# SMART Analysis Stack Copyright (C) 2015-2016 Allen Hill

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## Environment setup

clc  
% clear all  
close all  
  
% Load last processed file/path or initialize them  
try  
 load('angle\_state')  
catch  
 filename = '';  
 lastpath = strcat('\\letnet.net\fs\academics\Projects\AcademicAffairs\SchoolofEngineering\Projects',...  
 '\BME-JR-Research\2015\_16 SeniorDesign\BIOMECHANICS\DATA\_MoCap');  
 DEBUG = true;  
 DEBUG\_RAW = false;  
 DEBUG\_NORMALIZED = false;  
 DEBUG\_ANGLES = false;  
 DEBUG\_ALL = true;  
end

## File select

Get file name and path from user

[filename,lastpath] = uigetfile({'\*.trc','TRC motion files (\*.trc)';...  
 '\*.\*','All files (\*.\*)'},'Pick a file',strcat(lastpath,filename));  
file = strcat(lastpath,filename);  
  
% If uigetfile is "Canceled", filename and lastpath are returned empty.  
% Don't save 'state' if uigetfile was canceled.  
if size(file) ~= 0  
 save('angle\_state','lastpath','filename','DEBUG','DEBUG\_RAW',...  
 'DEBUG\_NORMALIZED','DEBUG\_ANGLES','DEBUG\_ALL')  
end

## Data retrieval/setup

Load data from .trc file

capture\_data = importdata(file,'\t',5);  
  
% Retrieve marker names for index searching  
file\_handle = fopen(file);  
fgetl(file\_handle);  
fgetl(file\_handle);  
h3 = textscan(file\_handle,'%d',4);  
NumMarkers = h3{1}(4);  
fgetl(file\_handle);  
S = textscan(file\_handle,'%s',NumMarkers+2);  
Markers = S{1}(:,1)';  
fclose(file\_handle);  
Markers = Markers(3:length(Markers));  
  
% Assign indexes for data segmentation  
for n=1:length(Markers)  
 switch Markers{n}  
 case {'Handlebars\_L','Handlebar\_L'}  
 l\_handlebars\_ind=n\*3;  
 case {'Handlebars\_R','Handlebar\_R'}  
 r\_handlebars\_ind=n\*3;  
% case 'R\_MetaC2'  
% r\_metac2\_ind=n\*3;  
% case 'R\_MetaC5'  
% r\_metac5\_ind=n\*3;  
% case 'R\_WristLat'  
% r\_wristlat\_ind=n\*3;  
% case 'R\_WristMed'  
% r\_wristmed\_ind=n\*3;  
% case 'L\_MetaC2'  
% l\_metac2\_ind=n\*3;  
% case 'L\_MetaC5'  
% l\_metac5\_ind=n\*3;  
% case 'L\_WristLat'  
% l\_wristlat\_ind=n\*3;  
% case 'L\_WristMed'  
% l\_wristmed\_ind=n\*3;  
 end  
  
end  
  
% Remove unneeded variables from workspace  
clear file\_handle h3 NumMarkers S Markers file n

## Data segmentation

Meta markers

l\_handlebar = capture\_data.data(:,l\_handlebars\_ind:l\_handlebars\_ind+2);  
r\_handlebar = capture\_data.data(:,r\_handlebars\_ind:r\_handlebars\_ind+2);  
r\_handlebar\_vmkr = mean(r\_handlebar);  
l\_handlebar\_vmkr = mean(l\_handlebar);  
  
% r\_metac2 = capture\_data.data(:,r\_metac2\_ind:r\_metac2\_ind+2);  
% r\_metac5 = capture\_data.data(:,r\_metac5\_ind:r\_metac5\_ind+2);  
% r\_wristlat = capture\_data.data(:,r\_wristlat\_ind:r\_wristlat\_ind+2);  
% r\_wristmed = capture\_data.data(:,r\_wristmed\_ind:r\_wristmed\_ind+2);  
% l\_metac2 = capture\_data.data(:,l\_metac2\_ind:l\_metac2\_ind+2);  
% l\_metac5 = capture\_data.data(:,l\_metac5\_ind:l\_metac5\_ind+2);  
% l\_wristlat = capture\_data.data(:,l\_wristlat\_ind:l\_wristlat\_ind+2);  
% l\_wristmed = capture\_data.data(:,l\_wristmed\_ind:l\_wristmed\_ind+2);  
  
clear capture\_data  
clear -regexp ind

## Raw Graphs

if (DEBUG && DEBUG\_RAW) || DEBUG\_ALL  
 figure  
  
% %subplot(2,1,1)  
 hold on  
 plot3(l\_handlebar(:,1),l\_handlebar(:,2),l\_handlebar(:,3),'.','Color','blue')  
 plot3(l\_handlebar\_vmkr(1),l\_handlebar\_vmkr(2),l\_handlebar\_vmkr(3),'o','Color','blue')  
 plot3(r\_handlebar(:,1),r\_handlebar(:,2),r\_handlebar(:,3),'.','Color','red')  
 plot3(r\_handlebar\_vmkr(1),r\_handlebar\_vmkr(2),r\_handlebar\_vmkr(3),'o','Color','red')  
 axis vis3d  
 rotate3d on  
 title('Raw Handlebar Data')  
 hold off  
  
% subplot(2,1,2)  
% hold on  
% plot3(l\_metac2(:,1),l\_metac2(:,2),l\_metac2(:,3),'.','Color','blue')  
% plot3(l\_metac2\_vmkr(1),l\_metac2\_vmkr(2),l\_metac2\_vmkr(3),'o','Color','blue')  
% plot3(l\_metac5(:,1),l\_metac5(:,2),l\_metac5(:,3),'.','Color','red')  
% plot3(l\_metac5\_vmkr(1),l\_metac5\_vmkr(2),l\_metac5\_vmkr(3),'o','Color','red')  
% axis vis3d  
% rotate3d on  
% title('Raw Left Meta Data')  
% hold off  
 %fig2plotly();  
end  
  
clear -regexp vmkr

## Normalizing Data

valid\_r\_handlebar = find(mean(r\_handlebar,2)~=0);  
valid\_l\_handlebar = find(mean(l\_handlebar,2)~=0);  
  
% Center all the data at 0,0,0  
r\_handlebar(valid\_r\_handlebar,:) = detrend(r\_handlebar(valid\_r\_handlebar,:),'constant');  
l\_handlebar(valid\_l\_handlebar,:) = detrend(l\_handlebar(valid\_l\_handlebar,:),'constant');  
  
% r\_metac2 = detrend(r\_metac2,'constant');  
% r\_metac5 = detrend(r\_metac5,'constant');  
% r\_wristlat = detrend(r\_wristlat,'constant');  
% r\_wristmed = detrend(r\_wristmed,'constant');  
% l\_metac2 = detrend(l\_metac2,'constant');  
% l\_metac5 = detrend(l\_metac5,'constant');  
% l\_wristlat = detrend(l\_wristlat,'constant');  
% l\_wristmed = detrend(l\_wristmed,'constant');  
%  
% combined = [r\_metac2; ...  
% r\_metac5; ...  
% r\_wristlat; ...  
% r\_wristmed; ...  
% l\_metac2; ...  
% l\_metac5; ...  
% r\_wristlat; ...  
% r\_wristmed ];  
  
% Perform PCA  
if DEBUG  
 tic  
 [ handlebar\_o, handlebar\_pc, handlebar\_Q ] = robustPCA([r\_handlebar(valid\_r\_handlebar,:); l\_handlebar(valid\_l\_handlebar,:)]);  
 %[ handlebar\_o, handlebar\_pc, handlebar\_Q ] = robustPCA(combined);  
 toc  
else  
 [ handlebar\_o, handlebar\_pc, ~ ] = robustPCA([r\_handlebar(valid\_r\_handlebar,:); l\_handlebar(valid\_l\_handlebar,:)]);  
 %[ handlebar\_o, handlebar\_pc, handlebar\_Q ] = robustPCA(combined);  
end  
  
% if DEBUG  
% r\_handlebar\_lims = lims(r\_handlebar);  
% l\_handlebar\_lims = lims(l\_handlebar);  
% end

## Normalized Graphs

if (DEBUG && DEBUG\_NORMALIZED) || DEBUG\_ALL  
 figure  
  
% subplot(2,1,1)  
 hold on  
 plot3(r\_handlebar(valid\_r\_handlebar,1),r\_handlebar(valid\_r\_handlebar,2),r\_handlebar(valid\_r\_handlebar,3),'.','Color','red')  
 plot3(handlebar\_o(1),handlebar\_o(2),handlebar\_o(3),'o','Color','red')  
 plot3(l\_handlebar(valid\_l\_handlebar,1),l\_handlebar(valid\_l\_handlebar,2),l\_handlebar(valid\_l\_handlebar,3),'.','Color','blue')  
 line([0 handlebar\_pc(1,1)/5],[0 handlebar\_pc(1,2)/5],[0 handlebar\_pc(1,3)/5],'Color','blue')  
 line([0 handlebar\_pc(2,1)/5],[0 handlebar\_pc(2,2)/5],[0 handlebar\_pc(2,3)/5],'Color','red')  
 line([0 handlebar\_pc(3,1)/5],[0 handlebar\_pc(3,2)/5],[0 handlebar\_pc(3,3)/5],'Color','green')  
 title('Normalized Handlebar Data')  
 axis vis3d  
 rotate3d on  
 hold off  
  
% subplot(2,1,2)  
% hold on  
% plot3(l\_metac2(:,1),l\_metac2(:,2),l\_metac2(:,3),'.','Color','blue')  
% plot3(0,0,0,'o','Color','blue')  
% plot3(l\_metac5(:,1),l\_metac5(:,2),l\_metac5(:,3),'.','Color','red')  
% plot3(0,0,0,'o','Color','red')  
% line([0 handlebar\_pc(1,1)/5],[0 handlebar\_pc(1,2)/5],[0 handlebar\_pc(1,3)/5],'Color','blue')  
% line([0 handlebar\_pc(2,1)/5],[0 handlebar\_pc(2,2)/5],[0 handlebar\_pc(2,3)/5],'Color','red')  
% line([0 handlebar\_pc(3,1)/5],[0 handlebar\_pc(3,2)/5],[0 handlebar\_pc(3,3)/5],'Color','green')  
% title('Normalized Left Meta Data')  
% axis vis3d  
% rotate3d on  
% hold off  
 %fig2plotly();  
end

## Angle Calculations

% l\_combined\_x = mean([l\_metac2(:,1),l\_metac5(:,1)],2);  
% l\_combined\_y = mean([l\_metac2(:,2),l\_metac5(:,2)],2);  
% l\_combined\_z = mean([l\_metac2(:,3),l\_metac5(:,3)],2);  
% l\_combined = [l\_combined\_x, l\_combined\_y, l\_combined\_z];  
%  
% [l\_combined\_angles, l\_combined\_ideal\_path, l\_combined\_radius] = CalculateAngles(l\_combined, handlebar\_pc);  
  
[angles, ideal\_path, handlebar\_radius] = CalculateAngles(r\_handlebar, l\_handlebar, handlebar\_pc);  
%[l\_handlebar\_angles, l\_handlebar\_ideal\_path, l\_handlebar\_radius] = CalculateAngles(l\_handlebar, handlebar\_pc);  
  
if (DEBUG && DEBUG\_ANGLES) || DEBUG\_ALL  
  
 figure  
 hold on  
 plot3(handlebar\_Q(:,1),handlebar\_Q(:,2),handlebar\_Q(:,3),'.','Color','blue')  
 plot3(handlebar\_o(1),handlebar\_o(2),handlebar\_o(3),'o','Color','red')  
 plot3(ideal\_path(:,1),ideal\_path(:,2),ideal\_path(:,3),'Color','red','LineWidth',2)  
 line([0 handlebar\_pc(1,1)/5],[0 handlebar\_pc(1,2)/5],[0 handlebar\_pc(1,3)/5],'Color','blue')  
 line([0 handlebar\_pc(2,1)/5],[0 handlebar\_pc(2,2)/5],[0 handlebar\_pc(2,3)/5],'Color','red')  
 line([0 handlebar\_pc(3,1)/5],[0 handlebar\_pc(3,2)/5],[0 handlebar\_pc(3,3)/5],'Color','green')  
 line([0 handlebar\_radius],[0 0],[0 0],'Color','cyan')  
 axis vis3d  
 rotate3d on  
 hold off  
 %fig2plotly();  
  
% figure  
% hold on  
% plot3(l\_combined(:,1),l\_combined(:,2),l\_combined(:,3),'.','Color','blue')  
% plot3(0,0,0,'o','Color','red')  
% plot3(l\_combined\_ideal\_path(:,1),l\_combined\_ideal\_path(:,2),l\_combined\_ideal\_path(:,3),'Color','red','LineWidth',2)  
% line([0 handlebar\_pc(1,1)/5],[0 handlebar\_pc(1,2)/5],[0 handlebar\_pc(1,3)/5],'Color','blue')  
% line([0 handlebar\_pc(2,1)/5],[0 handlebar\_pc(2,2)/5],[0 handlebar\_pc(2,3)/5],'Color','red')  
% line([0 handlebar\_pc(3,1)/5],[0 handlebar\_pc(3,2)/5],[0 handlebar\_pc(3,3)/5],'Color','green')  
% line([0 l\_combined\_radius],[0 0],[0 0],'Color','cyan')  
% axis vis3d  
% rotate3d on  
% hold off  
  
 figure  
 plot(angles(1:1000),'blue')  
 %plot(r\_handlebar\_new(1000:2000),'red')  
 %fig2plotly();  
end  
  
% angles = l\_combined\_angles;

## Saving and Workspace cleanup

if false  
 [savefilename,savelastpath] = uiputfile({'\*.xlsx','Excel files (\*.xlsx)'},'Save file name',lastpath);  
 file = strcat(savelastpath,savefilename);  
  
 if length(file) ~= 0  
 xlswrite(file,[[0.01:.01:length(angles)\*.01]',angles])  
 end  
  
 if ~DEBUG  
 clear all  
 end  
else  
 xlswrite(strcat(lastpath,filename(1:length(filename)-4),' handlebars.xlsx'),[[0.01:.01:length(angles)\*.01]',angles])  
end

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