# Calibration of Inertial Measurement Unit (IMU) device for daily living

The actibelt is a belt worn device to objectively measure physical activity in real life environment. While the first generation of actibelts were equipped with an accelerometer only, the upcoming one will integrate a gyroscope, magentometer and more. An essential part of the adjustment to the new sensors is to enrich the calibration process of the device.

## Tasks

- Build up know how on calibrating IMUS Get comfortable with the calibration possible. (see references)
- Selection of an calibration algorithm.
- Implementation or realization of the algorithm.

## General

- Languages: Java, R, if needed: Python and C.

## References

- MSF - Modular framework for multi sensor fusion based on an Extended Kalman Filter (EKF) https://github.com/ethz-asl/ethzasl_msf
- https://github.com/mjs513/FreeIMU-Updates
- https://github.com/mgiurato/IMU-Calibration
- R-Implementation of Madgwick AHRS algo: https://cran.r-project.org/web/packages/RAHRS
- Free Matlab library: https://www.mathworks.com/matlabcentral/fileexchange/63250-gyrolib-ahrs-library
- Madgwicks original report on his AHRS algorithm: http://x-io.co.uk/res/doc/madgwick_internal_report.pdf
- Overview of 9-DoF sensor fusion approach: https://github.com/kriswiner/MPU6050/wiki/Affordable-9-DoF-Sensor-Fusion
- Fusion Algorithm in C: https://github.com/xioTechnologies/Fusion
- Tips on AHRS Algorithm and the role of calibration: https://learn.adafruit.com/ahrs-for-adafruits-9-dof-10-dof-breakout?view=all
- Another blog post concerning Calibration&Fusion: https://hackaday.io/project/152729-8bitrobots-module/log/156135-good-software-imu-with-data-fusion
- A very interesting read that points to existing software to do the calibration: https://thecavepearlproject.org/2015/05/22/calibrating-any-compass-or-accelerometer-for-arduino/
- Paper describing how to calibrate Acc+Gyr+Mag in one go: A multi-position calibration method forconsumer-grade accelerometers, gyroscopes, andmagnetometers to field conditions.pdf
- Introduction to Gyro-Calibration: https://www.analog.com/media/en/technical-documentation/technical-articles/GyroCalibration_EDN_EU_7_2010.pdf
- "easy" way to achieve calibration of acc+gyro: A robust and easy to implement method for IMU calibration without external equipments.pdf
- Enhanced version of Madgwicks algorithm: *A New Quaternion-Based Kalman Filter for Real-Time Attitude Estimation Using the Two-Step Geometrically-Intuitive Correction Algorithm*
- https://www.ncbi.nlm.nih.gov/pmc/articles/PMC5621018/
- High-Precision Calibration of a Three-Axis Accelerometer
- IMU Errors and Their Effects
- Triaxial Accelerometer Static Calibration
- https://www.sensorsmag.com/components/compensating-for-tilt-hard-iron-and-soft-iron-effects
- https://appelsiini.net/2018/calibrate-magnetometer/
- https://github.com/kriswiner/MPU6050/wiki/Simple-and-Effective-Magnetometer-Calibration

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