Table of Contents


```
load('Kinematics.mat')
```

1

```
% get a big matrix for PCA
big = [];
for i=1:length(Kinematics.Trials)
    big = vertcat(big, Kinematics.Trials{i});
end
```

PCA

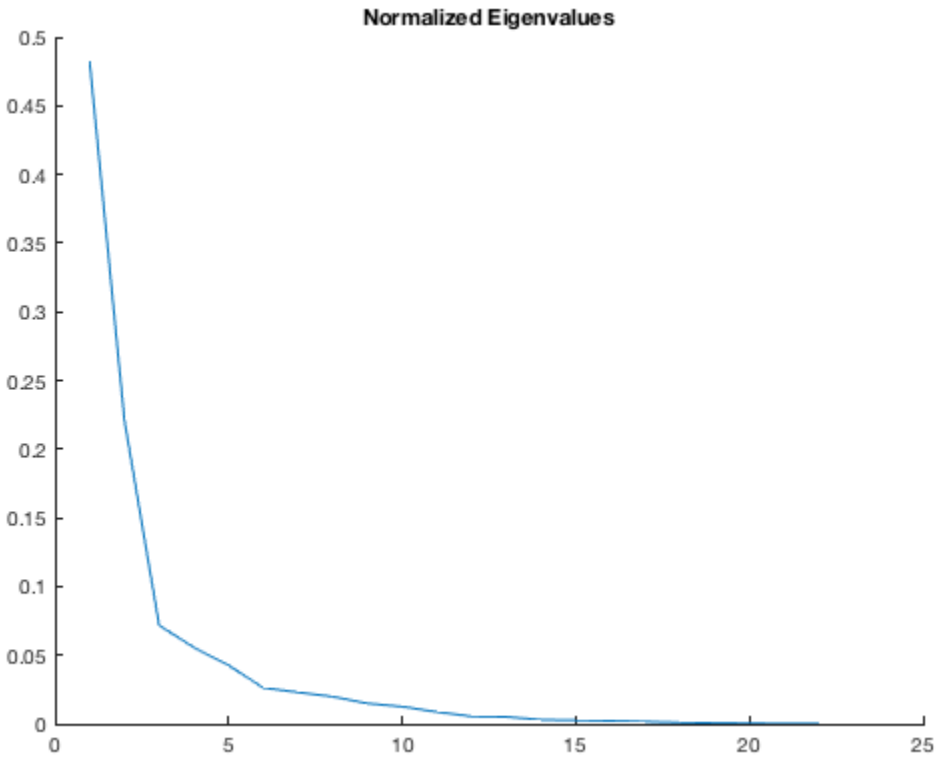
```
[coeff,score,latent,tsquared,explained,mu] = pca(big);
```

2

```
% normalize
latent = latent / sum(latent);

figure; hold on
plot(latent)
title("Normalized Eigenvalues")

fprintf("The first PC explains %2.4f percent of the variance\n",
 explained(1))
fprintf("The first two PCs explain %2.4f percent of the variance\n",
 explained(1) + explained(2))

total_explained = 0;
num_90 = 0;
for i=1:length(latent)
    total_explained = total_explained + explained(i);
    if total_explained >= 90
        num_90 = i;
        break
    end
end
```

```
fprintf("We need %1f PCs to explain at least 90 percent of the data
\n", num_90)
```

```
The first PC explains 48.1797 percent of the variance
The first two PCs explain 70.2845 percent of the variance
We need 7.000000 PCs to explain at least 90 percent of the data
```



3

I couldn't get it to publish with the PCplot, so uncomment this to use the PCplot for #3

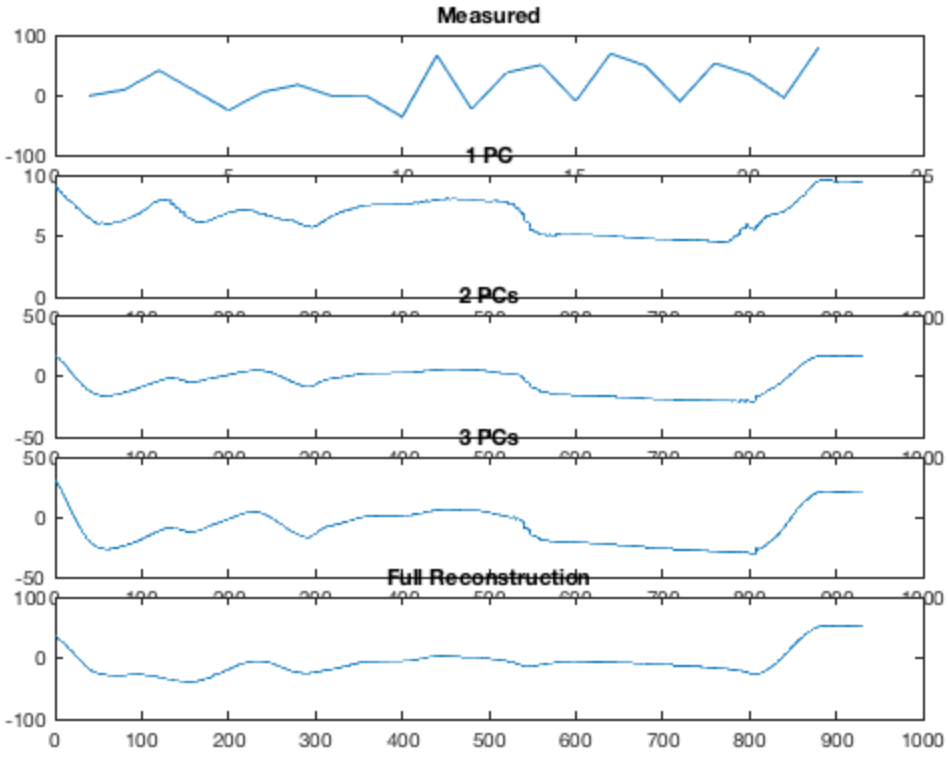
```
%[~] = PCplot(coeff, mean(big), 1, [0 90], [min(min(score))
 max(max(score))]);
%[~] = PCplot(coeff, mean(big), 2, [0 90], [min(min(score))
 max(max(score))]);
```

4

PC * score for 4, not other way around first PC reconstruction

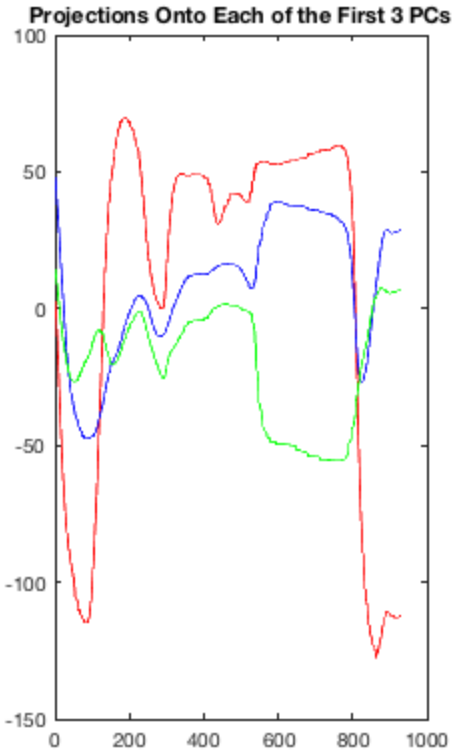
```
s = size(Kinematics.Trials{1});
% take only the 3rd row for wr_flexion_l
trial_1 = score(1:s(1),:);
```

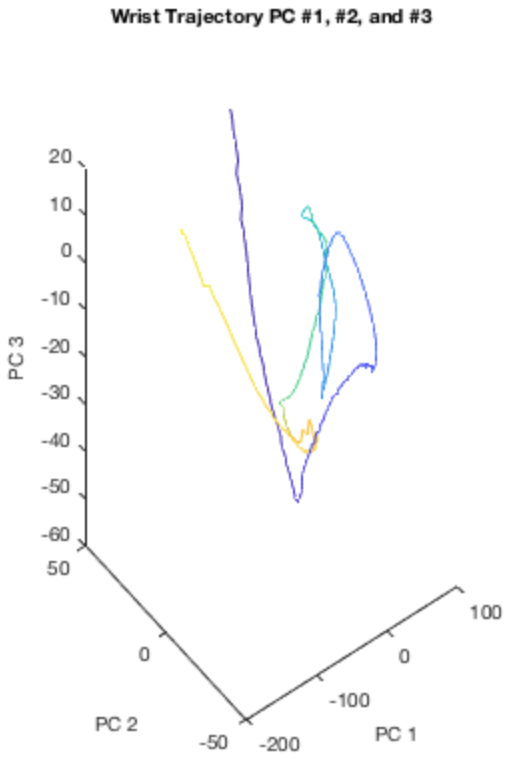
```
% reconstruct, PCA * trial transposed
reconstructed_1 = trial_1 * (coeff(:,1) * coeff(:,1)') + mu;
reconstructed_2 = trial_1 * (coeff(:,1:2) * coeff(:,1:2)') + mu;
reconstructed_3 = trial_1 * (coeff(:,1:3) * coeff(:,1:3)') + mu;
full_recon = trial_1 * coeff';

figure; hold on
subplot(10,1,[1 2])
plot(Kinematics.Trials{1}(3,:))
title("Measured")

subplot(10,1,[3 4])
plot(reconstructed_1(:,3))
title("1 PC")

subplot(10,1,[5 6])
plot(reconstructed_2(:,3))
title("2 PCs")

subplot(10,1,[7 8])
plot(reconstructed_3(:,3))
title("3 PCs")

subplot(10,1,[9 10])
plot(full_recon(:,3))
title("Full Reconstruction")
```



5

```
% real data * pc
% each row in real data is a time point

% demean the data
demeaned_trial_1 = big(1:s(1),:) - mu;

% project onto first pc
proj_1 = demeaned_trial_1 * coeff(:,1);

% project onto second pc
proj_2 = demeaned_trial_1 * coeff(:,2);

% project onto 3rd pc
proj_3 = demeaned_trial_1 * coeff(:,3);

figure; hold on
subplot(1,2,1)
plot(proj_1, 'r')
hold on
plot(proj_2, 'b')
hold on
plot(proj_3, 'g')
title("Projections Onto Each of the First 3 PCs")
sz = 10;
% this next part was not completely clear, but I assumed it meant plot
 the
% trajectory of those projections within the 3d space
subplot(1,2,2)
l = size(proj_1, 1);
cdata = [1:l NaN];
p = patch([proj_1' NaN],[proj_2' NaN], [proj_3' NaN], 0);
set(p,'cdata', cdata, 'edgecolor','interp','facecolor','none')
view(3)
title('Wrist Trajectory PC #1, #2, and #3', 'fontsize', sz);
xlabel('PC 1', 'fontsize', sz);
ylabel('PC 2', 'fontsize', sz);
zlabel('PC 3', 'fontsize', sz);
```

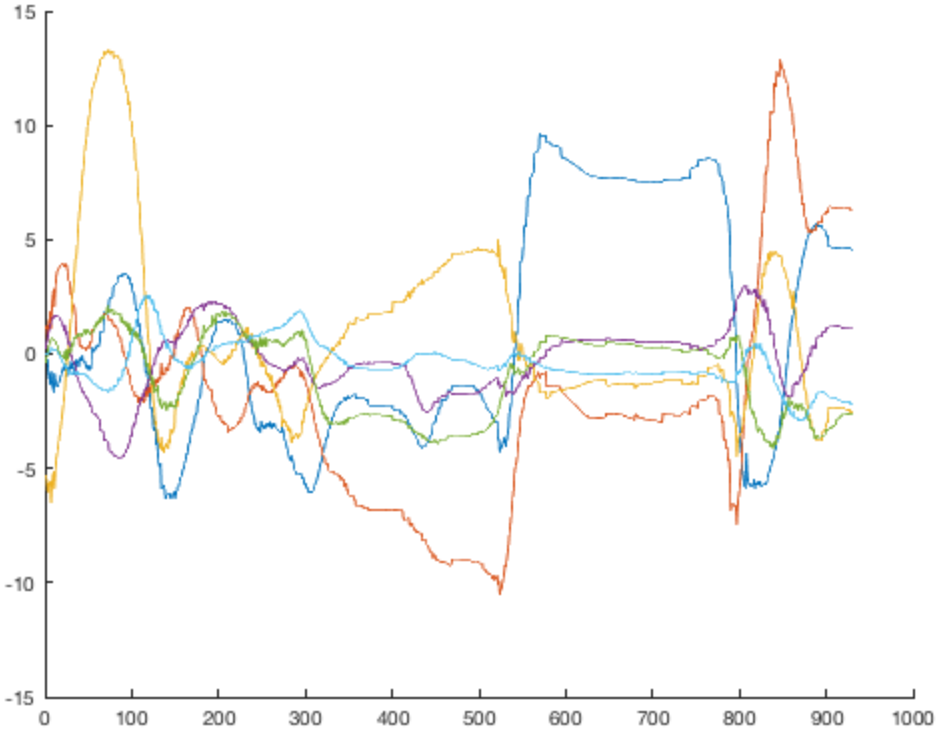




analysis

```
figure; hold on
for i=15:20
    hold on
    plot(demeaned_trial_1 * coeff(:,i));
end

fprintf("The amplitudes and frequencies tended to increase as the
 eigenvalues")
fprintf("decrease.")
```

*The amplitudes and frequencies tended to increase as the
 eigenvaluesdecrease.*



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