Quincy Muzik

STAT 330 – 002

Final Project

12/10/2024

Final Project: Motion Capture Hand Postures Statistical Analysis

This goal of this project is to demonstrate concepts learned from the STAT 330 course at University of Wisconsin – Stout and apply them to analyzing a big data set. For this project, I used the Motion Capture Hand Postures Dataset .CSV from the UC Irvine Machine Learning Repository. This dataset was created after recording 12 users with a Vicon Motion Capture system performing 5 different postures with 12 markers on the left-hand. After the data was chosen, I used the following technologies to create this project:

- Python3 (Matplotlib, Pandas, and Sklearn)
- Visual Studio Code
- Microsoft Excel

The reason I chose the Motion Capture Hand Postures dataset was because my career path after UW Stout is Motion Capture / Virtual Production. Therefore, what better way to take career path and apply the concepts I learned from the course into something that I am passionate about.

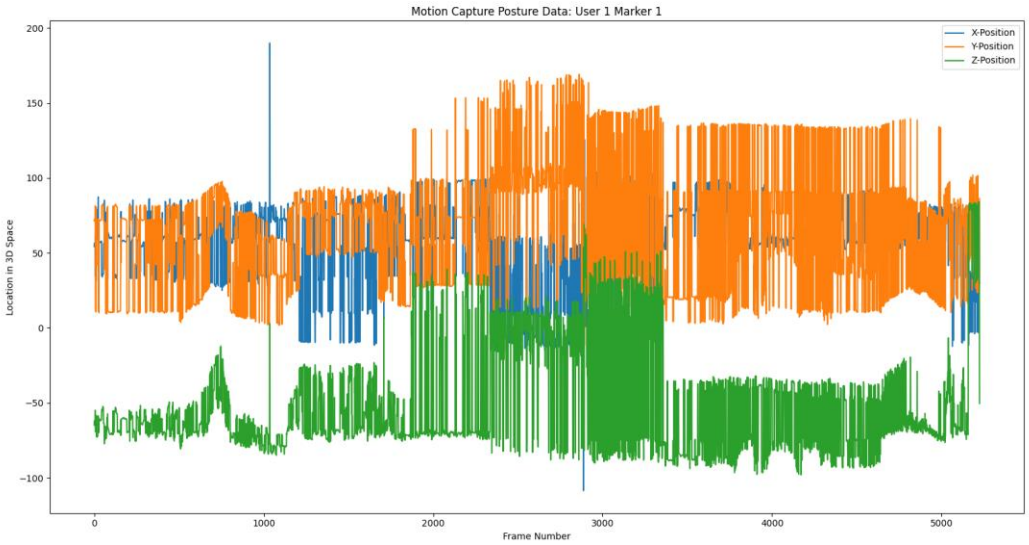
For this project, I only analyzed the first 3 users' postures and the first 3 markers out of the 12. This was done to due to consistency of the data being tracked and reduction of null data. Therefore, this leads me into the research questions and my findings for this project.

Research Questions:

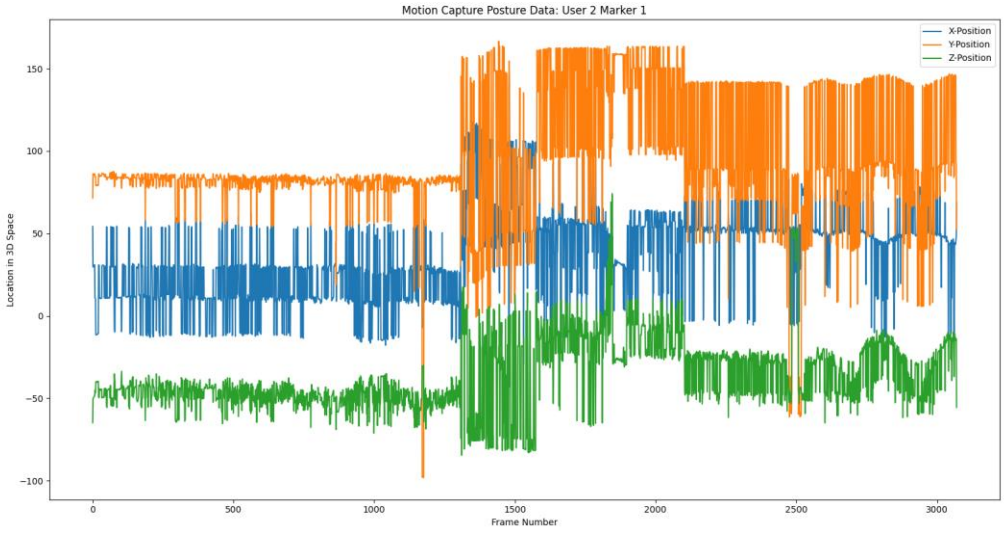
1. Does each user's hand posture produce the same data for each marker?
2. Which marker values are similar across all 3 users?
3. Which marker values are different across all 3 users?

Data Visualization for Marker 1:

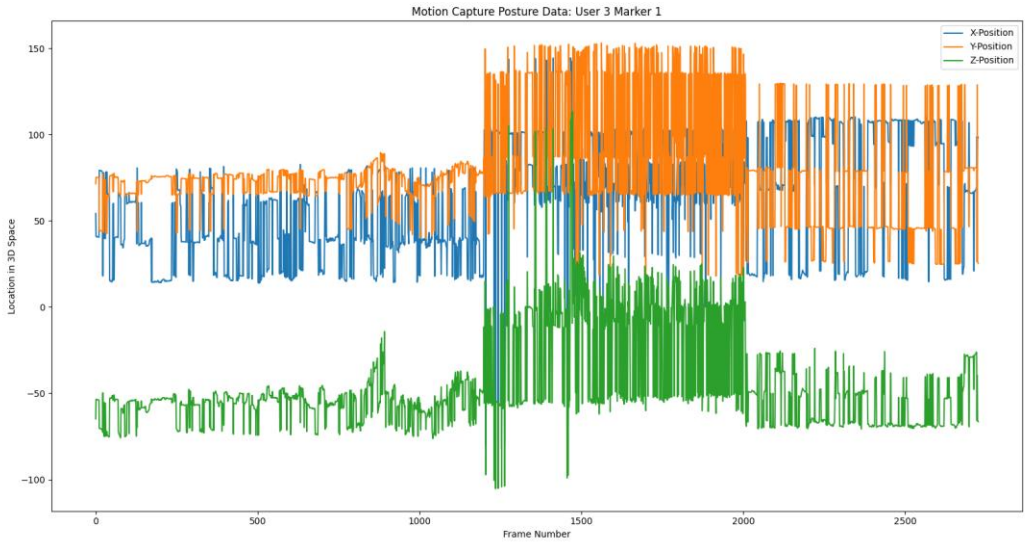
User 1:



User 2



User 3



Mean / Median / Variance:

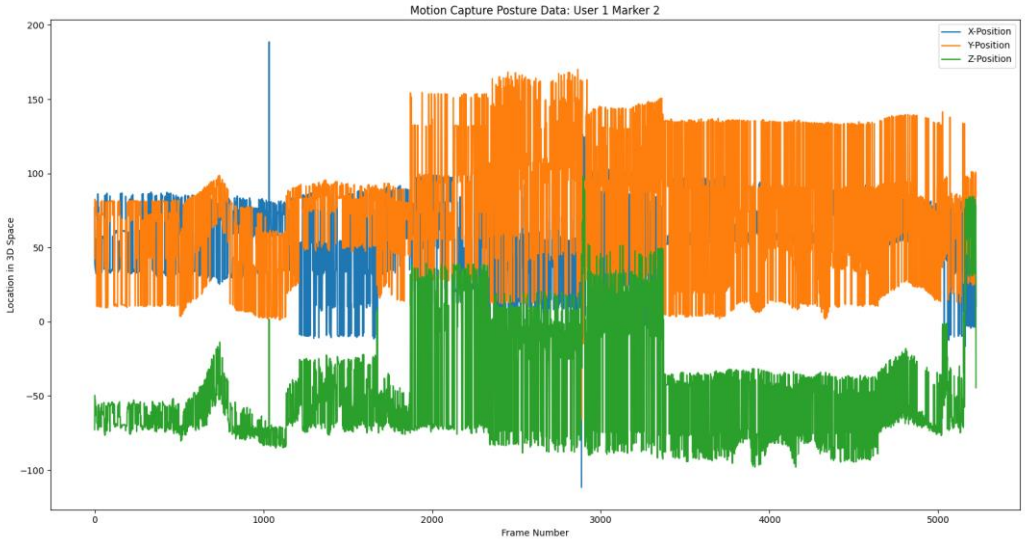
User 1:
Mean:
X0 56.911445
Y0 66.483680
Z0 -50.060325
Variance:
X0 709.532968
Y0 1591.847755
Z0 1249.190054
Median:
X0 59.698655
Y0 72.573015
Z0 -66.325850

User 2:
Mean:
X0 38.297834
Y0 95.054968
Z0 -36.337004
Variance:
X0 796.395049
Y0 1428.144664
Z0 440.213076
Median:
X0 43.624402
Y0 84.494543
Z0 -42.856146

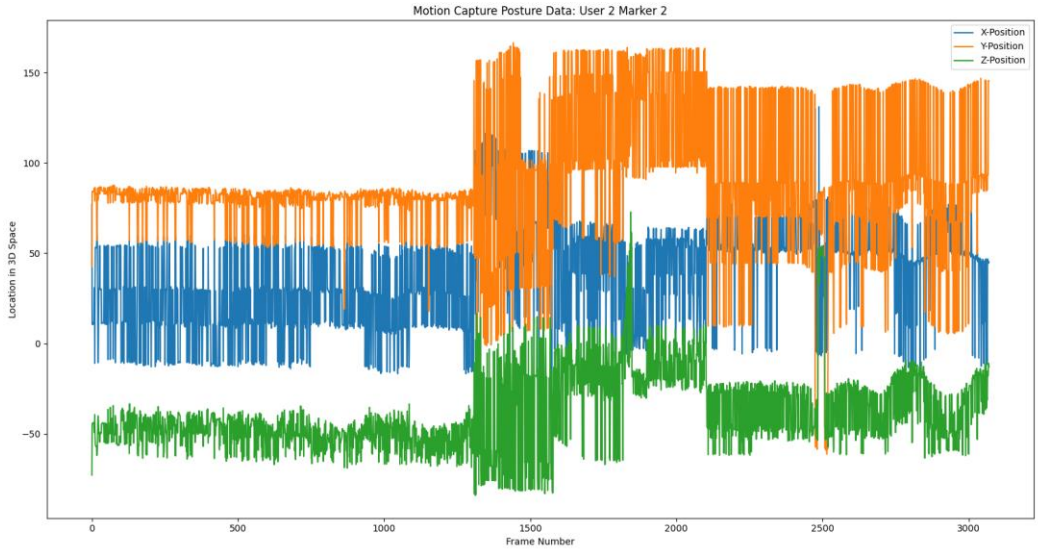
User 3:
Mean:
X0 62.912399
Y0 78.428093
Z0 -45.085385
Variance:
X0 1069.699770
Y0 869.611520
Z0 735.031493
Median:
X0 66.477217
Y0 74.951750
Z0 -53.231795

Data Visualization for Marker 2:

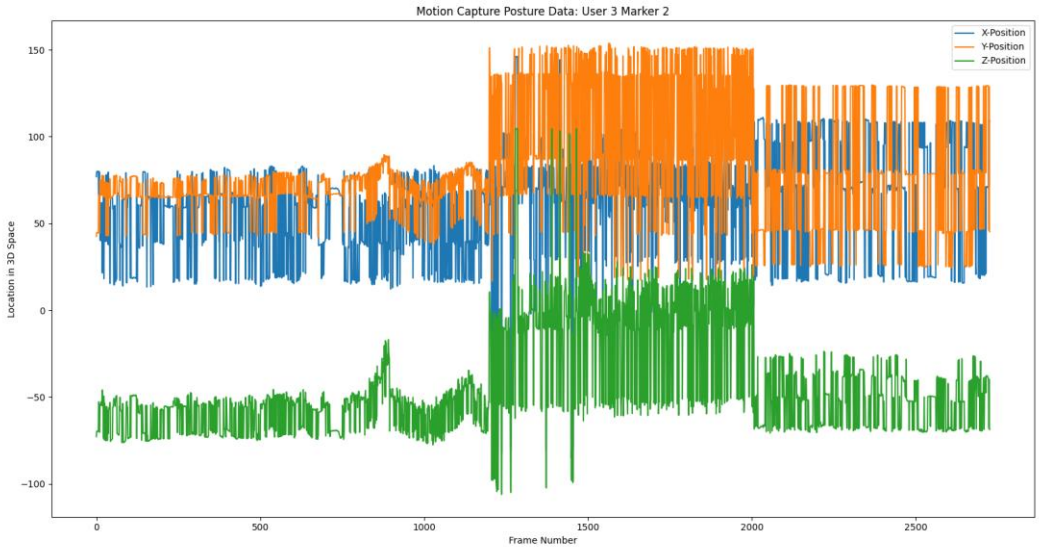
User 1



User 2



User 3



Mean / Median / Variance:

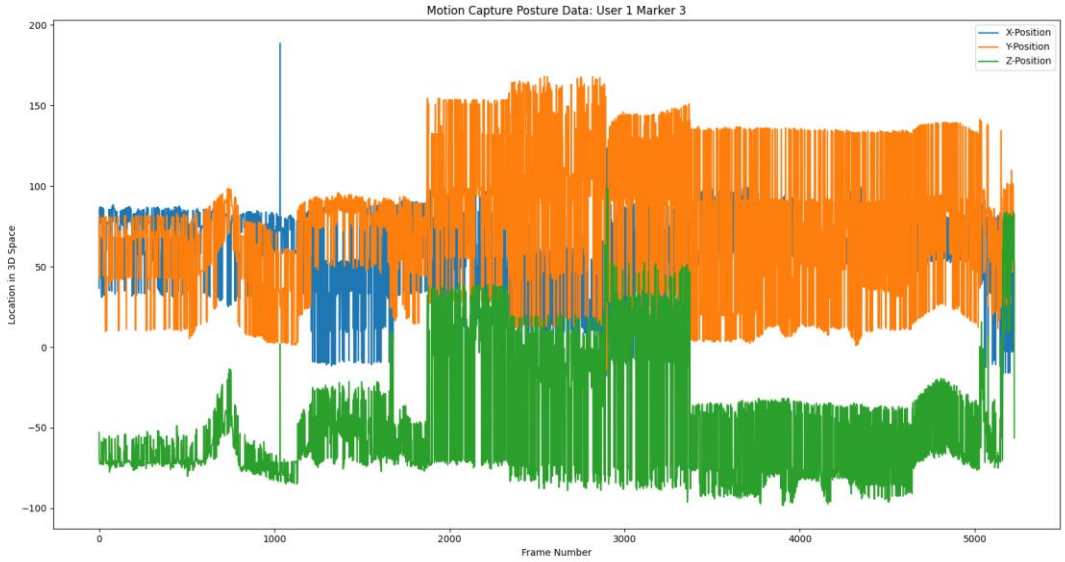
User 1:
Mean:
X1 56.374910
Y1 73.632549
Z1 -46.208712
Variance:
X1 633.989906
Y1 1724.663762
Z1 1346.884845
Median:
X1 59.123175
Y1 79.784698
Z1 -57.133381

User 2:
Mean:
X1 40.083709
Y1 88.082662
Z1 -38.161702
Variance:
X1 856.533257
Y1 1287.831326
Z1 464.874732
Median:
X1 49.297404
Y1 83.269481
Z1 -44.246276

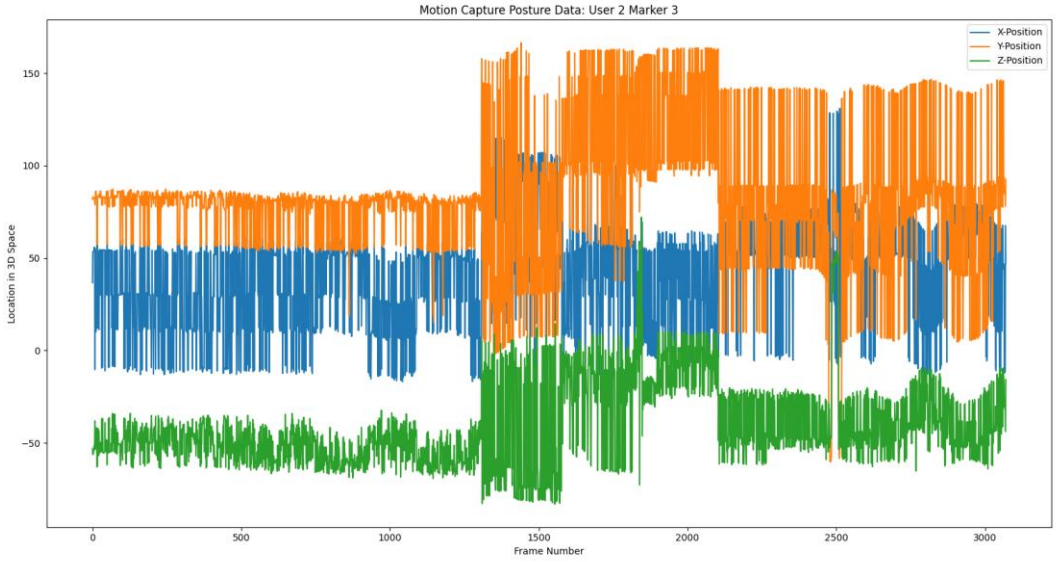
User 3:
Mean:
X1 62.172070
Y1 81.315361
Z1 -43.252467
Variance:
X1 956.910245
Y1 1055.501970
Z1 883.260861
Median:
X1 67.098144
Y1 75.689442
Z1 -52.154551

Data Visualization for Marker 3:

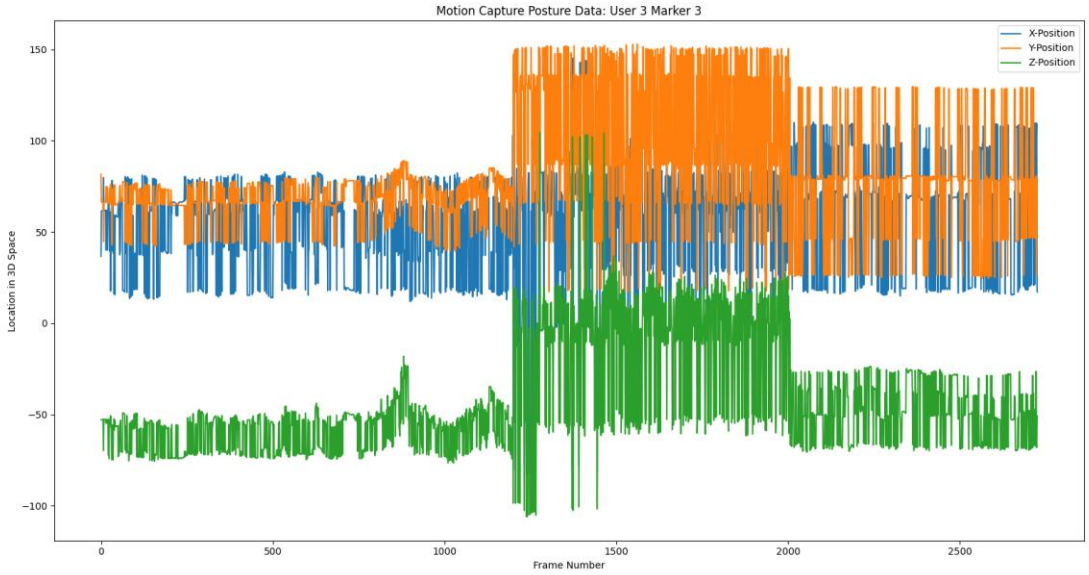
User 1



User 2



User 3



Mean / Median / Variance:

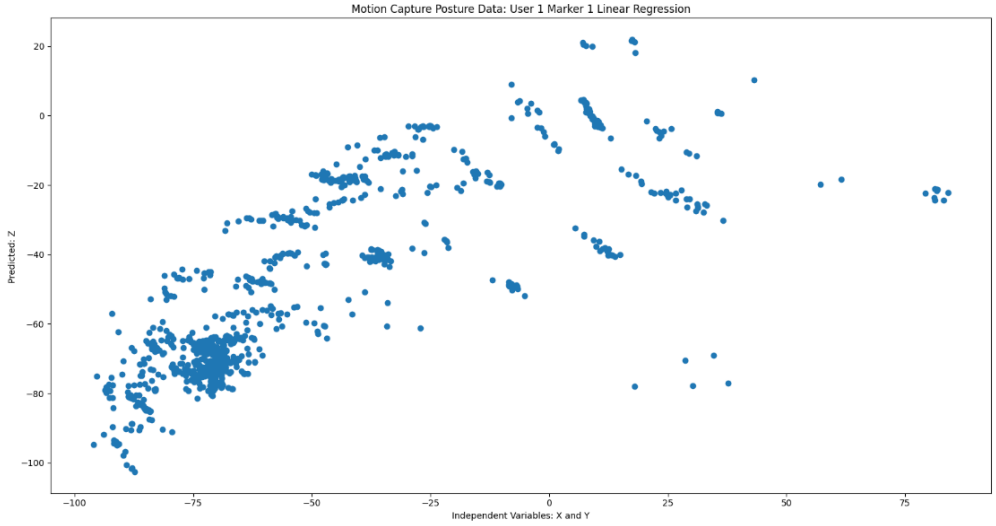
User 1:
Mean:
X2 57.926243
Y2 74.989953
Z2 -44.968430
Variance:
X2 620.052847
Y2 1685.421273
Z2 1441.738260
Median:
X2 59.501355
Y2 78.571885
Z2 -58.091407

User 2:
Mean:
X2 43.189058
Y2 82.968124
Z2 -40.241015
Variance:
X2 844.994023
Y2 1320.399382
Z2 509.919524
Median:
X2 51.513193
Y2 82.292364
Z2 -46.434468

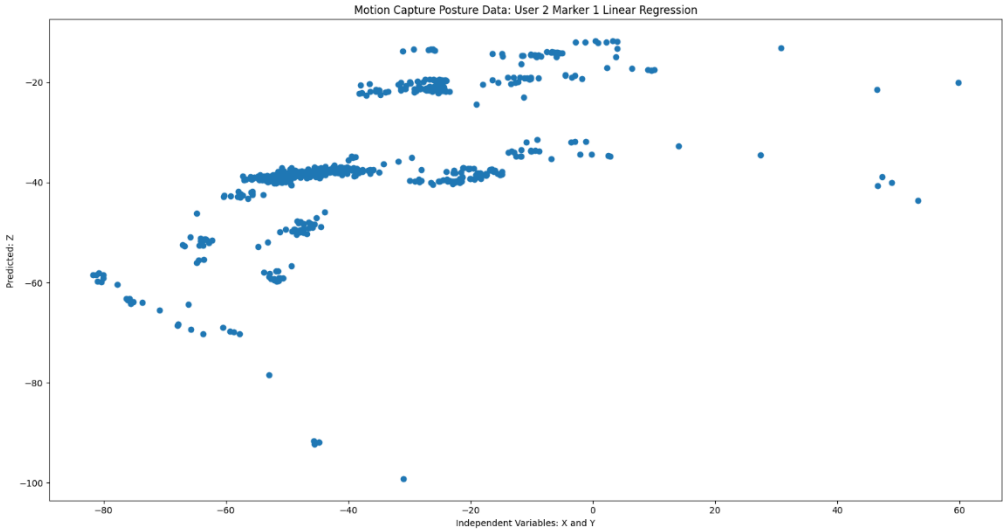
User 3:
Mean:
X2 58.972240
Y2 80.568448
Z2 -41.771573
Variance:
X2 971.150402
Y2 1060.415524
Z2 911.338396
Median:
X2 66.398059
Y2 76.750799
Z2 -51.431179

Linear Regression for Marker 1:

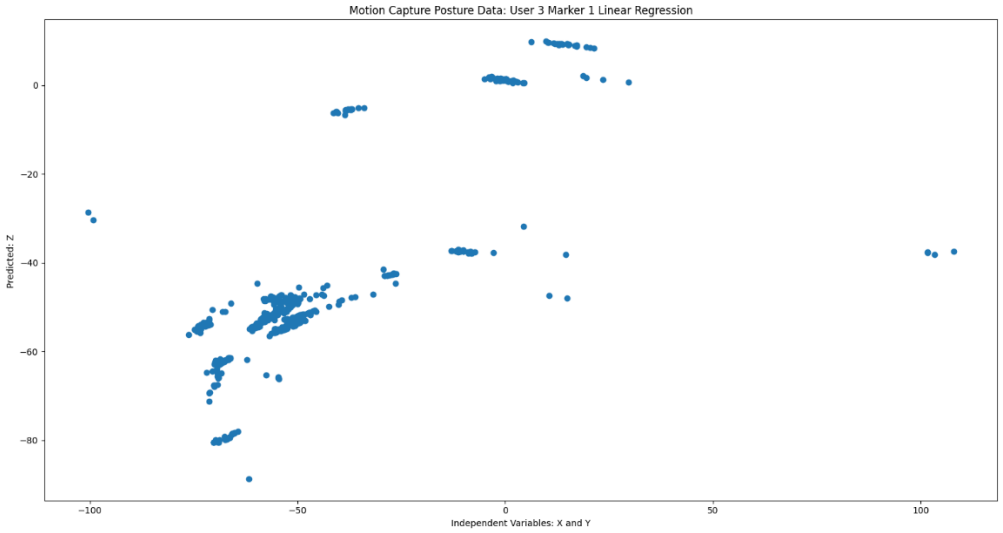
User 1



User 2



User 3



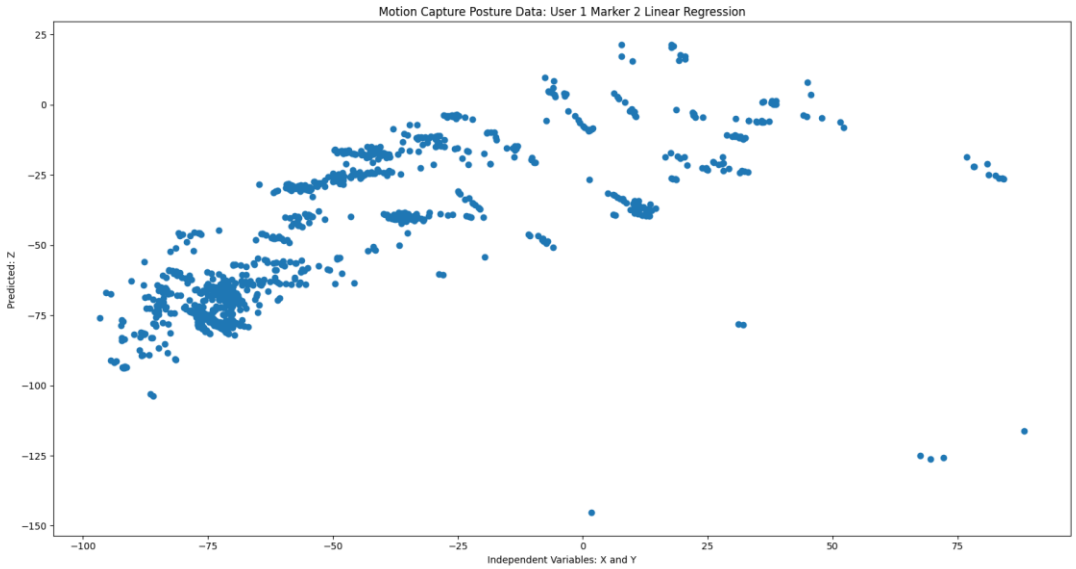
User 1:
Coefficients: [-0.5949293 0.44510671]
Intercept: -45.77599154193584
R-Squared: 0.6083378333700067

User 2:
Coefficients: [-0.0975721 0.34855353]
Intercept: -65.73358140575358
R-Squared: 0.40554585685644295

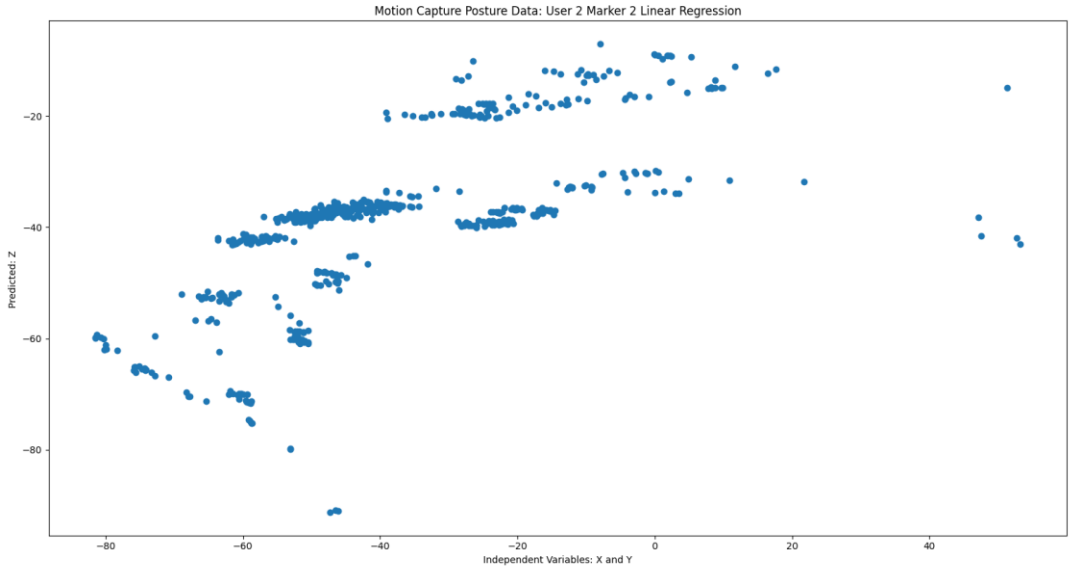
User 3:
Coefficients: [0.16215888 0.75560854]
Intercept: -114.58861678341506
R-Squared: 0.5979863897462455

Linear Regression for Marker 2:

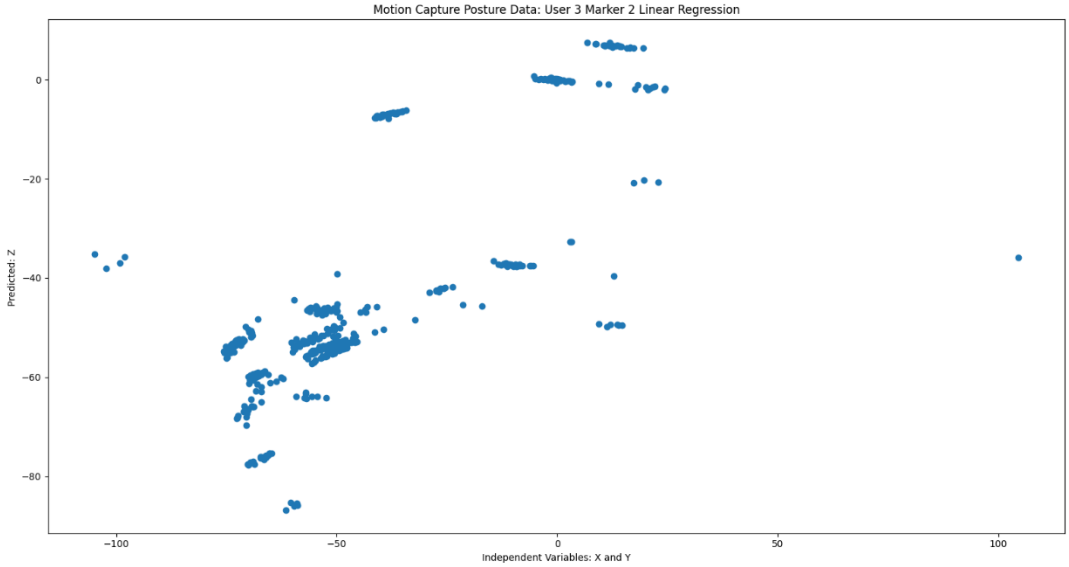
User 1



User 2



User 3



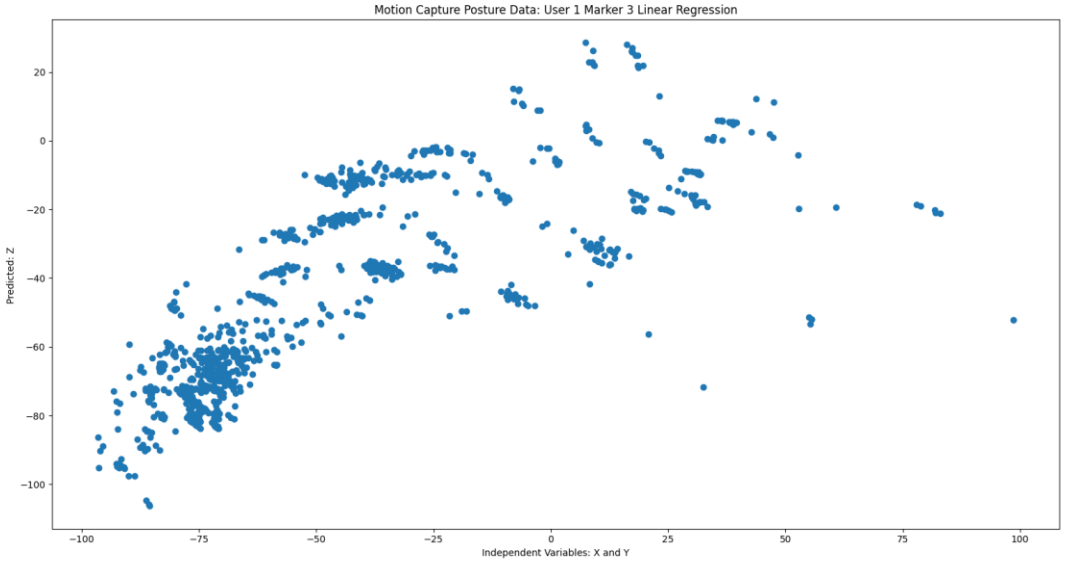
User 1:
Coefficients: [-0.57546458 0.45916079]
Intercept: -47.68384859701907
R-Squared: 0.46874506221915

User 2:
Coefficients: [-0.11714421 0.37185085]
Intercept: -66.30584130098926
R-Squared: 0.4764662896719628

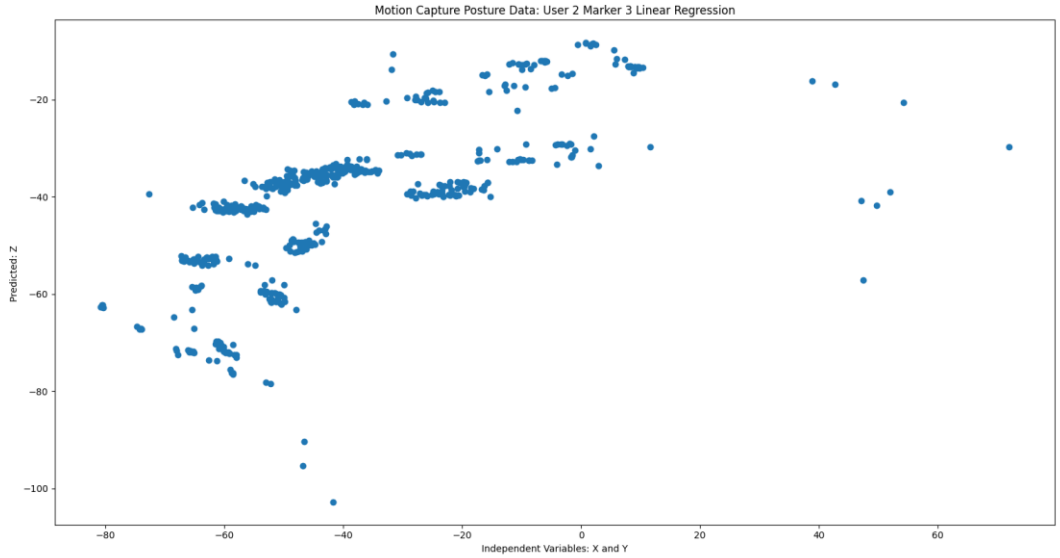
User 3:
Coefficients: [0.19023321 0.7215145]
Intercept: -113.54146964148215
R-Squared: 0.5840228136518861

Linear Regression for Marker 3:

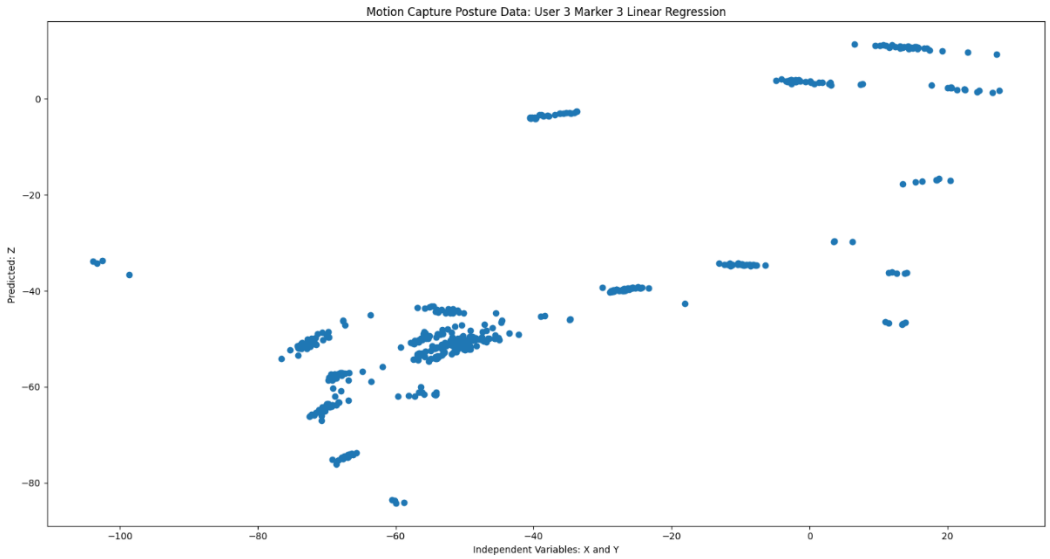
User 1



User 2



User 3



User 1:	User 2:	User 3:
Coefficients: [-0.56007384 0.51865178]	Coefficients: [-0.15179448 0.37328328]	Coefficients: [0.19061914 0.73827113]
Intercept: -51.228574732421976	Intercept: -64.80616199978033	Intercept: -112.23778826236631
R-Squared: 0.5982539088868244	R-Squared: 0.45849671917566137	R-Squared: 0.6403356009955976

Conclusion:

After using Matplotlib to graph the dataset and Sklearn to graph the linear regression, the result has determined that there are similarities between Marker values and each user. When the user switches posture the results can start off the same. However, due the data provided and lack of knowledge about user body size, different movement motions, and motion speeds this can cause the data to exhibit differences and variances.

In the first Users marker set, there are more frames from the Vicon system recording for each posture. Therefore, the data is more consistent. Due to the amount of recording frames decreasing for both user 2 and 3, the data becomes less consistent and produces variance in values.

In conclusion, each user's hand posture produces similar data with variances for each marker due to body size, movement speed, and motion speeds.