HW4 KDC writeup

Part 0

I wrote my own Kalman filter, found in _“KalmanFpart0.m”, which finds the location and velocity of the center of mass of the artifact without using the “known” distances from each marker to the center of mass. This filter produces values which are reasonably close to the values given by the example code. The marker error was calculated by subtracting the C matrix (called H in my code) multiplied by the state estimate from the measured marker data. This error was then used to adjust the predicted state estimate. The Kalman filter operates by predicting a state estimate and covariance using a prediction matrix and data from the previous time step. The difference between the measured, noisy data and the state estimate is calculated and used to adjust the predicted state estimate. The covariance of the differences is also used to update the predicted covariance. This process is repeated for many data points. The extra code in the folder, iterallfiles.m” and “part(1:3)allfiles.m”, were used to evaluate each Kalman filter on each provided data folder and to generate the required answer datafile.

Part1

The basic Kalman filter from part 0 was augmented with orientation estimation using Euler angles. Euler angles were used because they operate in the same axis system as the sensor readings and because they are easier to translate than quaternions.It is easier to work with angular velocities in the coordinate system when working with angles expressed in the coordinate system. The sensor matrix H encodes the motion generated by rotations by converting the Euler angles to radians which, when small enough, approximate a translation. The prediction matrix F predicts rotations by subtracting the motion of the markers due to the center of mass movement and generating motion based on predicted angular velocities. As in part 0, known values were not used in the Kalman filter. The code for this iteration of the Kalman filter can be found in “KalmanFpart1.m”; the answers can be found in the folder “part1ans”.

Part 2

The Kalman filter now handles occlusion by searching for erroneous values in the sensor readings and replacing this data with the predicted value to moderate the resulting residuals. The code for this version of the Kalman filter can be found in “KalmanFpart2.m”; the results can be found in folder “part2ans”.

Part 3

The Kalman filter from part 1 was augmented to predict the locations of each marker relative to the center of mass. The locations of the markers are the difference between the center of mass location and the sensor reading; values to this effect were added to the prediction and sensor encoding matrices. The code for this part of the homework can be found in “KalmanFpart3.m”, while the answers can be found in folder “part3ans”.