

Machine Learning for Signal Processing and Pattern Classification.

SIGNAL DENOISING – LEAST SQUARE APPROACH

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AIM:

To obtain the least square solution for the below given problem formulation for signal denoising.

$$\min_x (\|y - x\|_2^2 + \lambda \|Dx\|_2^2)$$

SOLUTION:

y is noisy input signal

x is the desired output denoised signal

D is the second order derivative and is used to smooth the signal.

The least square solution for signal denoising:

$$x = (I + \lambda D'D)^{-1} y$$

CODE:

```
clc;
clear all;
close all;
load data.txt; %loading the data
y = data; % data value
N = length(y); %taking the length of y
figure(1)
plot(y) %plotting the data
title('Data')
e = ones(N, 1);
D = spdiags([e -2*e e], 0:2, N-2, N); %D is a diagonal matrix of
2nd derivation with size N-2 X N
lam = 50; % lamda taking as 50
F = speye(N) + lam * D' * D; % F is a banded matrix
x = F \ y; % Matlab uses a fast solver for banded systems
figure;
subplot(2,1,1); plot(y); title('Data')
subplot(2,1,2); plot(x); title('Least squares smoothing')
```

OUTPUT

