Homework 1

1. A cheap IMU sensor must be calibrated to provide more accurate readings. In the file "measurements.csv" are raw three-axis accelerometer measurements from the sensor. You also have access to the ground truth of the acceleration readings, from a "perfect" IMU, which are in the file "groundtruth.csv". You may use whatever software or library you like (e.g. in Matlab, Python) to solve this problem.

   (a) Use least squares minimization to find the homogeneous transformation matrix that would provide the best possible correction function.

   (b) What is the resulting sum-of-squares error after applying the correction function to the data? Why isn't it zero?

   (c) Comment on the resulting computed 4-by-4 homogeneous matrix. How much offset and scaling was corrected? How much correction was made for nonorthogonal axes and/or rotation?

2. Is each of the following items a sensor (according to the definition given in the lectures and in Fraden Ch. 1,2)? If yes, then name the characteristics of the sensor (active / passive, simple / complex, local / global, absolute / relative). State your reasoning for your choices. Note that there may not be a right or wrong answer, but the reasoning is important.

   (a) Radar (for air traffic control)

   (b) Electron microscope

   (c) Magnifying glass

   (d) Smoke detector

   (e) The Large Hadron Collider

   (f) Metal detector (as in airport security)

   (g) Pocket radio