**HW1**

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**Q1:**

**Code:**

% Spectral density function

s = @(w) 1/(pi\*(1+w^2));

% Autocorrelation

R = @(tau) exp(-abs(tau));

% Generate random process and verify the results

N = 500; delta\_w = 0.016\*pi;

t = [0:0.01:5];

count = length(t);

no\_sample = 750;

y = zeros(1,count);

X = zeros(no\_sample,count);

for j=1:no\_sample

g=0;

for i = 1:N

phi = 2\*pi\*rand(1);

g = g + sqrt(2)\*((2\*s(delta\_w\*(i-1))\*delta\_w)^0.5)\*cos(delta\_w\*(i-1).\*t+phi);

end

X(j,:) = g;

end

for i=1:100

temp1 = [1:i:count-i];

temp2 = [1+i:i:count];

X1 = reshape([X(:,temp1)],[length(temp1)\*no\_sample,1]);

X2 = reshape([X(:,temp2)],[length(temp2)\*no\_sample,1]);

rho\_mat = corrcoef(X1,X2);

rho(i+1) = rho\_mat(1,2);

end

rho(1) = 1;

tau = [0:0.01:1];

hold on

scatter(tau,rho,'.');

plot(tau,R(tau),'linewidth',2);

legend('simulated','Target');

ylim([0:1.2]);

set(gca,'FontSize', 24);

xlabel('\tau');

ylabel('R(\tau)');

hold off

**Results:**

A close up of a map

Description automatically generated

**Q2:**

**Code:**

% Autocorrelation function

R = @(tau) exp(-abs(tau));

% Generate correlation matrix

t = [0:0.01:5];

n = length(t);

Rmatrix = zeros(n);

for i=1:n

for j=1:n

Rmatrix(i,j) = R((j-i)\*0.01);

end

end

% Generate eigval and eigvec

[V,D] = eig(Rmatrix);

lambda = diag(D);

% Generate random process and verify the results

N = 501;

count = length(t);

no\_sample = 500;

X = zeros(no\_sample,count);

for j=1:no\_sample

g=0;

for i=N:-1:N-100

zeta = randn(1);

g = g + sqrt(lambda(i))\*V(:,i)\*zeta;

end

g=g';

X(j,:) = g;

end

for i=1:100

temp1 = [1:i:count-i];

temp2 = [1+i:i:count];

X1 = reshape([X(:,temp1)],[length(temp1)\*no\_sample,1]);

X2 = reshape([X(:,temp2)],[length(temp2)\*no\_sample,1]);

rho\_mat = corrcoef(X1,X2);

rho(i+1) = (rho\_mat(1,2));

end

rho(1) = 1;

tau = [0:0.01:1];

hold on

scatter(tau,rho,'.');

plot(tau,R(tau),'linewidth',2);

legend('simulated','Target');

ylim([0:1.2]);

set(gca,'FontSize', 24);

hold off

**Result:**

A close up of a map

Description automatically generated