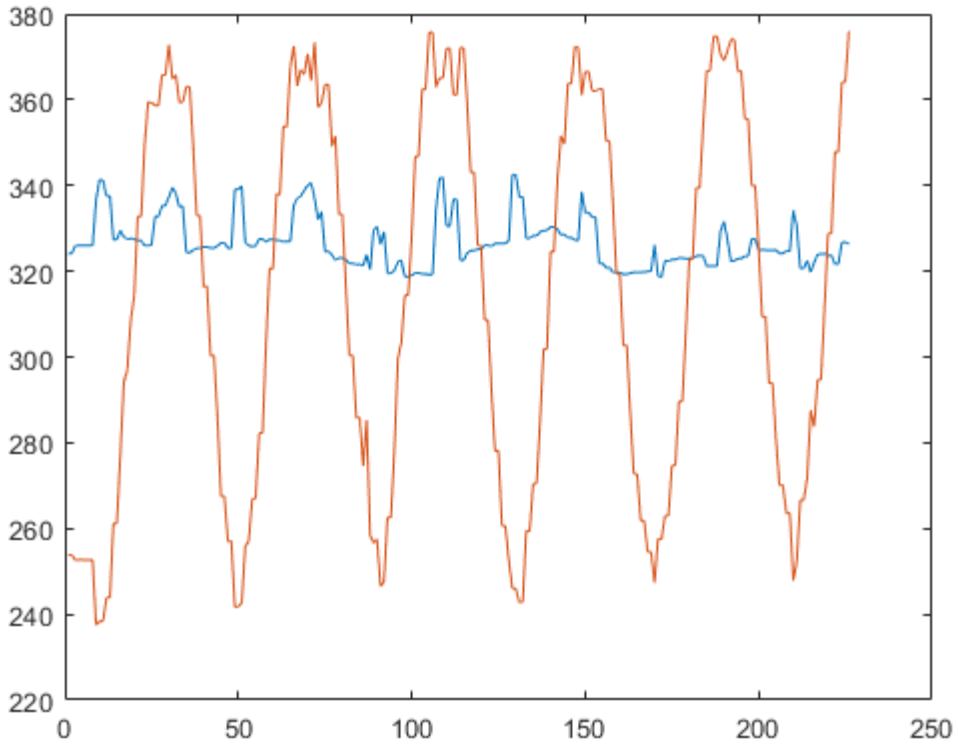
```
clear all; close all; clc
load('cam1_1.mat');
load('cam2_1.mat');
load('cam3_1.mat');
numFrames1 = size(vidFrames1_1,4);
numFrames2 = size(vidFrames2_1,4);
numFrames3 = size(vidFrames3_1,4);
```

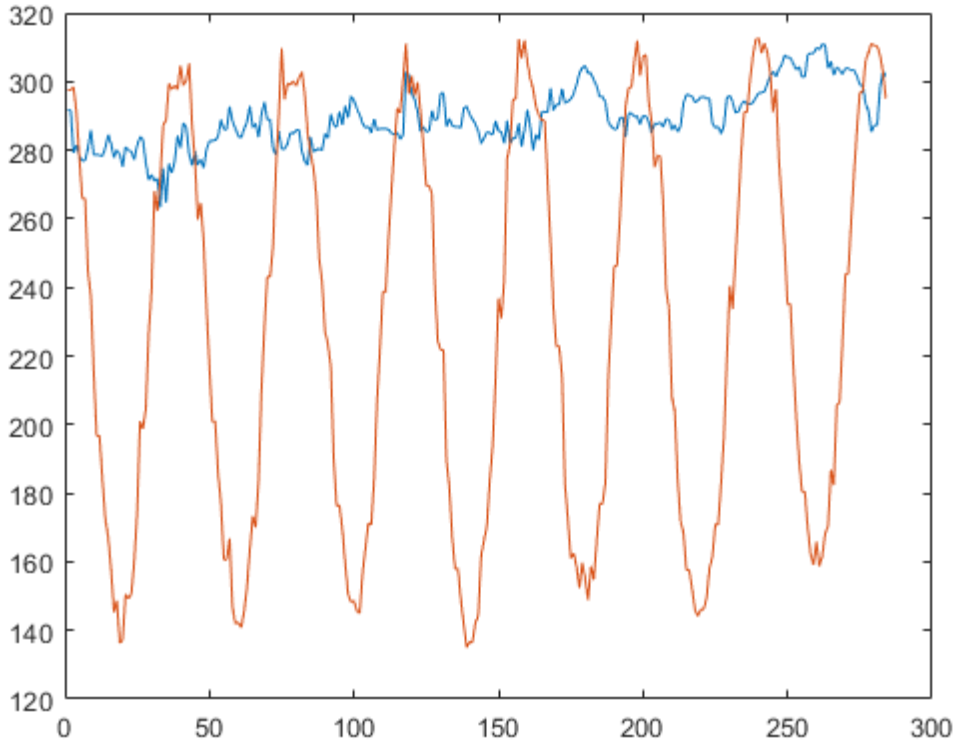
```
%cam1-1
data1 = [];
for j = 1:numFrames1

%filter for section out the movement.
width = 50;
filter = zeros(480,640);
filter(300-2.6*width:1:300+2.6*width, 350-width:1:350+width) = 1;


X1 = vidFrames1_1(:,:,:,j);
figure(1)

%subplot(2,1,1),imshow(X1);
%turn image into binary with gray scale filter.
level = 0.95;
X1b = im2bw(X1,level);

X1b = double(X1b);
X1b = X1b.*filter;


%subplot(2,1,2),imshow(X1b);

%label out section we need and find their centroid, store all objects in a
%stats array.
bw = bwlabel(X1b,4);
stats = regionprops(bw, 'BoundingBox', 'Centroid');

hold on

%initial center find and find center.
centerX = 0;
centerY = 0;
for object = 1:length(stats)
        bc = stats(object).Centroid;
        centerX = centerX+bc(1);
        centerY = centerY+bc(2);

end


hold off

centerX = centerX/length(stats);
centerY = centerY/length(stats);

%store center value into data array.
data1 = [data1;centerX,centerY];
end
plot(data1);
saveas(gcf,'cam1test1.png')
```



cam2-1

```
data2 = [];
for j = 1:numFrames2

%filter for section out the movement.
width = 50;
filter = zeros(480,640);
filter(251-3*width:1:250+3*width, 290-1.3*width:1:290+1.3*width) = 1;


X1 = vidFrames2_1(:,:,:,j);
figure(1)

%subplot(2,1,1),imshow(X1);
level = 0.95;
X1b = im2bw(X1,level);

X1b = double(X1b);
X1b = X1b.*filter;


%subplot(2,1,2),imshow(X1b);

bw = bwlabel(X1b,4);
stats = regionprops(bw, 'BoundingBox', 'Centroid');

hold on

centerX = 0;
centerY = 0;
for object = 1:length(stats)
        %bb = stats(object).BoundingBox;
        bc = stats(object).Centroid;
        centerX = centerX+bc(1);
        centerY = centerY+bc(2);
        %rectangle('Position',bb,'EdgeColor','r','LineWidth',2)
        %plot(bc(1),bc(2), '-m+')
        %a=text(bc(1)+15,bc(2), strcat('X: ', num2str(round(bc(1))), '    Y: ', num2str(round(bc(2)))));
        %set(a, 'FontName', 'Arial', 'FontWeight', 'bold', 'FontSize', 12, 'Color', 'yellow');
end
```

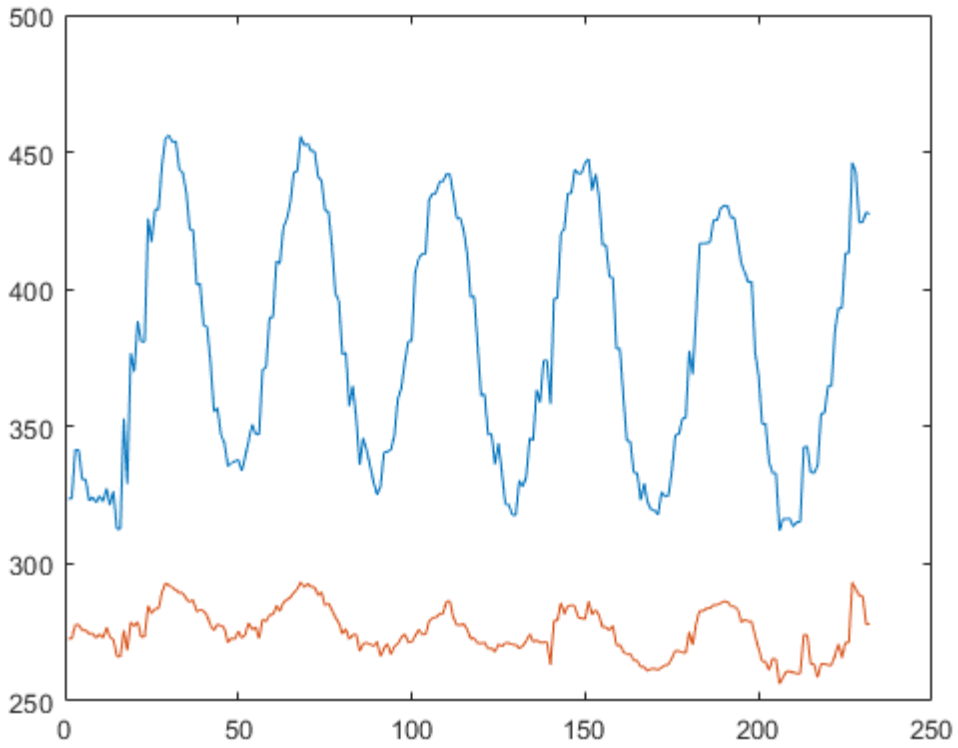
```
hold off

centerX = centerX/length(stats);
centerY = centerY/length(stats);

data2 = [data2;centerX,centerY];



end


plot(data2);
saveas(gcf,'cam2test1.png')
```



cam3-1

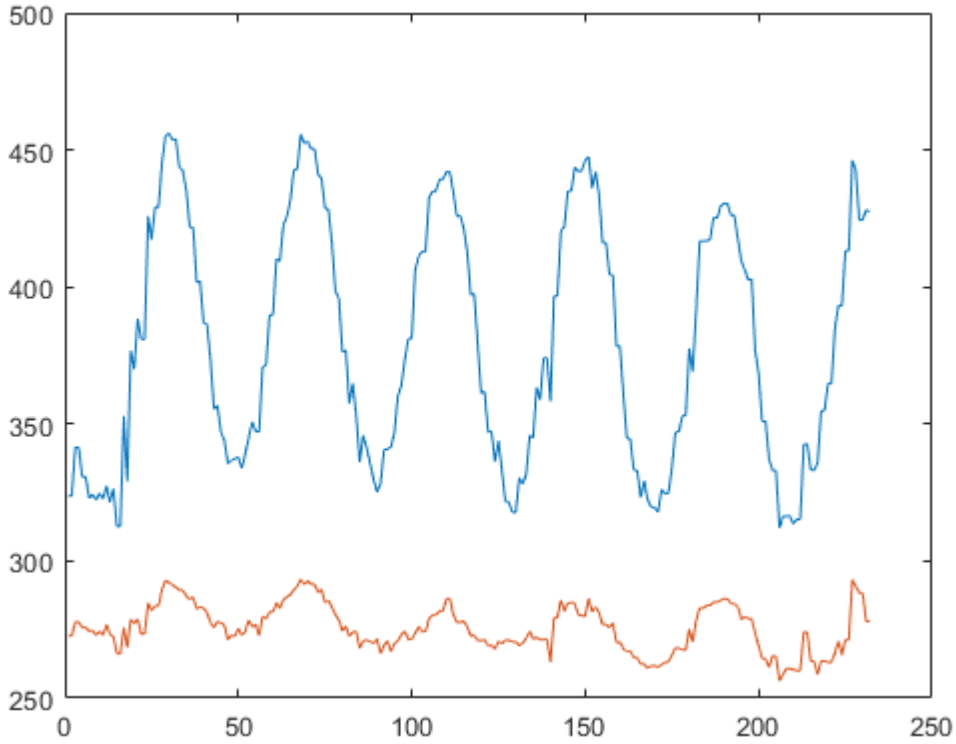
```
data3 = [];
for j = 1:numFrames3
%filter for section out the movement.
width = 50;
filter = zeros(480,640);
filter(250-1*width:1:250+2*width, 360-2.5*width:1:360+2.5*width) = 1;


X1 = vidFrames3_1(:,:,:,j);
figure(1)

%subplot(2,1,1),imshow(X1);
level = 0.95;
X1b = im2bw(X1,level);

X1b = double(X1b);
X1b = X1b.*filter;
```

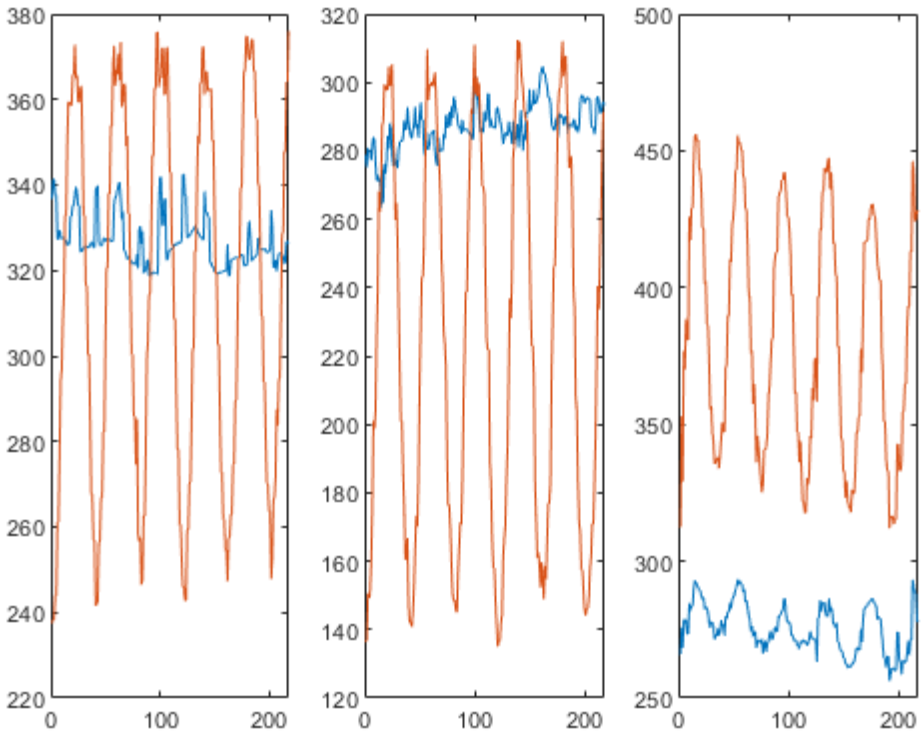
```
%subplot(2,1,2),imshow(X1b);

bw = bwlabel(X1b,4);
stats = regionprops(bw, 'BoundingBox', 'Centroid');

hold on

centerX = 0;
centerY = 0;
for object = 1:length(stats)
        %bb = stats(object).BoundingBox;
        bc = stats(object).Centroid;
        centerX = centerX+bc(1);
        centerY = centerY+bc(2);
        %rectangle('Position',bb,'EdgeColor','r','LineWidth',2)
        %plot(bc(1),bc(2), '-m+')
        %a=text(bc(1)+15,bc(2), strcat('X: ', num2str(round(bc(1))), '    Y: ', num2str(round(bc(2)))));
        %set(a, 'FontName', 'Arial', 'FontWeight', 'bold', 'FontSize', 12, 'Color', 'yellow');
end



hold off

centerX = centerX/length(stats);
centerY = centerY/length(stats);

data3 = [data3;centerX,centerY];


end


plot(data3);
saveas(gcf,'cam3test1.png')
```




```
%clean and format datapoint

[M,I] = min(data1(1:25,2));
data1  = data1(I:end,:);
[M,I] = min(data2(1:25,2));
```

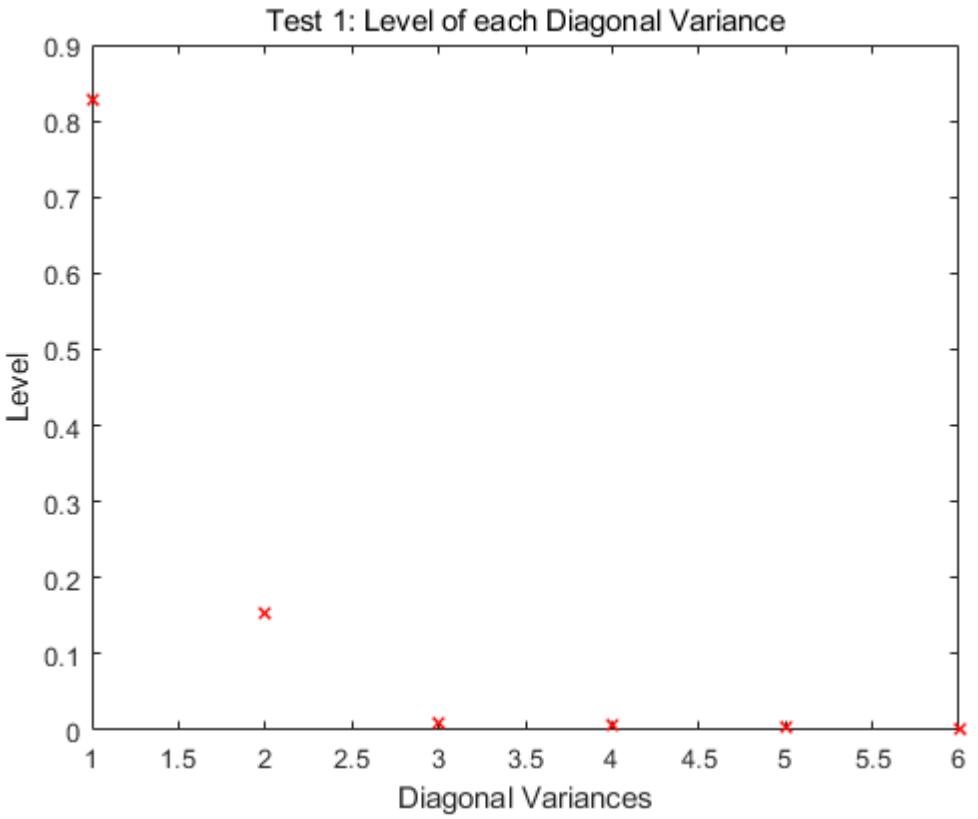
```
data2  = data2(I:end,:);
[M,I] = min(data3(1:25,1));
data3  = data3(I:end,:);

%invert data3 on column
data3vter = [];
data3vter(:,1) = data3(:,2);
data3vter(:,2) = data3(:,1);


data2 = data2(1:length(data1), :);
data3vter = data3vter(1:length(data1), :);


figure(5)
subplot(1,3,1), plot(data1);
subplot(1,3,2), plot(data2);
subplot(1,3,3), plot(data3vter);
saveas(gcf,'cam1to3test1.png')
```

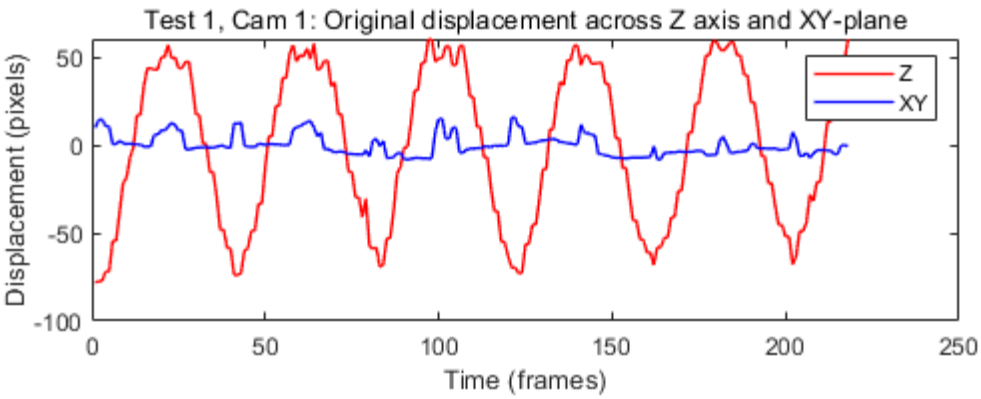


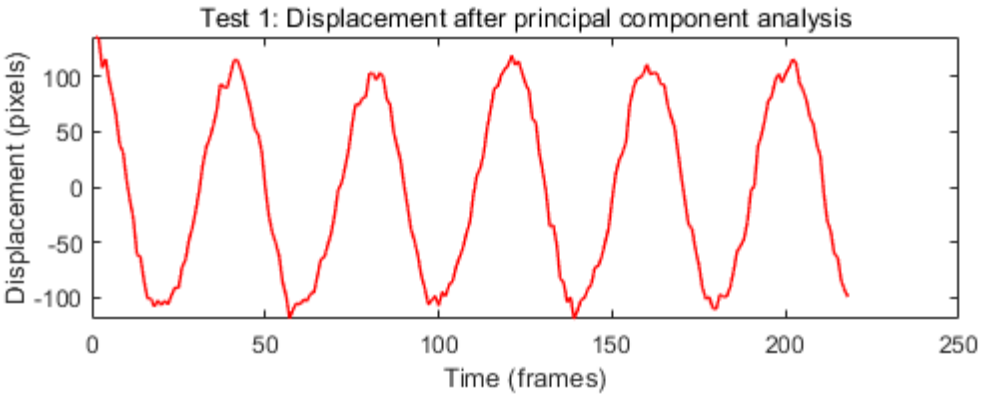



```
dataAll = [data1';data2';data3vter'];
% Compute data size
[M,N]=size(dataAll);
% Compute mean for each row and subtract mean with all the data.
mean=mean(dataAll,2);
dataAll=dataAll-repmat(mean,1,N);
% Deploy the SVD
[u,s,v]=svd(dataAll'/sqrt(N-1));
%diagonal variances
lam=diag(s).^2;
%the principal components projection
Y= dataAll' * v;
%find signal
sig=diag(s);
```

```
close all;

figure(6)
plot(1:6, lam/sum(lam), "rx", 'Linewidth', 1);
title("Test 1: Level of each Diagonal Variance");
xlabel("Diagonal Variances"); ylabel("Level");
saveas(gcf,'pcaleveltest1.png')

figure(7)
subplot(2,1,1),plot(1:218, dataAll(2,:),"r",1:218, dataAll(1,:),"blue", 'Linewidth', 1);
ylabel("Displacement (pixels)"); xlabel("Time (frames)");
title("Test 1, Cam 1: Original displacement across Z axis and XY-plane");
legend("Z", "XY")

subplot(2,1,2) ,plot(1:218, Y(:,1),'r','Linewidth', 1);
ylabel("Displacement (pixels)"); xlabel("Time (frames)");
title("Test 1: Displacement after principal component analysis");
saveas(gcf,'pcatest1.png')
```







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