Homework 2

Guixiang Zhang

Matlab Code:

```
clear all
close all
a= load('3D vectors sample.mat');
x= cell2mat(struct2cell(a));
u = mean(x);          % average of Xij in each column
P= x-u;               % Pij= Xij-uj
Q=P'*P;               % positive semi definite matrix
[V,D] = eig(Q);       % eigenvalue decomposition
%% find smallest eigenvalue and corresponding eigenvector
b = size(D);
emin= D(1,1);
for i=1:b(1)
    if emin>=D(i,i)
        emin = D(i,i);
        ev = i;
    end
end
%% find solution plane
d = u*V(:,ev);        % d parameter of the hyper plane
fmesh(@(x,y) V(1,ev)/-V(3,ev)*x+V(2,ev)/-V(3,ev)*y-d/-V(3,ev));
hold on
plot3(x(:,1),x(:,2),x(:,3),'k.','markersize',15);
```

Describe:

In this project, I first set a 3D vectors sample matrix named “3D vectors sample” which has 6 rows and 3 columns mean 6 points in the 3D coordinate system. If we want to get the linear least-squares solution of the best fit of the plane, according to what we learned in the class, we will first compute the average of value of each column denoted as u. Then we get a new matrix P = x-u which means each value of x subtract the average value of its column. The goal of LS is to find the eigenvector associate to the smallest eigenvalue of Q=P’*P. After we get the solution eigenvector V(:,ev), we can compute the distance d and disaplay the plane. The black points are the 3D points in the sample.

Result: