EP486 Microcontroller Applications

Topic 12
Arduino Apps: MPU 6050 IMU Sensor

Department of Engineering Physics
University of Gaziantep

Nov 2014
**IMU (Inertial Measurement Unit)**

- IMU measures craft's velocity, orientation, and gravitational forces.

- IMU sensors usually consists of two or more parts: accelerometer, gyroscope, magnetometer, and altimeter.

- IMU sensors like the MPU 6050 are used in self balancing robots, UAVs, smartphones, etc.

- The MPU 6050 is a 6 DOF (Degrees of Freedom) or a six axis IMU sensor, which means that it gives six values as output.
**MPU 6050**

- IMU sensors like the MPU 6050 are used in self balancing robots, UAVs, smartphones, etc.

- The MPU 6050 is a 6 DOF (Degrees of Freedom) or a six axis IMU sensor, which means that it gives six values as output. These are:
  
  Acceleration components: ax, ay, az  
  Angular velocity components: wx, wy, wz

- MPU 6050 is a sensor based on MEMS (Micro Electro Mechanical Systems) technology. Both the accelerometer and the gyroscope is embedded inside a single chip. This chip uses I2C (Inter Integrated Circuit) protocol for communication.
MPU 6050
Interfacing
Coding

1. Download the following two files from course web page:
   www1.gantep.edu.tr/~bingul/ep486/src/MPU6050.zip
   www1.gantep.edu.tr/~bingul/ep486/src/I2Cdev.rar

2. Unzip/extract these files.

3. Paste them inside the arduino’s "library" folder.
Coding
Coding

- MPU6050_raw: no modification has been done.
- MPU6050_DMP6: contains many useful functions.

Note on modifying raw data:
Each value (ax, ay, az, gx, gy, gz) is in the range [-32768, +32767].

ACCEL_CONFIG = +/- 2g, 4g, 8g or 16g where g = 9.8 m/s^2
+16384 = +1g (at a sensitivity of 2g)
-32768 = -2g (at a sensitivity of 2g)

GYRO_CONFIG = +/- 250, 500, 1000, or 2000 deg/sec.
+32767 = +250 deg/sec
-32768 = -250 deg/sec
Coding

Conversion from raw acceleration (ax) to SI units
\[ rax = 2 \times 9.8 \times ax / 32767 \text{ (m/s}^2 \text{)} \]

To get velocity:
\[ vx = vx0 + rax \times dt \]

Conversion from raw gyroscope (gx) to SI units
\[ rgx = 250 \times gx / 32767 \text{ (deg/s)} \]

To get angle:
\[ \text{thetax} = \text{thetax0} + rgx \times dt \]