

Assignment_2

May 5, 2025

0.1 Observation model - SolvePnP

#Process model

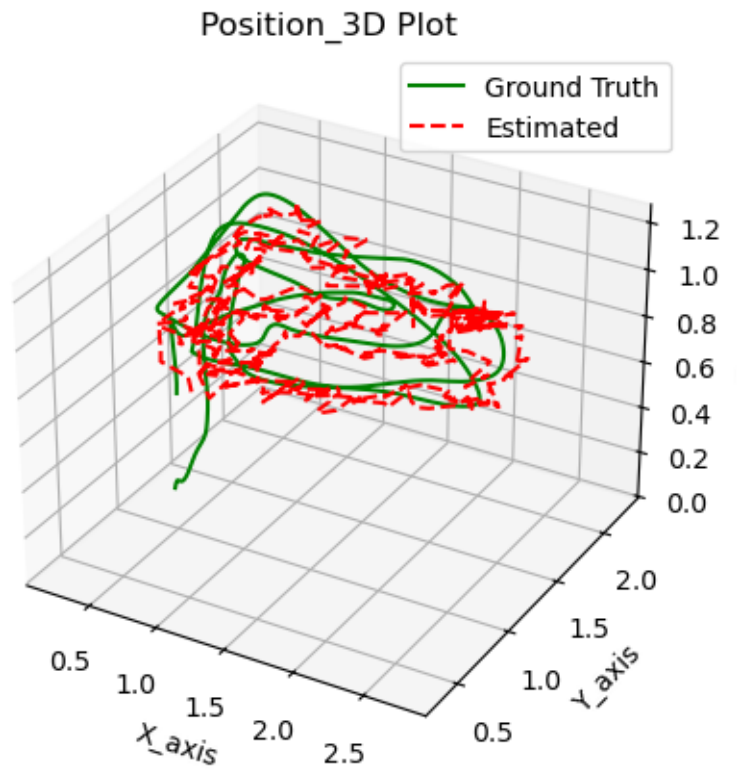
$$\dot{\mathbf{x}} = \begin{bmatrix} \dot{\mathbf{p}} \\ G(\mathbf{q})^{-1}(\mathbf{u}_\omega - \mathbf{b}_g) \\ \mathbf{g} + R(\mathbf{q})(\mathbf{u}_a - \mathbf{b}_a) \\ \mathbf{n}_{bg} \\ \mathbf{n}_{ba} \end{bmatrix}$$

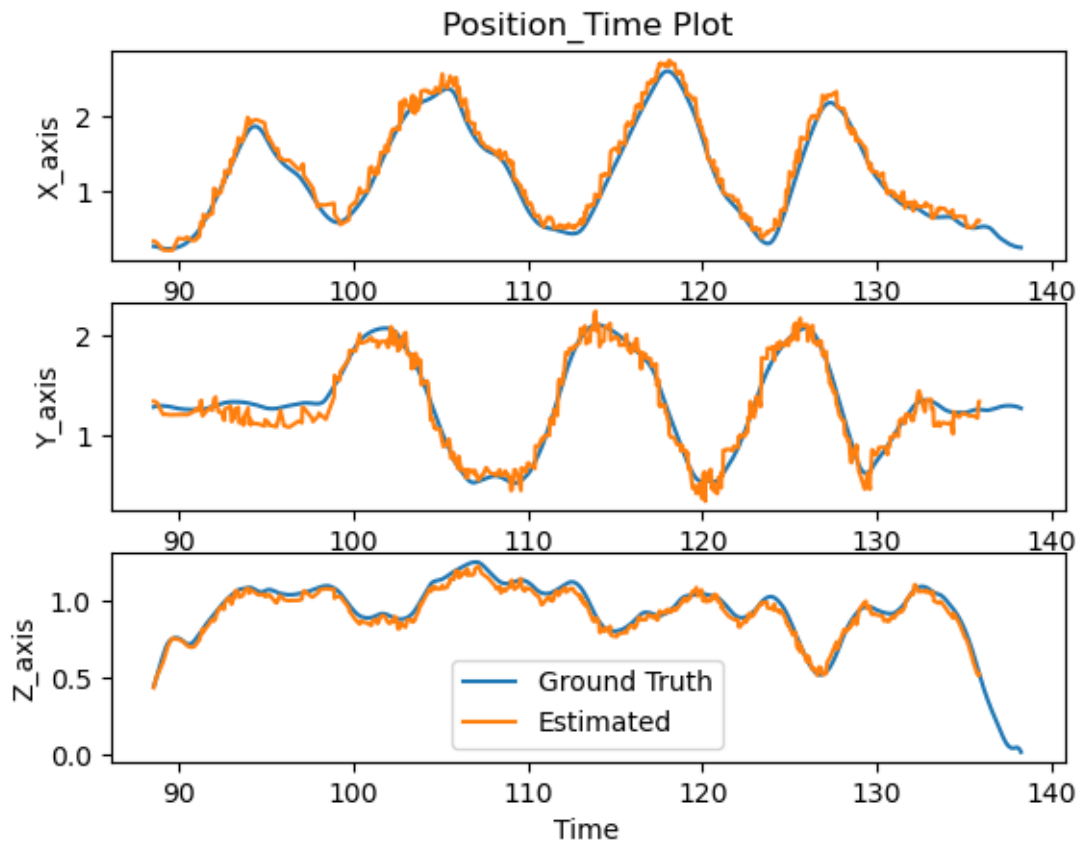
0.1.1 Plots

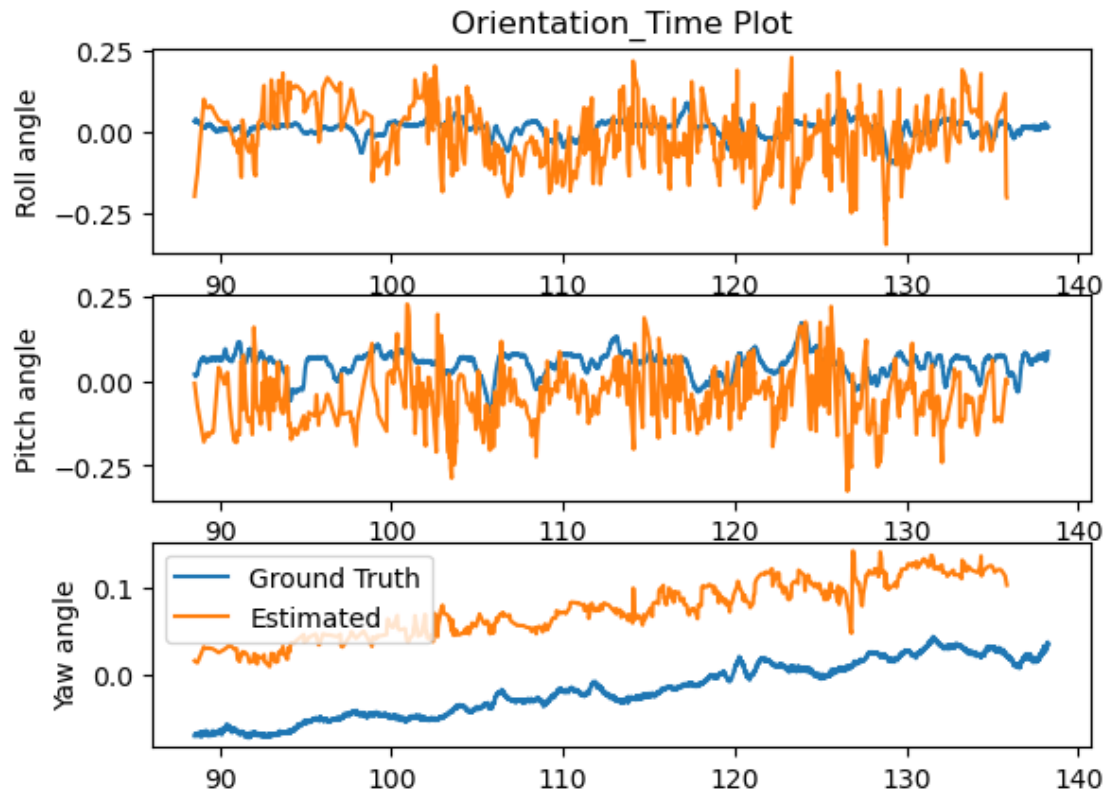
```
[ ]: #Simulate the results and plot

from simulation import simulation

filename = "data\data\studentdata0.mat"
simulation(filename)
```





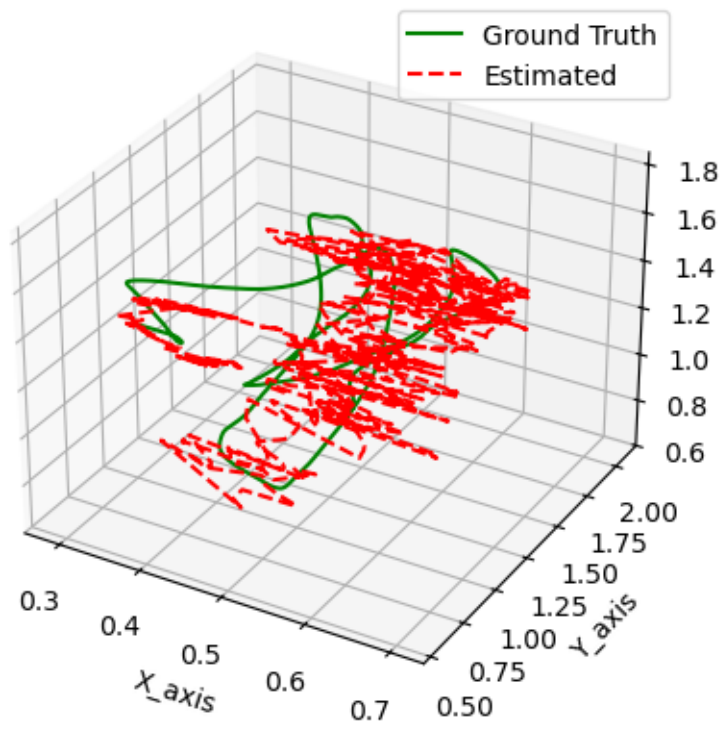


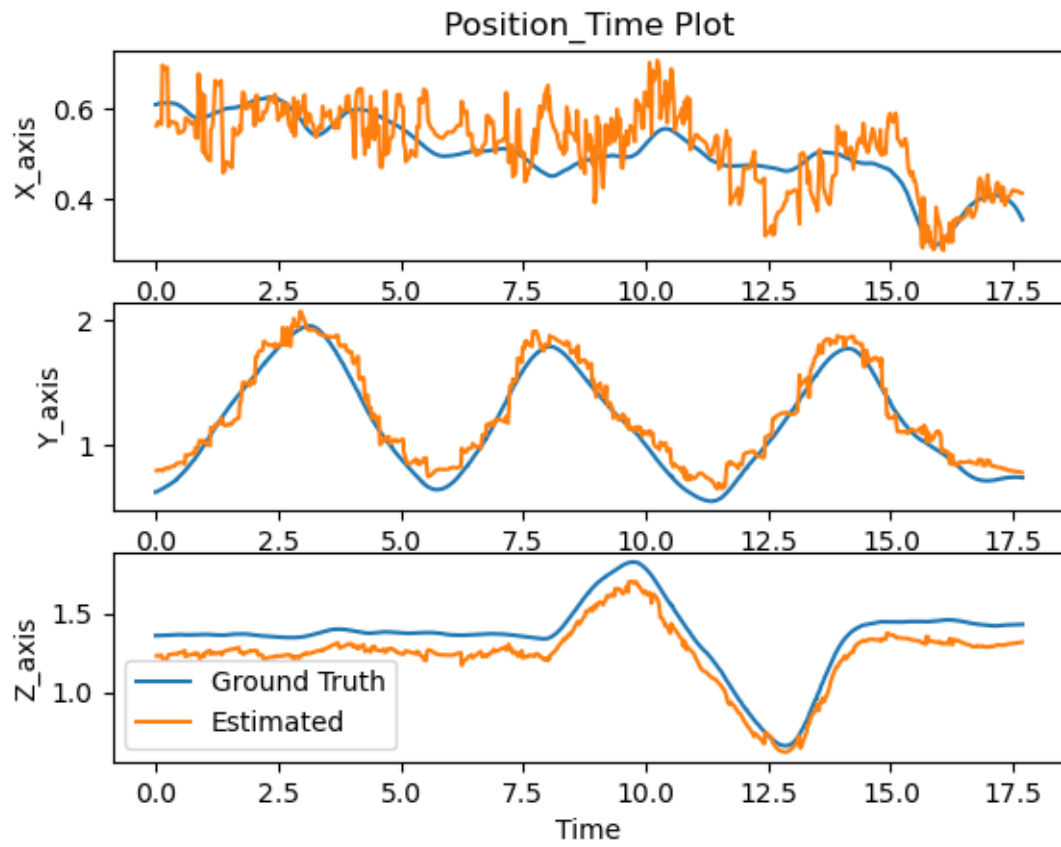
```
[ ]: #Simulate the results and plot

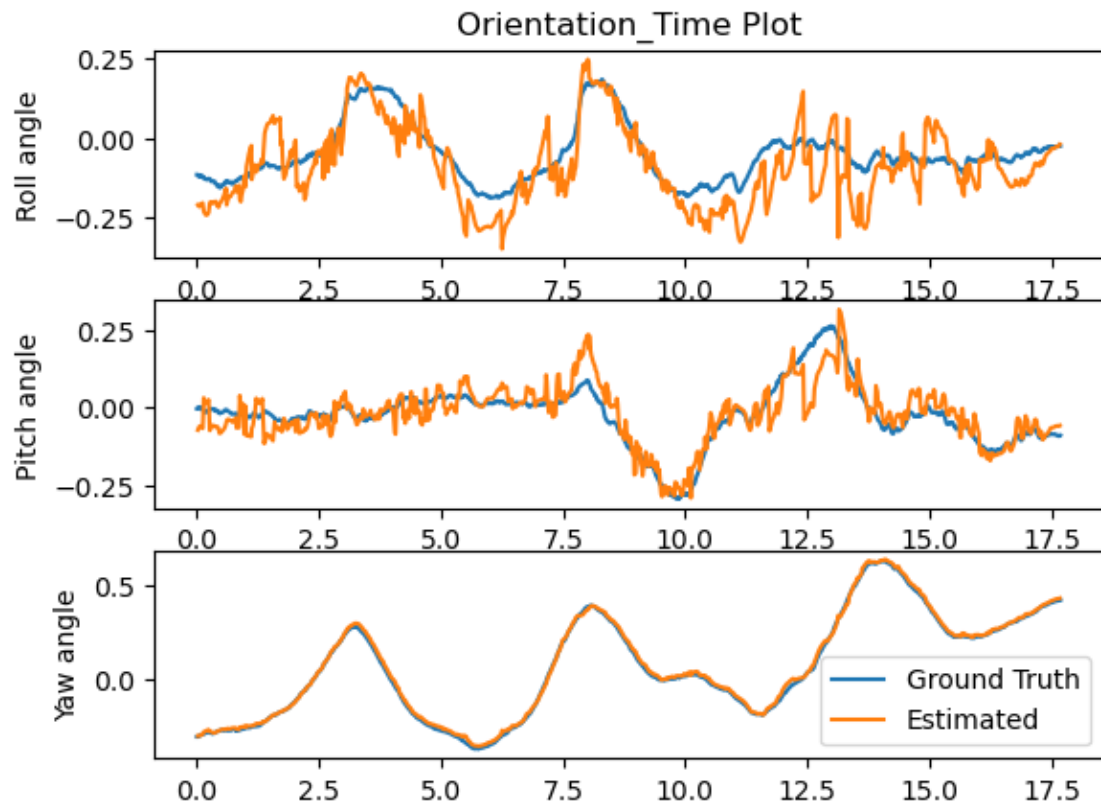
from simulation import simulation

filename = "data\data\studentdata1.mat"
simulation(filename)
```

Position_3D Plot





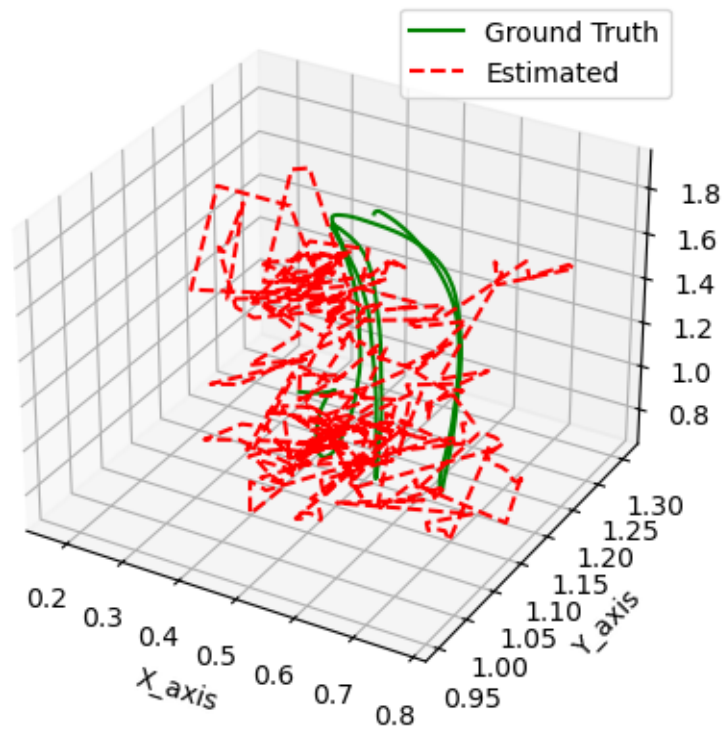


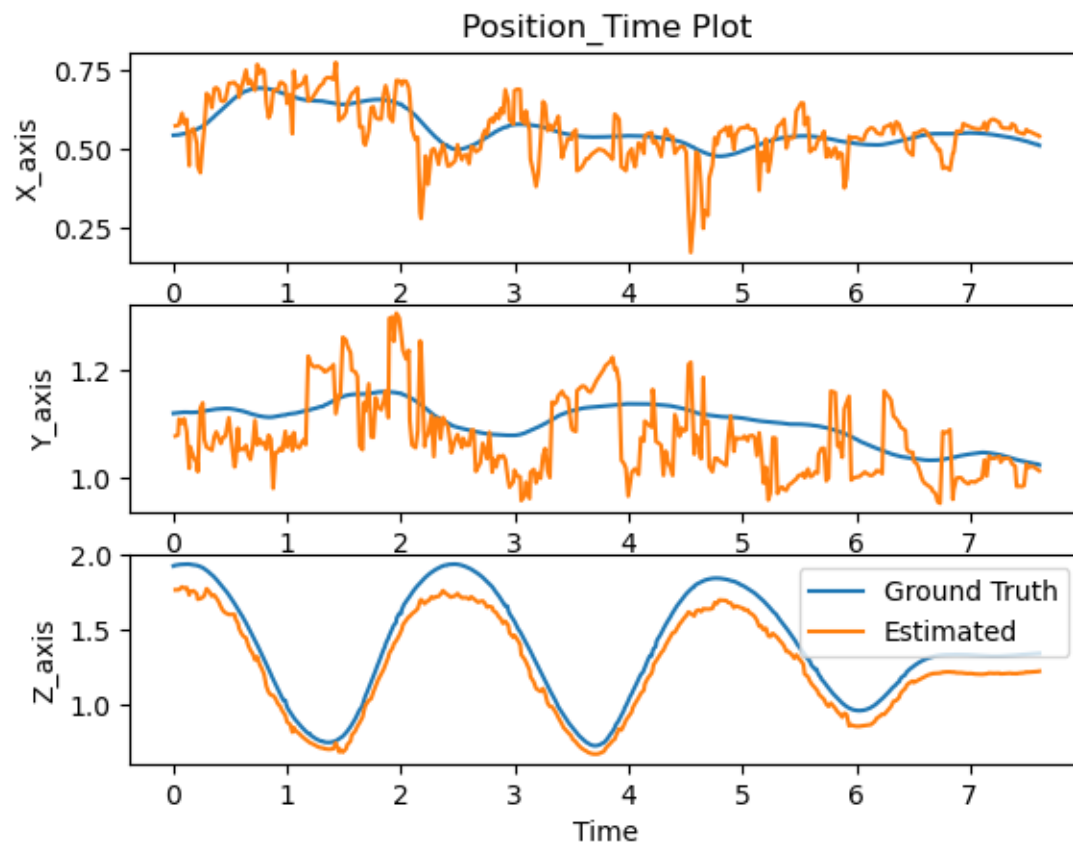
```
[ ]: #Simulate the results and plot

from simulation import simulation

filename = "data\data\studentdata2.mat"
simulation(filename)
```

Position_3D Plot





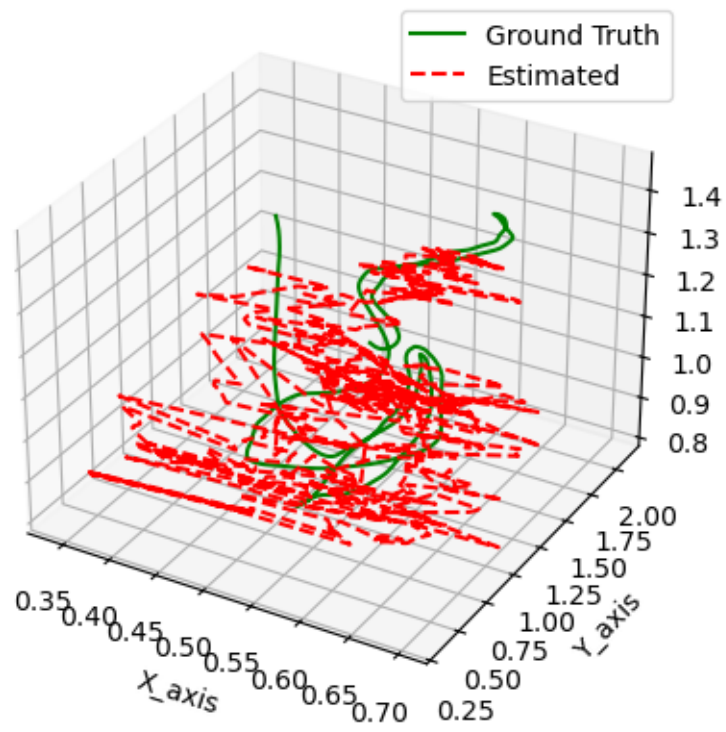


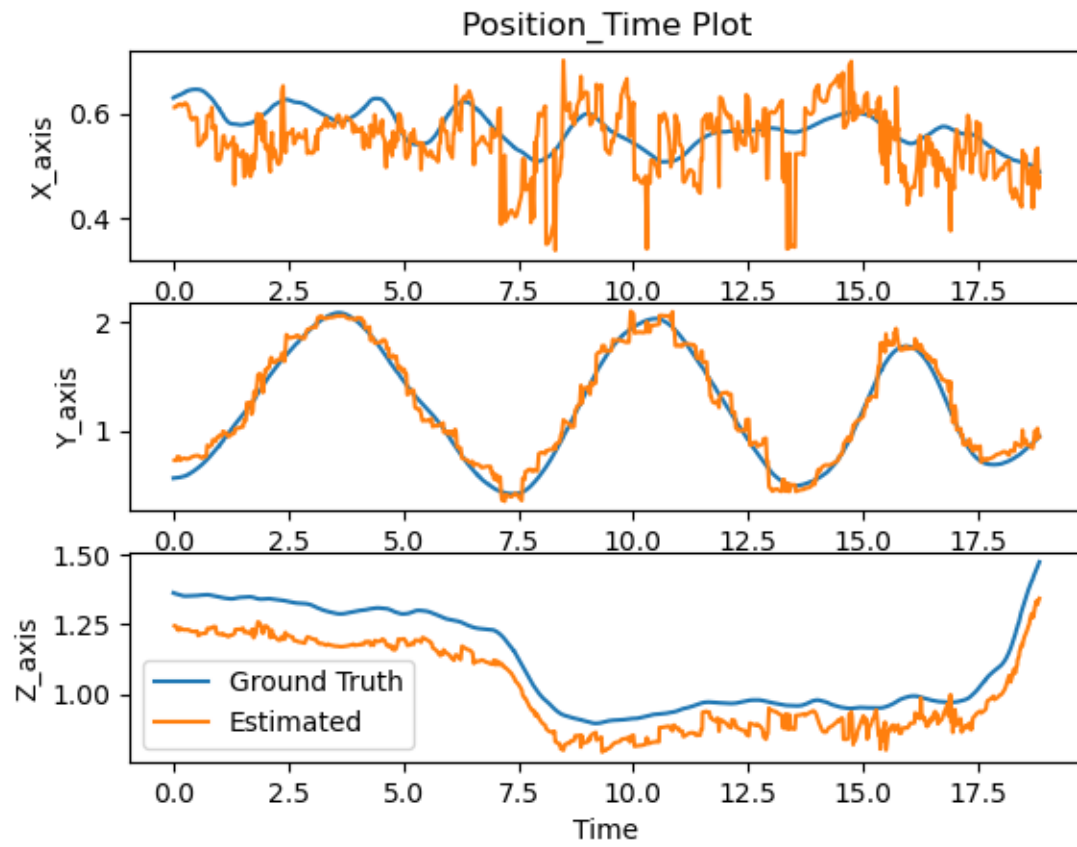
```
[ ]: #Simulate the results and plot

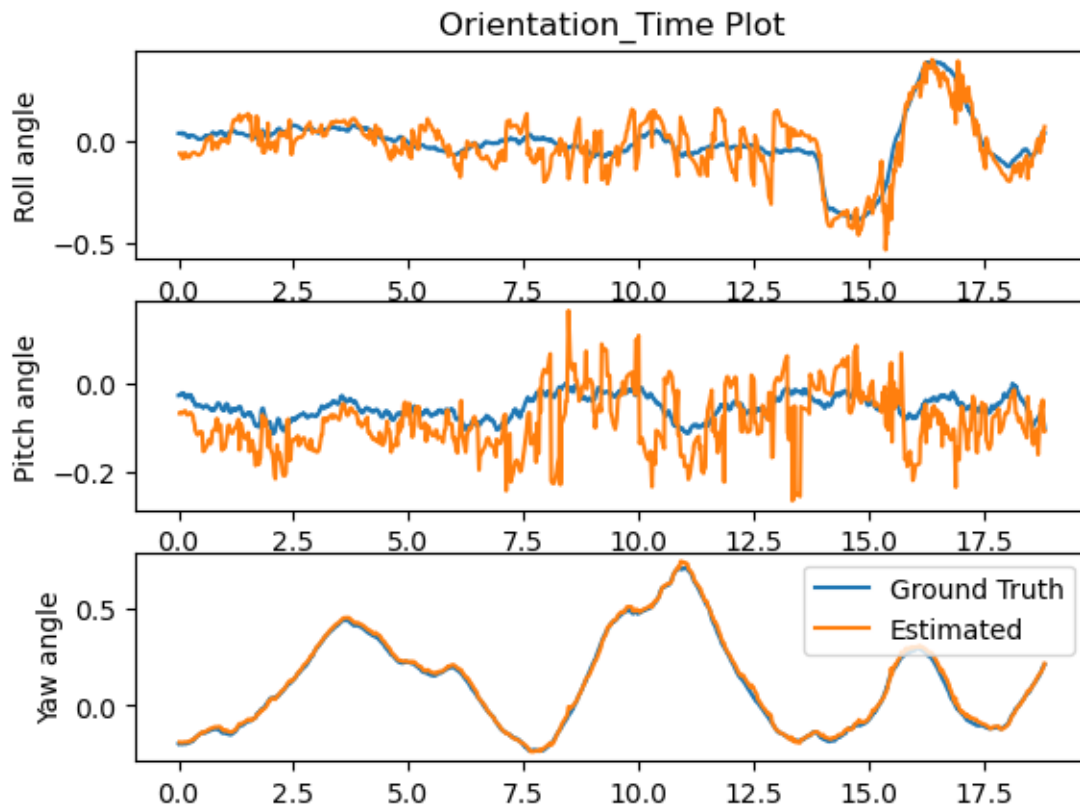
from simulation import simulation

filename = "data\data\studentdata3.mat"
simulation(filename)
```

Position_3D Plot



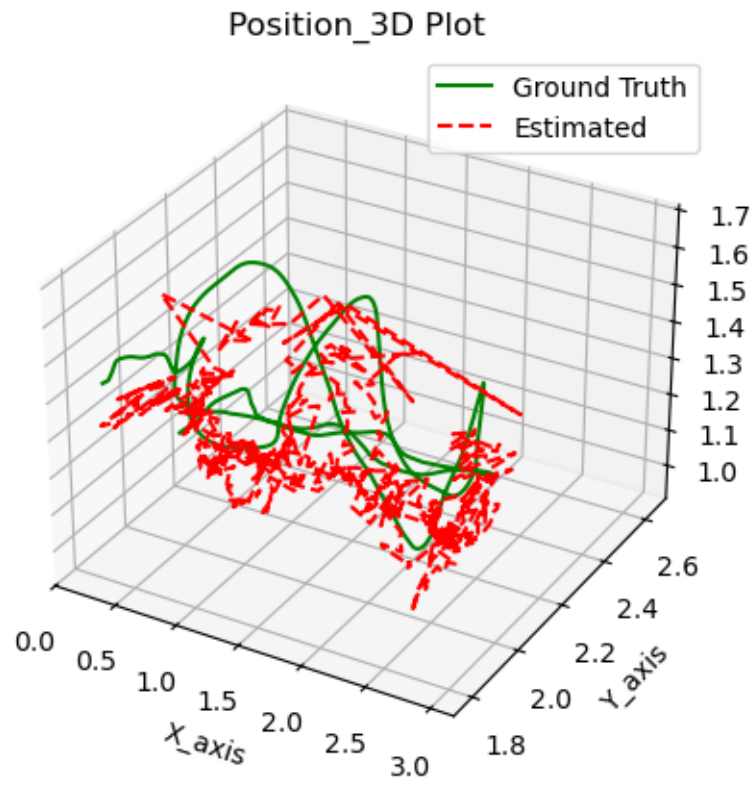


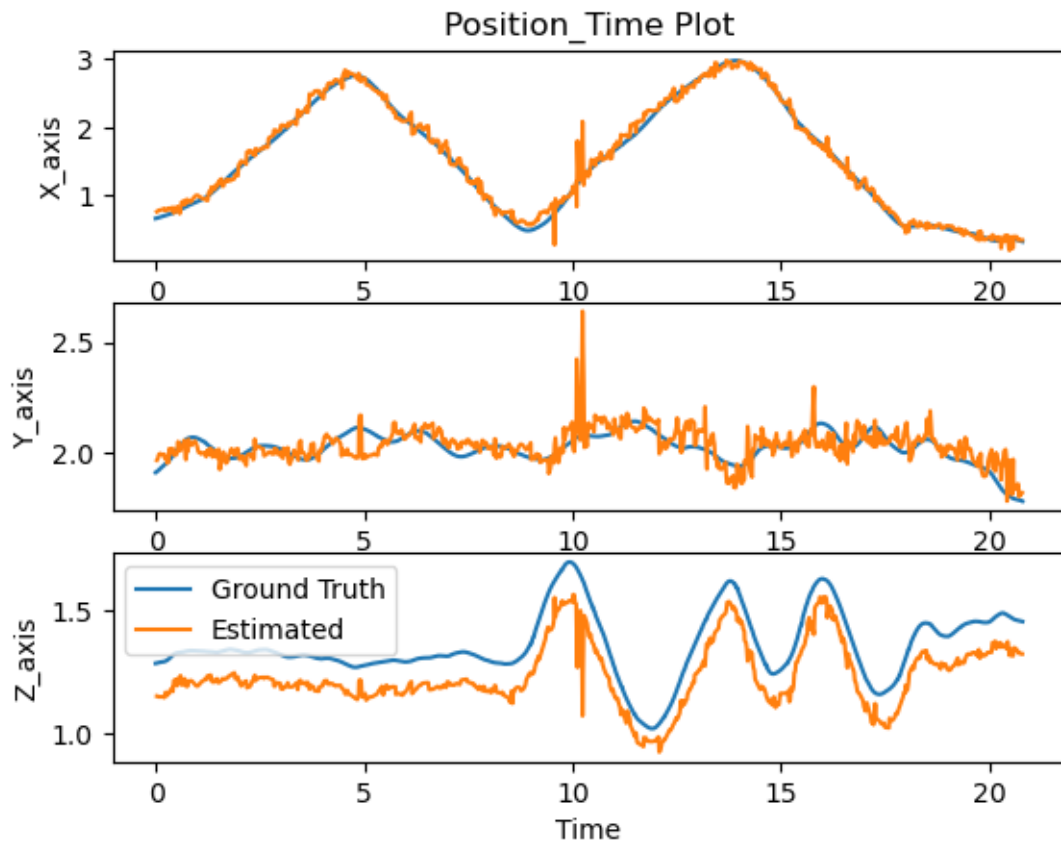


```
[ ]: #Simulate the results and plot

from simulation import simulation

filename = "data\data\studentdata4.mat"
simulation(filename)
```



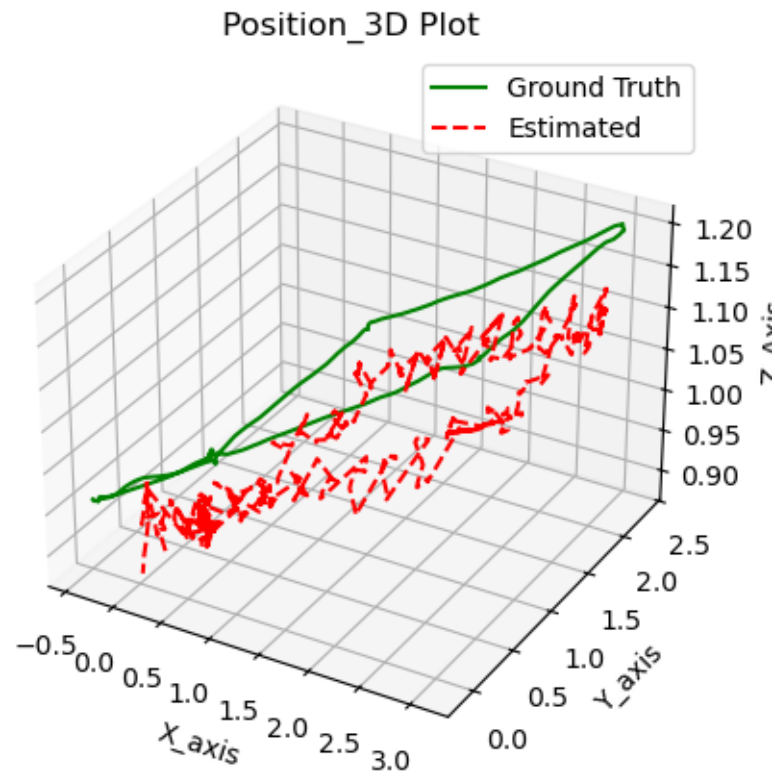


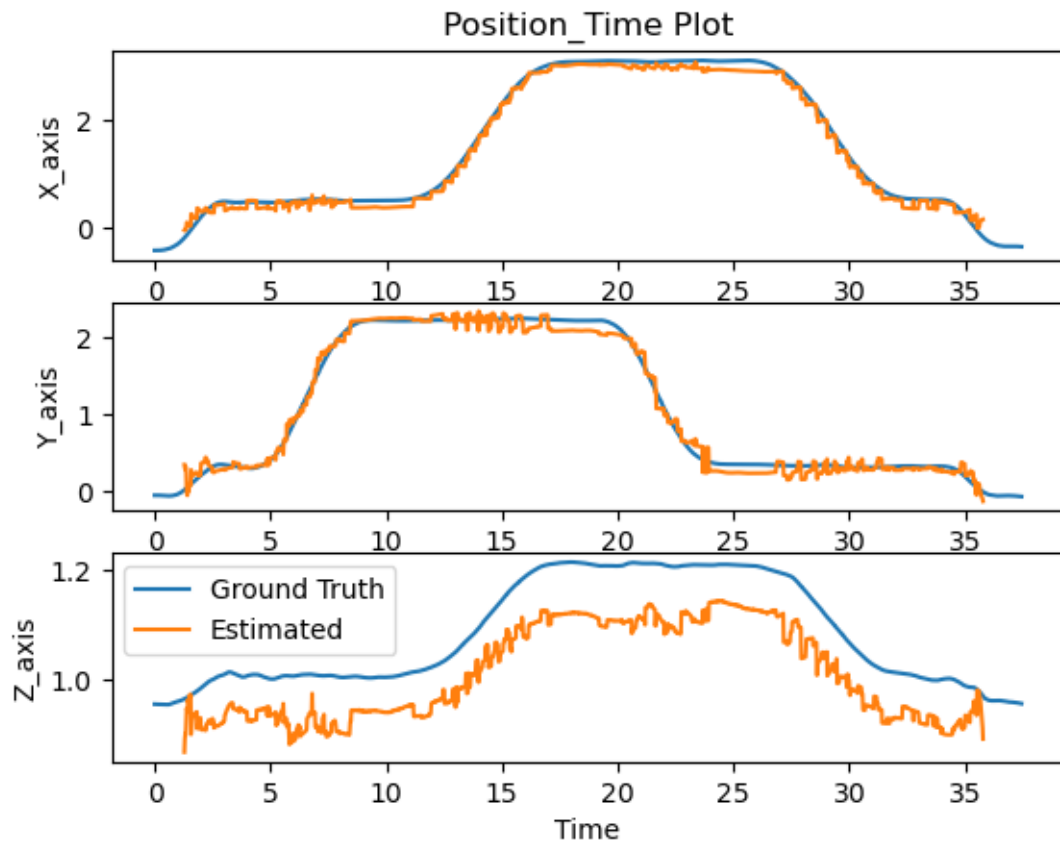


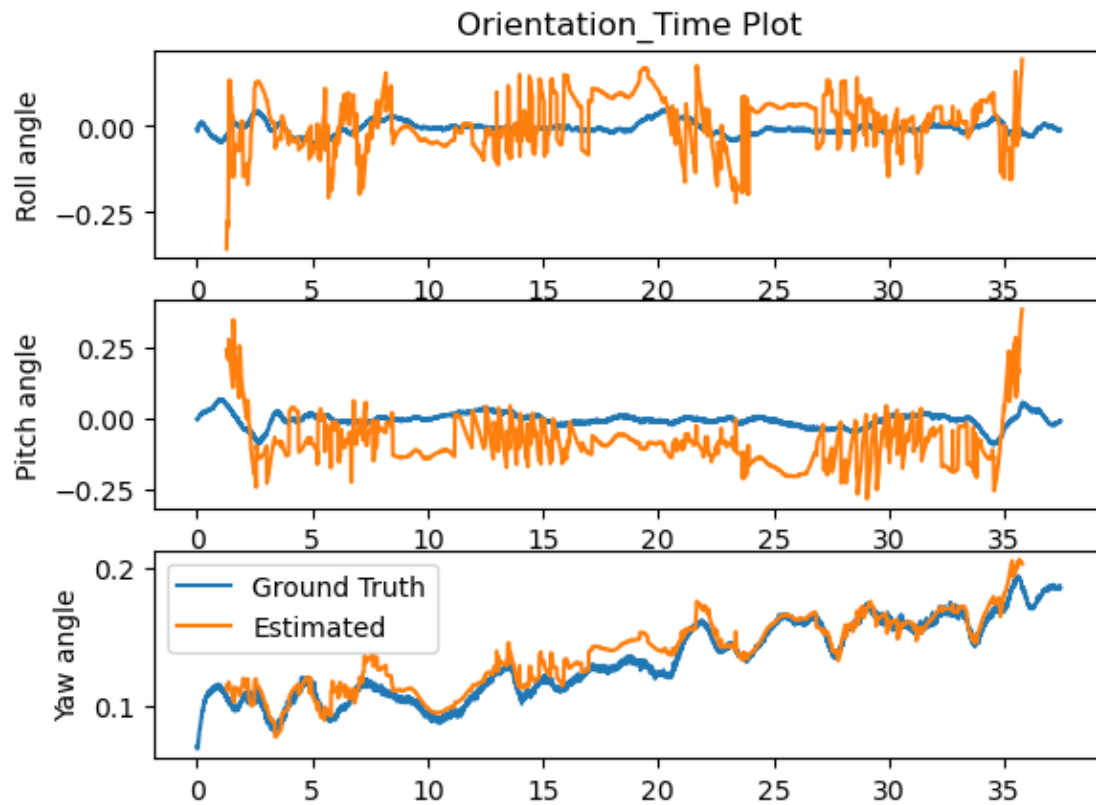
```
[ ]: #Simulate the results and plot

from simulation import simulation

filename = "data\data\studentdata5.mat"
simulation(filename)
```



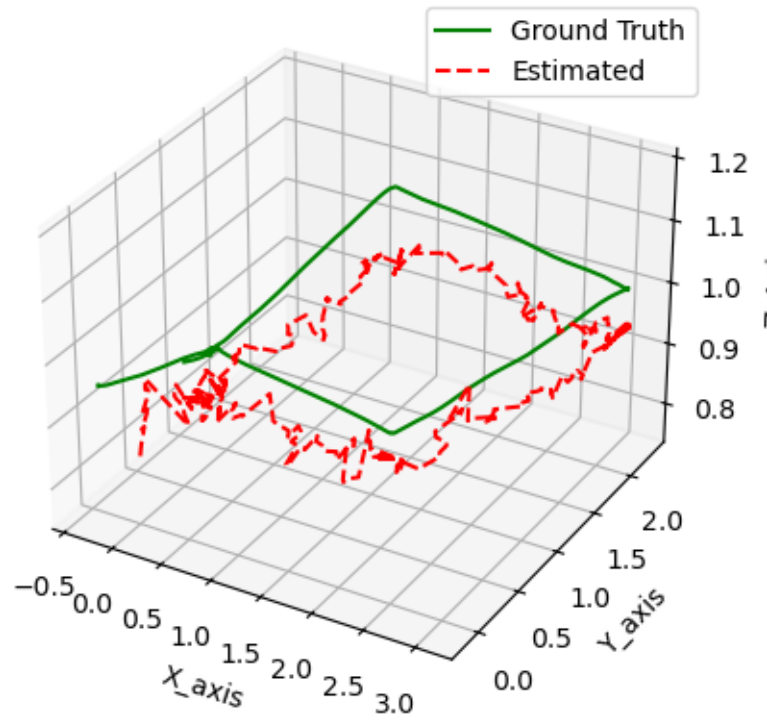


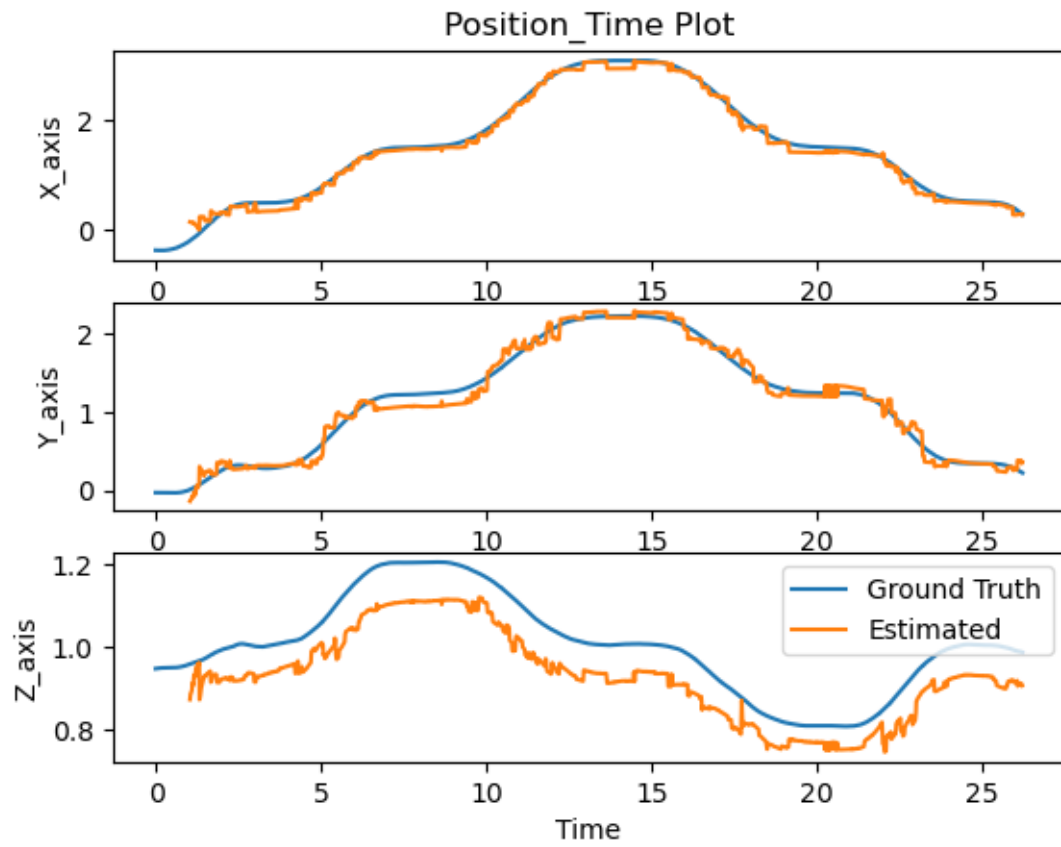
```
[ ]: #Simulate the results and plot

from simulation import simulation

filename = "data\data\studentdata6.mat"
simulation(filename)
```

Position_3D Plot



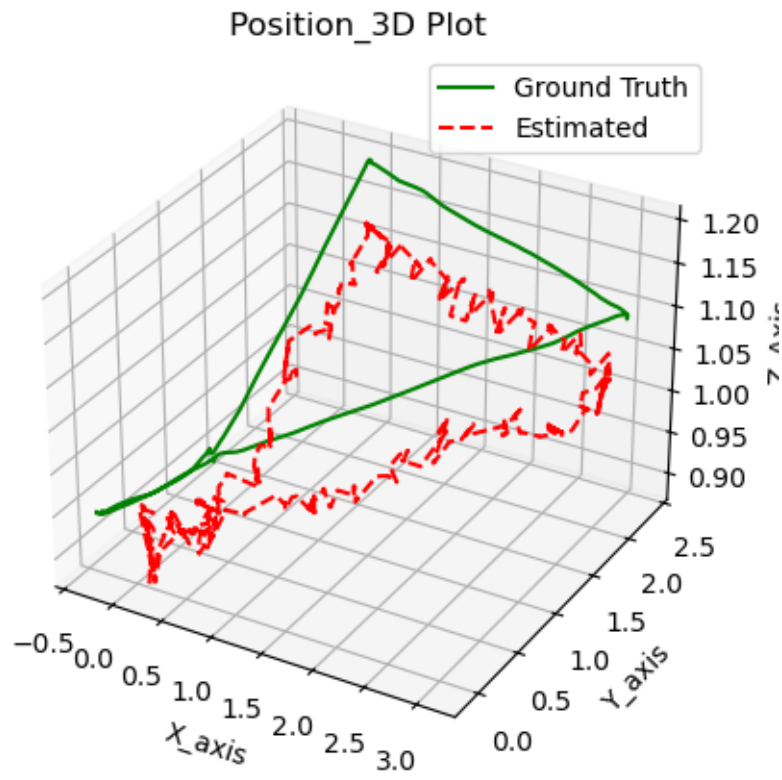


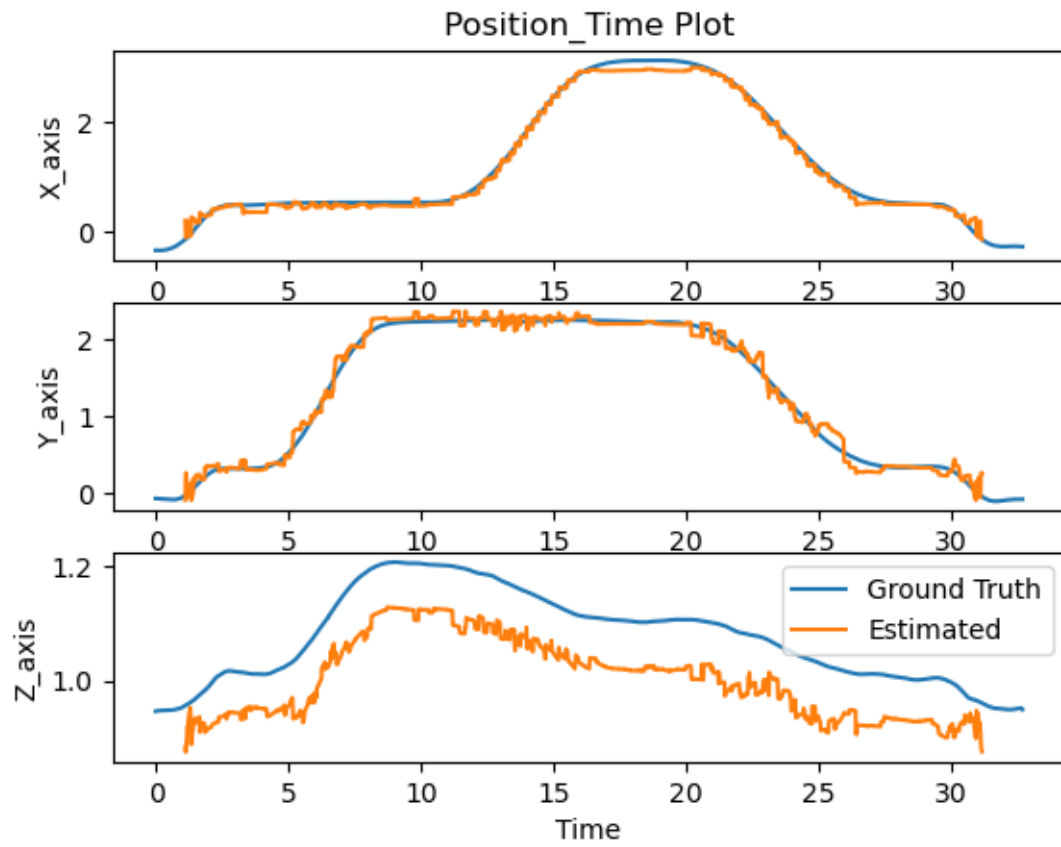


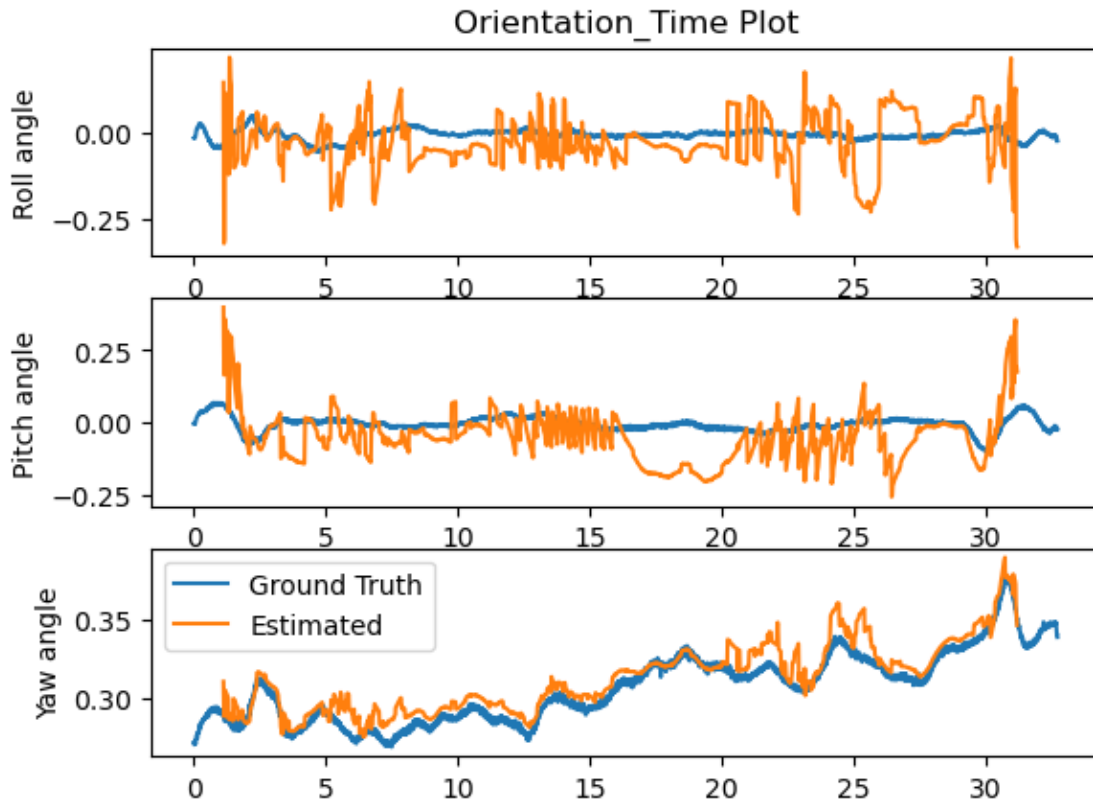
```
[ ]: #Simulate the results and plot

from simulation import simulation

filename = "data\data\studentdata7.mat"
simulation(filename)
```







0.1.2 Covariance Estimation

$$\mathbf{R} = \frac{1}{n-1} \sum_{i=1}^n \mathbf{e}_i \mathbf{e}_i^T$$

```
[ ]: from compute_covariance import estimate_covariances
```

```
filename = "data\data\studentdata0.mat"
R1 = estimate_covariances(filename)
for r in R1:
    print(r)
```

```
[ 1.27571527e-02 -1.22373208e-03 -2.26586235e-03  5.71715720e-03
 -3.16530175e-03  6.90542130e-07]
[-1.22373208e-03  9.46707010e-03 -9.39463133e-06 -7.94539481e-04
  3.21981614e-03 -8.83479279e-03]
[-2.26586235e-03 -9.39463133e-06  1.42043860e-03 -1.83397337e-03
  2.80861370e-03  4.58762966e-05]
[ 0.00571716 -0.00079454 -0.00183397  0.00617153 -0.00588002 -0.00175872]
[-0.0031653  0.00321982  0.00280861 -0.00588002  0.01485504 -0.00178213]
[ 6.90542130e-07 -8.83479279e-03  4.58762966e-05 -1.75872282e-03
 -1.78213348e-03  1.09927540e-02]
```

```
[ ]: from compute_covariance import estimate_covariances
```

```
filename = "data\data\studentdata1.mat"  
R1 = estimate_covariances(filename)  
for r in R1:  
    print(r)
```

```
[ 0.00388765  0.00137588 -0.002194   0.00357385  0.00271331 -0.00374972]  
[ 0.00137588  0.01152343 -0.0087345  0.00871436  0.00079941 -0.01564061]  
[-0.002194   -0.0087345   0.01363072 -0.01409915 -0.00095324  0.01746758]  
[ 0.00357385  0.00871436 -0.01409915  0.07771512  0.00388306 -0.08113346]  
[ 0.00271331  0.00079941 -0.00095324  0.00388306  0.00255503 -0.00399178]  
[-0.00374972 -0.01564061  0.01746758 -0.08113346 -0.00399178  0.08979912]
```

```
[ ]: from compute_covariance import estimate_covariances
```

```
filename = "data\data\studentdata2.mat"  
R1 = estimate_covariances(filename)  
for r in R1:  
    print(r)
```

```
[ 0.00469535 -0.00016317  0.00121406 -0.00129691  0.0033353  0.00261369]  
[-0.00016317  0.00453132  0.00426904 -0.01150902  0.00226472  0.00732564]  
[ 0.00121406  0.00426904  0.01663601 -0.0450797  0.00470427  0.04005239]  
[-0.00129691 -0.01150902 -0.0450797  0.13917236 -0.0127082  -0.12511394]  
[ 0.0033353  0.00226472  0.00470427 -0.0127082  0.00442442  0.01140617]  
[ 0.00261369  0.00732564  0.04005239 -0.12511394  0.01140617  0.11582511]
```

```
[ ]: from compute_covariance import estimate_covariances
```

```
filename = "data\data\studentdata3.mat"  
R1 = estimate_covariances(filename)  
for r in R1:  
    print(r)
```

```
[ 0.00382009 -0.00111364  0.00305626  0.00148812  0.00391268 -0.00125908]  
[-0.00111364  0.00776675 -0.0038508  -0.00150115 -0.00059182 -0.0045505 ]  
[ 0.00305626 -0.0038508  0.01013987 -0.01208102  0.00383705  0.01286366]  
[ 0.00148812 -0.00150115 -0.01208102  0.08111448 -0.00091351 -0.0778804 ]  
[ 0.00391268 -0.00059182  0.00383705 -0.00091351  0.00465756  0.00036231]  
[-0.00125908 -0.0045505  0.01286366 -0.0778804  0.00036231  0.08064901]
```

```
[ ]: from compute_covariance import estimate_covariances
```

```
filename = "data\data\studentdata4.mat"  
R1 = estimate_covariances(filename)  
for r in R1:  
    print(r)
```

```
[ 0.00629859  0.00051784 -0.0036302  -0.02943021  0.00184732  0.02542373]
[ 0.00051784  0.00352115 -0.00179894 -0.00501927 -0.00178247  0.00360912]
[-0.0036302  -0.00179894  0.01551217  0.12448864 -0.00069884 -0.12294708]
[-0.02943021 -0.00501927  0.12448864  1.29146785 -0.00892843 -1.28428258]
[ 0.00184732 -0.00178247 -0.00069884 -0.00892843  0.00213806  0.00831116]
[ 0.02542373  0.00360912 -0.12294708 -1.28428258  0.00831116  1.28067495]
```

```
[ ]: from compute_covariance import estimate_covariances
```

```
filename = "data\data\studentdata5.mat"
R1 = estimate_covariances(filename)
for r in R1:
    print(r)
```

```
[ 0.01205878  0.00301829  0.00645284 -0.01090449  0.01202621  0.0092862 ]
[ 0.00301829  0.00759613  0.00216171 -0.00353661  0.00393655 -0.00315722]
[ 0.00645284  0.00216171  0.00687049 -0.01149893  0.00643097  0.00963138]
[-0.01090449 -0.00353661 -0.01149893  0.02117194 -0.01064063 -0.0181961 ]
[ 0.01202621  0.00393655  0.00643097 -0.01064063  0.01221453  0.00816332]
[ 0.0092862  -0.00315722  0.00963138 -0.0181961  0.00816332  0.02139768]
```

```
[ ]: from compute_covariance import estimate_covariances
```

```
filename = "data\data\studentdata6.mat"
R1 = estimate_covariances(filename)
for r in R1:
    print(r)
```

```
[ 0.00723943  0.00101316  0.00372928 -0.01193981  0.0079227  0.01241721]
[ 0.00101316  0.00899029  0.00098678 -0.002951  0.00310033 -0.00587956]
[ 0.00372928  0.00098678  0.00628686 -0.01881851  0.00418896  0.01796356]
[-0.01193981 -0.002951  -0.01881851  0.06071602 -0.01356374 -0.0583019 ]
[ 0.0079227  0.00310033  0.00418896 -0.01356374  0.00925444  0.01206347]
[ 0.01241721 -0.00587956  0.01796356 -0.0583019  0.01206347  0.06519425]
```

```
[ ]: from compute_covariance import estimate_covariances
```

```
filename = "data\data\studentdata7.mat"
R1 = estimate_covariances(filename)
for r in R1:
    print(r)
```

```
[ 0.00790903  0.000768  0.00439006 -0.01512829  0.00777631  0.01658907]
[ 0.000768  0.00682457 -0.00104063  0.00353468  0.00293868 -0.00931223]
[ 0.00439006 -0.00104063  0.00725859 -0.02651481  0.00386292  0.02776991]
[-0.01512829  0.00353468 -0.02651481  0.10120251 -0.01316888 -0.10524239]
[ 0.00777631  0.00293868  0.00386292 -0.01316888  0.00840407  0.01269382]
[ 0.01658907 -0.00931223  0.02776991 -0.10524239  0.01269382  0.11503893]
```