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```
clear; clc; close all
```

Generate some data (sines and cosines plus noise)

```
numTrials = 100;
time = 0:1:100;
numTimesteps = length(time);
for trial = 1:numTrials
    data(:,1,trial) = sin(time)'+normrnd(0,1,numTimesteps,1);
    data(:,2,trial) = cos(time)'+normrnd(0,1,numTimesteps,1);
end
```

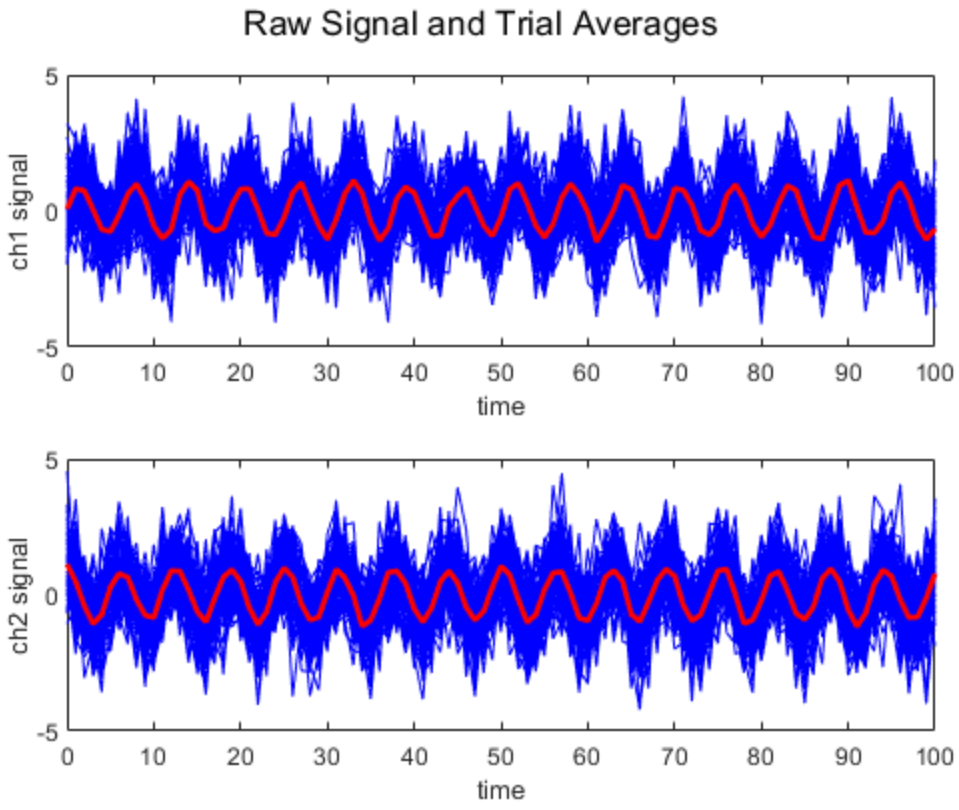
Take trial averages

```
trialAvg = mean(data,3);
```

Make sure data looks ok

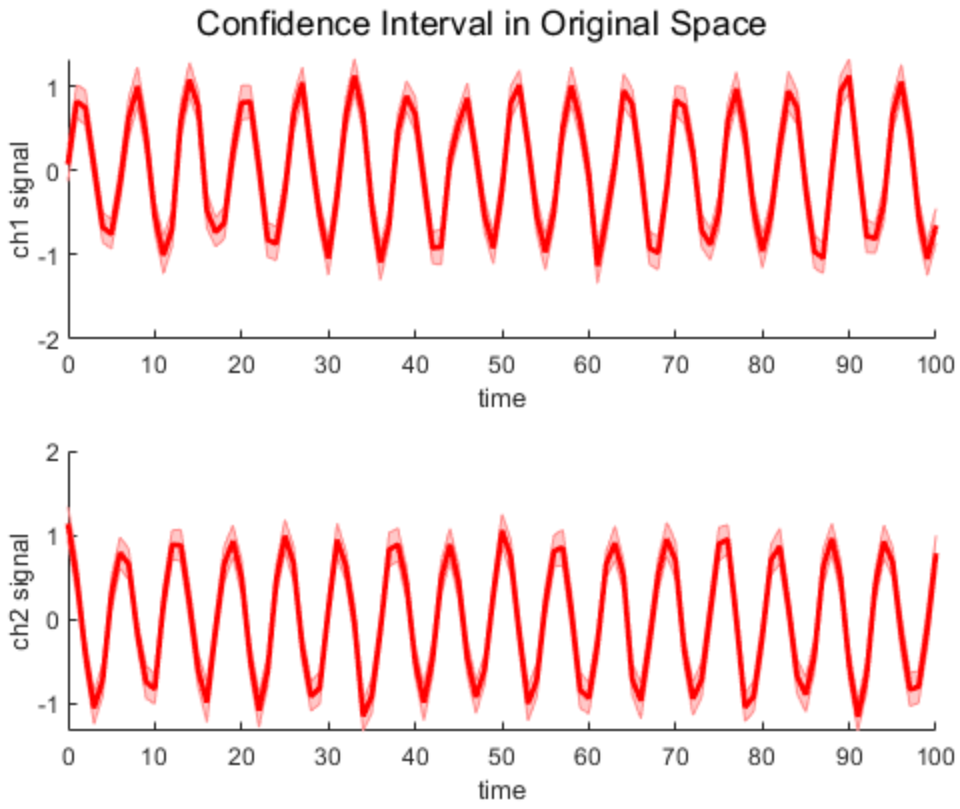
```
figure
for trial = 1:numTrials
    subplot(2,1,1)
        plot(time,data(:,1,trial),'b')
        hold on
    subplot(2,1,2)
        plot(time,data(:,2,trial),'b')
        hold on
end
subplot(2,1,1)
    plot(time,trialAvg(:,1),'r','LineWidth',2)
    xlabel('time')
    ylabel('ch1 signal')
subplot(2,1,2)
```

```
    plot(time,trialAvg(:,2),'r','LineWidth',2)
    xlabel('time')
    ylabel('ch2 signal')
sgtitle('Raw Signal and Trial Averages')
```



Get confidence intervals in original space; plot with trial avgs

```
    CI = 1.96*std(data,0,3)./sqrt(numTrials);
    figure
    subplot(2,1,1)
        shadedErrorBar(time,trialAvg(:,1),CI(:,1),'lineprops',
{'LineWidth',2,'Color','r'})
        xlabel('time')
        ylabel('ch1 signal')
    subplot(2,1,2)
        shadedErrorBar(time,trialAvg(:,2),CI(:,2),'lineprops',
{'LineWidth',2,'Color','r'})
        xlabel('time')
        ylabel('ch2 signal')
    sgtitle('Confidence Interval in Original Space')
```



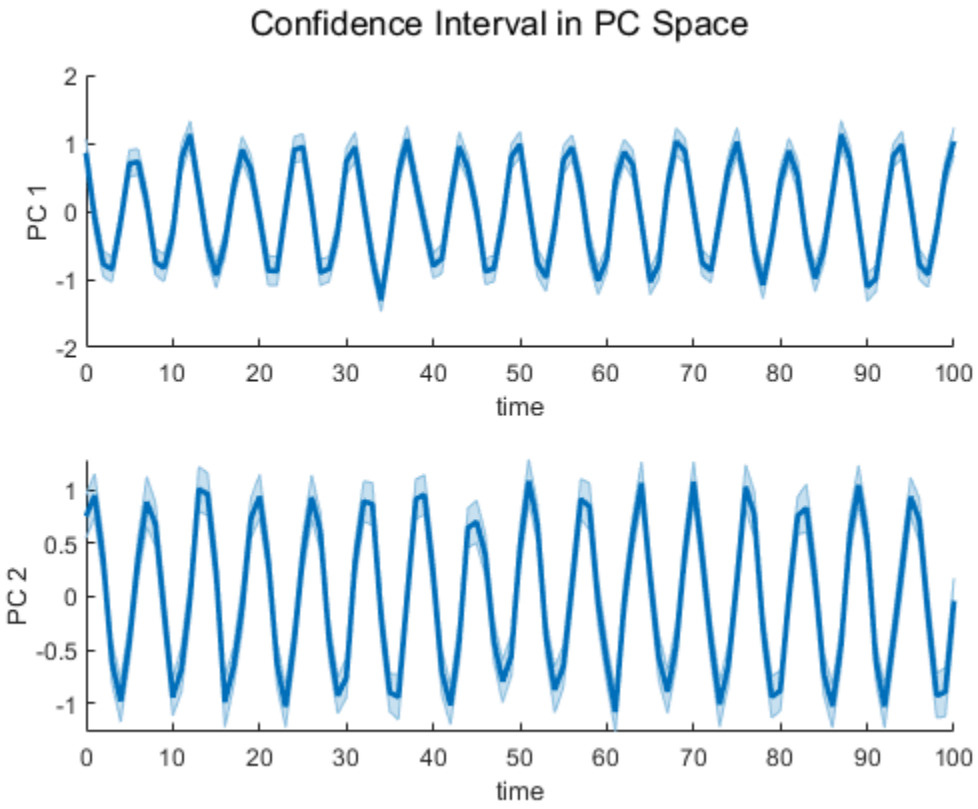
Do PCA on Trial Averages

```
[coeff,score,latent,tsquared,explained,mu] = pca(trialAvg);
%Project all data into PC space
PCProj = NaN(size(data));
for trial = 1:numTrials
   PCProj(:,:,trial) = (data(:,:,trial)-mu)*coeff;
end
%Project trial averages into PC space
trialAvgPCProj = (trialAvg-mu)*coeff;
```

Get confidence intervals in PC space, plot w PC avgs

```
PCCI = 1.96*std(PCProj,0,3)./sqrt(numTrials);
figure
subplot(2,1,1)
    shadedErrorBar(time,trialAvgPCProj(:,1),PCCI(:,1),'lineprops',
{'LineWidth',2})
    xlabel('time')
    ylabel('PC 1')
subplot(2,1,2)
    shadedErrorBar(time,trialAvgPCProj(:,2),PCCI(:,2),'lineprops',
{'LineWidth',2})
```

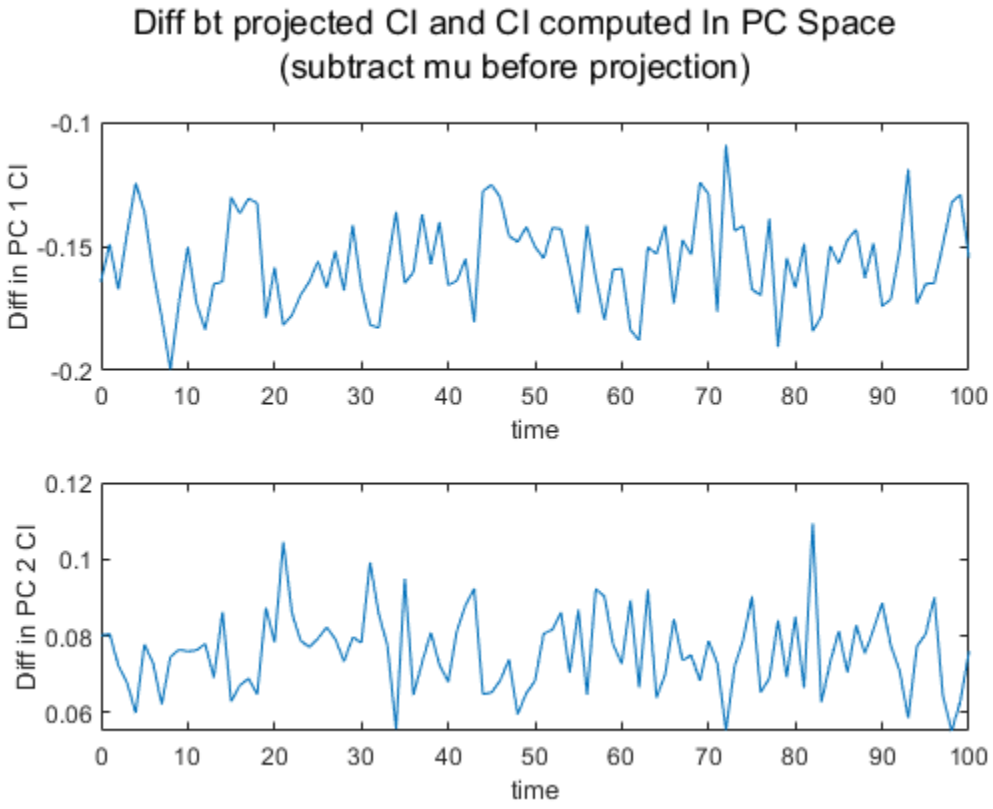
```
    xlabel('time')
    ylabel('PC 2')
sgtitle('Confidence Interval in PC Space')
```



Project CI into PC space; ask if equal to CI computed in PC space; plot differences to be sure

```
CIToPCCI = (CI-mu)*coeff;
isequal(CIToPCCI,PCCI)
differenceInCI = CIToPCCI-PCCI;

figure
subplot(2,1,1)
    plot(time,differenceInCI(:,1))
    xlabel('time')
    ylabel('Diff in PC 1 CI')
subplot(2,1,2)
    plot(time,differenceInCI(:,2))
    xlabel('time')
    ylabel('Diff in PC 2 CI')
sgtitle(['Diff bt projected CI and CI computed In PC
Space',newline,...
    '(subtract mu before projection)'])
```

```
ans =

  logical

   0
```



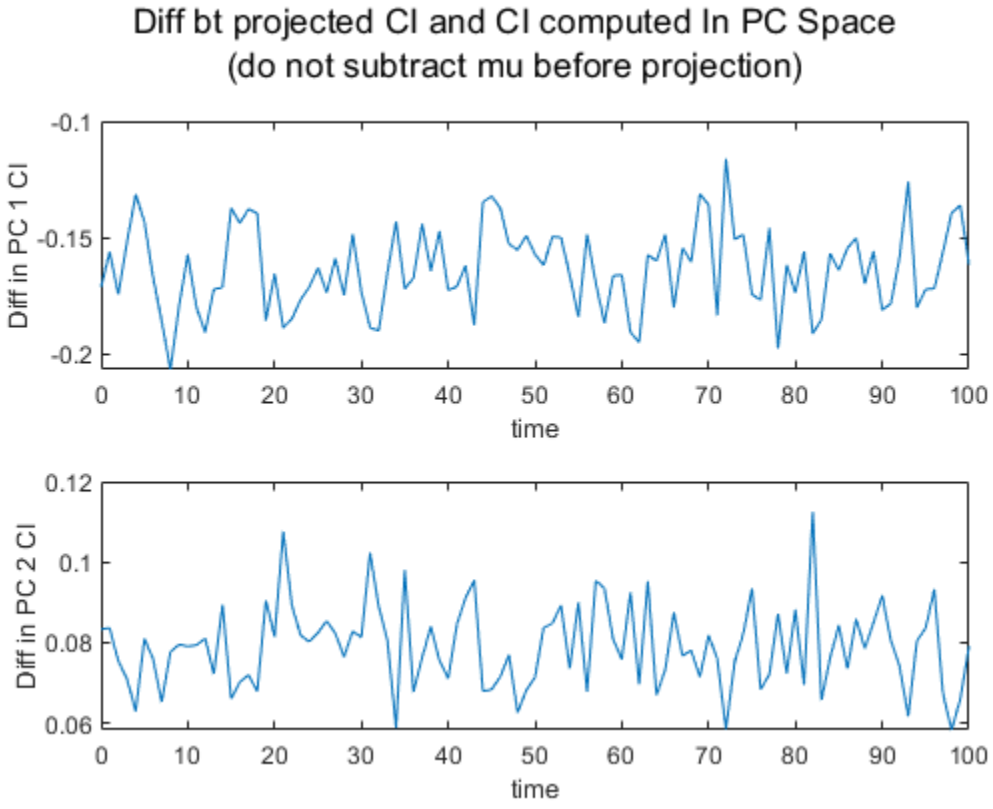
Maybe you're not supposed to subtract mu first, since the CI is more like a distance than a location.

Nope, that didn't work, either

```
CIToPCCInoMu = (CI)*coeff;
isequal(CIToPCCInoMu,PCCI)
differenceInCINoMu = CIToPCCInoMu-PCCI;

figure
subplot(2,1,1)
    plot(time,differenceInCINoMu(:,1))
    xlabel('time')
    ylabel('Diff in PC 1 CI')
subplot(2,1,2)
```

```
        plot(time,differenceInCINoMu(:,2))
        xlabel('time')
        ylabel('Diff in PC 2 CI')
    sgtitle(['Diff bt projected CI and CI computed In PC
Space',newline,...
        '(do not subtract mu before projection)'])
```

```
ans =

  logical

   0
```



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