Unscented-Kalman-Filter

GOALS :

Two differerent pedestrian tracking datasets were provided for this project. The data includes Laser and Radar measurements. The goal was to create a Unscented Kalman Filter to make preditions of the pedestrian position using the CTRV motion model and then update the expected position.

How to run:

- Make build directory: **mkdir build && cd build**
- Compile the code: **cmake .. && make**
- Run the code: **./UnscentedKF**
- has value 1 for lidar, 2 for radar and 3 for both - : can be modify to any number such that we can minimize RMSE -: can be modify to any number such that we can minimize RMSE - example : % ../build/UnscentedKF 3 0.5 2.0 /tmp/NIS2

Criteria #01: RMSE = [0.09, 0.10, 0.40, 0.30]

- For data set #1 :RMSE1 = [0.0596703, 0.0889668, 0.350039, 0.250488]
- For data set #2:RMSE2 = [0.06206, 0.0588282, 0.243091, 0.21729]
- when running : % ../build/UnscentedKF 3 0.5 2.0 /tmp/NIS2
- The key improvement is from moving the initialization of R*radar* and R*lidar* to UKF constructor.

Criteria #02 : Follow the Correct Algorithm

Lecture sample code are used to add to the project one at a time:

```
*  Augmentation
*  SigmaPoint prediction
*  Predict meand and Covariance
*  Predict Radar/Licar measurement
*  Update UKF for radar, Lidar
```

Criteria : Code Efficiency

```
* Modularization to simimplify code in main.cpp for easier to debug
    void Init_Radar_Parameters (MeasurementPackage meas_package);
    void Init_Laser_Parameters (MeasurementPackage meas_package);
    void Init_weights ();
* The Prediction() also modularize to match lecture notes for easy ref
erence during debug:
    void AugmentedSigmaPoints(MatrixXd* Xsig_out);
    void SigmaPointPrediction(MatrixXd* Xsig_out, MatrixXd Xsig_aug, d
ouble delta_t);
    void PredictMeanAndCovariance(VectorXd* x_pred, MatrixXd* P_pred,
 MatrixXd Xsig_pred_);
* Factorize code so that both Lidar and Radar share :
    void UpdateUKF(MeasurementPackage meas_package, MatrixXd Zsig);
    void UpdateRadar(MeasurementPackage meas_package);
    void UpdateLidar(MeasurementPackage meas_package);
```

Criteria : NIS information is collected.

```
* How to use this to tune parameter for UKF is still a myth.
* Here is the graph collected.
* It seemed that the Lidar path is working great but not the radar pat
h.
```

In [4]:
```
1 from IPython.display import Image
2 Image("./Nis_info2.png")
```

Out[4]: