased'); %division de xcorr par N-m
corr_x1ub=xcorr(x1,'unbiased'); %division de xcorr par N

largcorr=N-1; % pour centrer l'etude de xcorr autour de tau = 0
tau=(-largcorr:largcorr)*Te;
figure(2)
subplot(3,1,1)
plot(tau,corr_x1(N-largcorr:N+largcorr), 'r.')
xlabel('Temps tau /s');
ylabel('corr(x1) /V^2');
legend('cx','Location','North')

subplot(3,1,2)
plot(tau,corr_x1b(N-largcorr:N+largcorr), 'r.')
xlabel('Temps tau /s');
ylabel('corr(x1) /V^2');
legend('Cx biased','Location','North')

subplot(3,1,3)
corr_theox1=0.5*a^2*cos(2*pi*f1*tau);
plot(tau,corr_x1ub, 'r.', tau,corr_theox1,'k.')
xlabel('Temps tau /s');
ylabel('corr(x1) /V^2');
legend('Rouge Cx','noir corr_x1 theor','Location','North')

%EX1 tp3_5b%%

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close all;
clear all;
f1= 10.5;
f2=60;

N=256;
Fe=512;
Te=1/Fe;
Tmax =(N-1)*Te;
t=0:Te:Tmax;

a=2;
x1=a*cos(2*pi*f1*t);
x2=cos(2*pi*f2*t+pi/4);

figure(1)
subplot(211)
plot(t,x1);

xlabel('temps / s');
ylabel('x1 / V');
legend('x1');

subplot(212)
plot(t,x2);

xlabel('temps / s');
ylabel('x2 / V');
legend('x2');

corr_x1x2=xcorr(x1,x2,'unbiased'), %division de xcorr par N-m

figure(2)
largcorr=N-1;
tau=(-largcorr:largcorr)*Te;
plot(tau,corr_x1x2(N-largcorr:N+largcorr), 'r.')
xlabel('Temps tau /s');
ylabel('corr(x1,x2) /V^2');

%EX1 tp3_5c%%%%%%%%

close ALL;
clear all;

N=256;
Fe=512;
Te=1/Fe;
Tmax=(N-1)*Te;
t=0:Te:Tmax;

x=randn(1,N);
xf = filtrage_reel(x,Te,N,50);%filtrage de x

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figure(1)
subplot(2,1,1)
plot(t,x);
xlabel('Temps / s');
ylabel('x / v');
legend('Bruit Blanc');

subplot(2,1,2)
plot(t,xf);
axis([0 0.5 -1 1])
xlabel('Temps / s');
ylabel('x filtré / v');
legend('Bruit non Blanc');

corr_x=xcorr(x,'unbiased');
corr_xf=xcorr(xf,'unbiased');

figure(2)
larg_corr=N-1; %permet de centrer l'étude de xcrr autour de tau=0
tau=(-larg_corr:larg_corr)*Te;
subplot(2,1,1)
plot(tau,corr_x(N-larg_corr:N+larg_corr),'r.')
xlabel('Temps tau / s');
ylabel('xcrr(x) / v^2');
legend('rouge corr x','location','NorthEast');

subplot(2,1,2)
plot(tau,corr_xf,'b.')
xlabel('Temps tau / s');
ylabel('xcrr(xf) / v^2');
legend('bleu corr x filtré','location','NorthEast');

%EX1 tp3_5d%%%%%

close ALL;
clear all;

N=256;
Fe=512;
Te=1/Fe;
Tmax=(N-1)*Te;
t=0:Te:Tmax;

a1=1;
a2=0.1;
a3=1;
f1=10;
phi=pi/6;
x1=a1*cos(2*pi*f1*t);
x2=a2*cos(2*pi*f1*t+phi)+a3*randn(1,N);

figure(1)
subplot(211)

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plot(t,x1);

xlabel('Temps');
ylabel('x1');
legend('x1');

subplot(212)
plot(t,x1);

xlabel('Temps');
ylabel('x2');
legend('x2');

%etude de la fonction d'intercorrelation x et y

corrub12=xcorr(x1,x2,'unbiased'); %division de xcor par N-m

figure(2)
largcorr=80;
largtau= [-largcorr:largcorr];

tau=largtau*Te;
plot(tau,corrub12(N+largtau),'k-')
xlabel('temps tau');
ylabel('corr(x1 x2)');
title('intercorrelation entre x1 et x2 (unbiased)');

%EX1 tp3_5e%%%%%%%%

close ALL;
clear all;
load x;
load y;
N=length(x);
Fe=512;
Te=1/Fe;
Tmax=(N-1)*Te;
t=0:Te:Tmax;

figure(1)
subplot(2,1,1)
plot(t,x);
xlabel('Temps');
ylabel('x');
legend('x');

subplot(2,1,2)
plot(t,y);
xlabel('Temps');
ylabel('y');
legend('y');

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corrxyub=xcorr(x,y,'unbiased');

figure(2)

largcorr=N-1;
largtau=[-largcorr:largcorr];
tau=largtau*Te;
plot(tau,corrxyub(N+largtau),'r')
xlabel('Temps tau')
ylabel('corr(x y)');
legend('rouge corrxy unbiased','location','NorthWest');

%EX1 tp3_5d%%%%
close all;
clear all;

f1=10.5;
N=256;
Fe=512;
Te=1/Fe;
Tmax=(N-1)*Te;
t=0:Te:Tmax;

a=2;
x= a*cos(2*pi*f1*t);

figure (1)
freq=(0:N/2)/(N*Te);
cx=xcorr(x,'biased'); % divise par N
c=cx(N:2*N-1); % on garde pr tau>0 de xcrr
C=fft(c,N)*Te; % FFT de la partie droite de xcrr
T_Fourier_C=2*real(C)-Te*c(1);

semilogy(freq,T_Fourier_C(1:N/2+1),'ko')
xlabel('Fréquence / Hz');
ylabel('TF de corr(y) / V^2 Hz^-^1');
hold on ;
X=fft(x,N)*Te;
DSP=(abs(X).^2)/(N*Te);
semilogy(freq,DSP(1:N/2+1),'r.')

figure(2)
plot(freq,abs(T_Fourier_C(1:N/2+1)),'k')
hold on

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