**CODE :**

clear all;

pwl\_fit\_data;

cvx\_quiet('true')

figure

plot(x,y,'k:','linewidth',2)

hold on

% Single line

p = [x ones(100,1)]\y;

alpha = p(1)

beta = p(2)

plot(x,alpha\*x+beta,'b','linewidth',2)

mse = norm(alpha\*x+beta-y)^2

for K = 2:4

% Generate Lagrange basis

a = (0:(1/K):1)';

F = max((a(2)-x)/(a(2)-a(1)),0);

for k = 2:K

a\_1 = a(k-1);

a\_2 = a(k);

a\_3 = a(k+1);

f = max(0,min((x-a\_1)/(a\_2-a\_1),(a\_3-x)/(a\_3-a\_2)));

F = [F f];

end

f = max(0,(x-a(K))/(a(K+1)-a(K)));

F = [F f];

cvx\_begin

variable z(K+1)

minimize(norm(F\*z-y))

subject to

(z(3:end)-z(2:end-1))./(a(3:end)-a(2:end-1)) >= (z(2:end-1)-z(1:end-2))./(a(2:end-1)-a(1:end-2))

cvx\_end

% Calculate alpha and beta

alpha = (z(2:end)-z(1:end-1))./(a(2:end)-a(1:end-1))

beta = z(2:end)-alpha(1:end).\*a(2:end)

% Plot solution

y2 = F\*z;

mse = norm(y2-y)^2

if K==2

plot(x,y2,'r','linewidth',2)

elseif K==3

plot(x,y2,'g','linewidth',2)

else

plot(x,y2,'m','linewidth',2)

end

end

xlabel('x')

ylabel('y')

|  |  |  |  |
| --- | --- | --- | --- |
| **K** | **Values of alpha 1,…..,K** | **Values of beta 1,…,K** | **J** |
| 1 | 1.91 | -0.87 | 12.73 |
| 2 | -0.27, 4.09 | -0.33, -2.51 | 2.62 |
| 3 | -1.80, 2.67, 4.25 | -0.10, -1.59, -2.65 | 0.60 |
| 4 | -3.15, 2.11, 2.68, 4.90 | 0.03, -1.29, -1.57, -3.23 | 0.22 |

A close up of a map

Description generated with high confidence

**Additional Exercise 1 : Total Variation Image Interpolation**

**CODE :**

clear all;

tv\_img\_interp;

% l2 interpolation

cvx\_begin

variable Ul2(m,n);

% Fix known pixel values

Ul2(Known) == Uorig(Known)

% Horizontal Differences

Ux = Ul2(2:end,2:end) - Ul2(2:end,1:end-1);

% Vertical Differences

Uy = Ul2(2:end,2:end) - Ul2(1:end-1,2:end);

% l2 roughness measure

minimize(norm([Ux(:);Uy(:)], 2));

cvx\_end

% total variation interpolation

cvx\_begin

variable Utv(m,n);

% Fix known pixel values

Utv(Known) == Uorig(Known)

% Horizontal Differences

Ux = Utv(2:end,2:end) - Utv(2:end,1:end-1);

% Vertical Differences

Uy = Utv(2:end,2:end) - Utv(1:end-1,2:end);

% l2 roughness measure

minimize(norm([Ux(:);Uy(:)], 2));

cvx\_end

% Graph everything.

figure(1); cla;

colormap gray;

subplot(221);

imagesc(Uorig)

title('Original image');

axis image;

subplot(222);

imagesc(Known.\*Uorig + 256-150\*Known);

title('Obscured image');

axis image;

subplot(223);

imagesc(Ul2);

title('l\_2 reconstructed image');

axis image;

subplot(224);

imagesc(Utv);

title('Total variation reconstructed image');

axis image;

**A screenshot of a cell phone

Description generated with very high confidence**