

ASSIGNMENT 9 (BOOSTXL-SENSHUB): TREMOR DETECTION

Use the gyroscope to implement a tremor detector.

The gyroscope measures the **change of the rotation angles around the X, Y and Z axes**. By integration of the changes, the corresponding angles can be calculated. When all changes are zero, the device is perfectly calm.

Theoretically, at rest the readings for all axes should be zero. This is not the case in reality. **Thus the sensor needs to be calibrated.** Don't move the device and read 1000 gyroscope measurements in a loop (10 ms pause between two measurements). Display the index of the current measurement on the LCD. For every axes, add the measurements. Finally divide the sum by 1000 to obtain the corrections **gyroBiasX**, **gyroBiasY**, **gyroBiasZ**. Indicate the end of calibration on the LCD.

The calibration should be executed only once. Restarting the system or reconnect power supply or a download of updated code should not initiate a new calibration.

To detect tremor, read the gyroscope measurements in an endless loop (10 ms pause between two measurements). For every measurement (rawX,rawY,rawZ), calculate

$$d = \sqrt{(rawX - gyroBiasX)^2 + (rawY - gyroBiasY)^2 + (rawZ - gyroBiasZ)^2}.$$

Take the moving average of 10 adjacent d values:

$$m = \frac{1}{10} \sum_{j=0}^9 d[i-j]$$

Here, d[i] denotes the latest d value. Your score is increased by 1 if the moving average values are less than 400 for 1 second. The current score shall be displayed on the LCD.

The **MPU9150 initialisation** is given in Table 3. The layout of the gyroscope measurements is shown in Table 5. Note that high byte and low byte have to be combined to a 16 bit measurement (e.g. **rawZ**).