Final Project Proposal

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***Abstract*—The overall goal for the project is to create a new, more organic user interface (UI) for computing, with potential applications for augmented reality (AR) and virtual reality (VR) systems. A critical part of the overall system is accurate, hyperlocal 3D relative location tracking. From the research I have done so far, the best way to track this is by using Kalman Filtering. Working on this subsection of the problem requires some interesting digital signal processing, so I hope this portion could serve as a final project for the class.**

I. Introduction

THE final result I want from the digital signal processing portion of this overall problem is to be able to take in data from a set of accelerometer/gyroscope chips mounted on the fingers and palm of a glove via an Arduino. Interpret this data in order to track the movements in three dimensions, probably by utilizing Kalman filtering (I tried just doubly integrating the acceleration input from this but there was a huge amount of error).

A. Phase one: Creating and testing the Kalman filter

The first phase for the project is going to be setting up the state space and trying to understand how to create the matrices necessary for Kalman filtering. Matlab has a Kalman function built into it but I would like to actually understand the algorithms behind it. To test the state space and matrix setups for the problem I will simulate some clean data in Matlab.

B. Phase two: Adding noise to the Kalman filter

The second phase of the project will be to apply the filter on a data set that I add some noise to. I'll probably use a couple different types of noise:

1) Zero mean added white gaussian noise (AWGN)
2) Positive mean AWGN using various sound to noise ratios (SNRs)
3) Burst noise
4) Just adding random numbers

Professor Tracey, if you have any recommendations for other noises I could use for testing the filtering setup I would appreciate any input.

C. Phase three: Using the raw data from the Arduino

I then want to apply the working Kalman filter to real data. This can be broken down into four sub-phases:

1) Controlling a single accelerometer/gyroscope chip by hand
    a) first work in one dimension, then move into two, then three.
2) Mounting and tracking a single chip on a glove
3) Simultaneously tracking multiple chips and relative positions
4) Simultaneously tracking multiple chips on a glove

This data could then be plotted into a three dimensional graph to be able to visualize the success of the tracking.