**Calibration process for MPU6050 used in oXs.**

1. Principle

oXs can use a MPU6050 accelerometer/gyro to :

* Get a more reactive vario (VSpeed)
* Calculate roll and pitch
* Calculate Angle of Attack (this feature is experimental and requires also a GPS)
* Stabilize a pan/tilt camera
* Stabilize the model.

To get best results from the MPU6050, this device should be calibrated for acceleration and gyro. Furthermore, for all purposes (except vario), it is also important to define the orientation of the sensor in the model.

There are several steps envolve:

* Calibrate the accelerometer (offsets/scales)
* Keep model horizontal and perform an « Horizontal » calibration
* Put nose of the model up and perform a « Vertical » calibration

1. Additional software to use

To perform the calibration of the accelerometer, you have to use an external software available for windows. This firmaware is Magneto 1.2. It can be downloaded from here:

<https://sites.google.com/view/sailboatinstruments1/a-download-magneto-v1-2?authuser=0>

A copy is available in the doc folder of the oXs project under the name magneto12.exe.

This software can be run without prior installation.

For calibration, oXs has to be connected to the PC (via USB) and a serial monitor has to run on the PC to enter commands and see/get the results.

1. Accelerometer calibration.

The process is similar to the one explained in this video (but with the help of oXs).

<https://www.youtube.com/watch?v=-1tmYPE7MAQ>

So the principe will be make measurements of the accelerations in many different orientations of the MPU6050.

The MPU6050 may not move during a measurement. So it is important to have some way to keep it still in all orientations. Keeping it in the hand will not be good enough.

Connect oXs to the PC (via USB) and let a serial monitor run on the PC.

To start the process, enter the command MPUCAL=A

oXs will display a message.

When the sensor is in a fixed orientation, press ENTER.

oXs will perform 100 measurements and display for information the sequence number of the measurement and the average acceleration values (in X, Y, Z). If there was to much noise in those measurement, oXs will say it and discards this measurement. In this cas just press ENTER to perform the measurement in the same position.

When a measurement is done, move the sensor to another orientation and press ENTER.

Makes measurements in many different orientations of the sensor.

When all measurements have been done, stop the process with the command MPUCAL=E

This will print:

* the number of measurements being done
* the scale used by the MPU6050 that has to be specified as “norm” in magneto12 software.
* The list of all measurements.

Make a copy (usualy CTRL+C) of the list of measurements (just the part with the 3 values).

Open a text editor (e.g. notepad) and paste the list of measurements. Save this as a txt file.

Starts magneto12.exe firmare and :

fill the norm field with the value given by oXs (usually 16384)

press the open button and select the txt file you just saved

press the calibrate button.

Note the results : combined bias(b) = offsets X, Y,Z, Correction for combined scale factors (A) is a set of 9 values (in fact 3 are always duplicated , so 6 different values).

Enter MPUACC= command with the 12 values from the result(in row sequence and separated by a blank) e.g.

MPUACC=93.633688 142.927034 -1067.694384 0.993415 0.000002 -0.003749 0.000002 1.000666 0.001992 -0.003749 0.001992 0.998804

Enter SAVE command to save it.

1. Horizontal calibration

Install oXs in the model (in the definitieve orientation). If it is not possible to connect oXs to the PC when installed in the model, keep oXs outside the model but in an orientation that is very similar to the one it will be when installed.

While oXs does not move, enter the command MPUCAL=H

If the model move to much during this test, you will get a warning message. Then, reenter the command.

When OK, Enter SAVE to save the result.

1. Vertical calibration

This is similar to the Horizontal calibration but the model must be kept with the nose 90° up.

If oXs is not installed in the model, it must be in the same oriention as when installad in the model with nose 90° up.

For this step, it is not so important that oXs does not move at all. So holding it in the hand should be OK.

When ready, enter the command MPUCAL=V

oXs will give a message giving the orientation being detected.

If OK, enter SAVE to register the parameters.

Note: MPU parameters are displayed like other parameters with the ENTER command (when accelerometer calibration is not running)