## Use of the sensor board 9dof Sparkfun

For the stabilization of the model the 9 Degree of Freedom (9DoF) Stick from SparkFun is used. To verify orientation the stick provides an accelerometer, gyroscope and a magnetometer. Please refer to the final report of the previous group or to the datasheet of the sensor board [2] for exact information. Each sensor returns a value for the x, y, and z axis. Because each axis of the accelerometer and the gyroscope have a different range of values it is necessary to convert the output range into a uniform range. Only then it is possible to use the sensor values in the following modules of the flight controller. So the accelerometer and the gyroscope must be calibrated.

[1] Bumblebee\_Documentation/Final\_Report : Section 4.2.3

[2] <https://www.sparkfun.com/products/10724>

## Calibration of accelerometer

In contrast to the gyroscope the deviations of the accelerometer are invariable. For this reason calibration must be done just once. The results of calibration are an offset value and a scale value for each axis. This values are needed to convert the output range of the sensor into a uniform range.

To get the offset value and the scale value for each axis the maximum, minimum and the zero point values are needed. The How-to “Calibration of the accelerometer” [3] describes the procedure to get the values. The output data of the accelerometer is shown in the following chart (ref Output data of the accelerometer). The offset value is the result of the difference between zero and the measured value zero point.

[3] Path…../Calibration of the accelerometer.pdf

Figure 1: Output data of the accelerometer

x

y

z

MAX

MIN

0

249

-13

-276

-264

-3

264

280

-227

26

The chart (ref Output data minus offset value) shows the range of the three axes after subtracting the offset value. To get the same range for all three axes a maximum value of 300 and a minimum value of -300 was defined. Therefore the scale value for the x axis is 300/262, the scale value for the y axis is 300/267 and the scale value for the z axis is 300/254. The offset value and the scale value are used in the “SensorDataFilter.c” component of the flight controller.

Figure 2: Output data minus offset value

x

y

z

MAX

MIN

0

262

0

-263

-267

0

267

254

-253

0

## Calibration of Gyro meter

A Gyro meter when started has does not start in a defined state, there is an error offset, especially if the sensor has been moved while it was switched of. Additionally the sensor has a warmup phase. In that phase the Values are invalid, they change over time even if the sensor doesn’t move.   
The calibration (measuring the offset) of the gyro meter needs to be done at every system start.  
To get the offset and warm up the gyro meter the Sensor Data Manager provides an init-method which takes samples and compares them until the difference between the samples is small enough then it saves the last sample as offset and the gyro meter is initialized.