

## ME/CS 133(a): Lab #1

(Due Friday Nov. 9. 2018)

This lab is “computational” in nature. The goal is to get familiar with motion tracking, and in particular the OptiTrack motion tracking system in the CAST lab. You can perform this lab in groups of up to 3 people. Only one lab report need be submitted for the entire group.

During your lab time in the CAST center, a “wand” will be carried around in the tracking volume of the OptiTrack system. The wand contains 5 markers, whose positions were tracked by the OptiTrack camera tracking system (at approximately 120 times per second). In addition to tracking the marker positions, Optitrack also estimated the position of a reference frame attached to the wand, assuming that all 5 markers were attached to the same rigid body.

**Data:** A “snippet” of the data gathered during this experiment is the basis for this lab:

- Download the data file (in a “csv” format) from the course web site. This spreadsheet contains an interval of OptiTrack data (sampled at 120 frames per second) from a period after the start of the data gathering process. Note that the first part of the data contains both marker positions as well as OptiTrak’s estimate of body configuration. The second part contains only the data from the markers (the body position estimate is removed).
- Download the file “optiTrack\_matlab\_template.m”. This file allows you to read in the data from the .CSV file into MATLAB. You need not use MATLAB for this assignment.

The top rows of the .CSV file contain labels to tell you the source and nature of the data in each column. These columns have the following format:

- **Columns 1, 2:** The first column is an index of the “frame.” The second column is the actual time at which the data is gathered.
- **Columns 3, 4, 5, and 6** (labeled X, Y, Z, and W). Each column is one of the four elements of a quaternion which quantifies the estimated orientation of the object (obtained by using all the markers in the field of view). These columns correspond to the quaternion that represents rotation angle  $\phi$  about rotation axis  $\vec{\omega} = [\omega_x \ \omega_y \ \omega_z]$  as:

$$q = \underbrace{\cos\left(\frac{\phi}{2}\right)}_{\text{column W}} + \underbrace{\omega_x \sin\left(\frac{\phi}{2}\right)}_{\text{column X}} i + \underbrace{\omega_y \sin\left(\frac{\phi}{2}\right)}_{\text{column Y}} j + \underbrace{\omega_z \sin\left(\frac{\phi}{2}\right)}_{\text{column Z}} k . \quad (1)$$

- **Columns 7, 8 ,9:** These are OptiTrack’s estimate of the rigid body’s  $x$ ,  $y$ , and  $z$  positions, as estimated by tracking the 5 markers.