



HREF Sensor Calibration Issues

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September, 2012

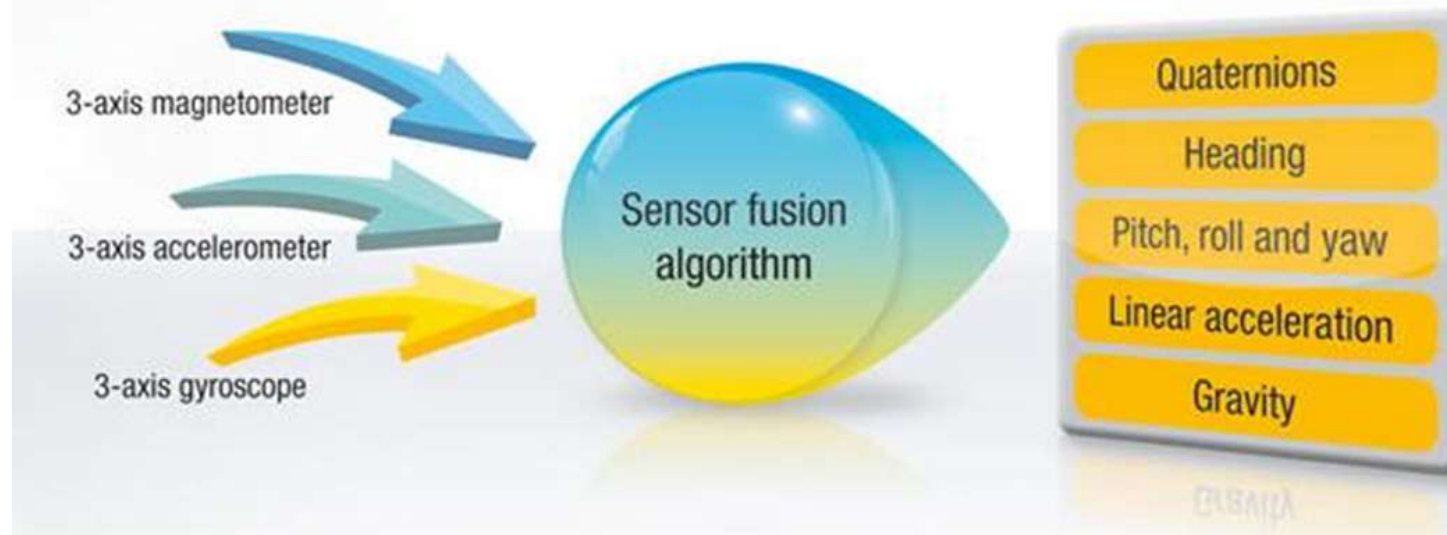
Why calibration is needed ?

- **Static error**
 - Bias or offset error
 - Scale factor or gain error. Scale factor captures the sensors sensitivity to the intended physical value
 - Axis misalignment: for 3 dimensional sensors each axis may not be exactly perpendicular with the other axes
 - Reference misalignment between 3 dimensional sensors. Data fusion algorithms performance can then be affected. Such misalignment depends on the sensors placement on the platform and can even occur in combo sensor
- Only low variations depending for instance on temperature
- **Calibration: remove these structural errors in the sensor outputs**
 - Any of these errors are repeatable can be calculated during calibration
 - During actual measurements errors can be compensated in real-time

- Dynamic error
MEMS sensors are sensitive to dynamic perturbations and errors
 - Gyroscope: suffer from a drift that cannot be calibrated out in a laboratory
 - Magnetometer: sensitive to the electromagnetic perturbations in the immediate environment whereas goal is to retrieve the direction of the magnetic pole
 - Interference from other components and power lines located near the sensor
 - hard iron: static error, due to component producing a magnetic field
 - soft iron: dynamic error due to material disturbing magnetic field measurement, depends on phone orientation
 - Interference from electronic appliances located nearby. These interferences will vary depending on phone orientation and user movement: soft iron, dynamic error
- Mobile Market uses low cost MEMS sensors (consumer grade)
➔ sensitive to static and dynamic errors
- Calibration process delicate, not adapted at production level.
 - Sensor manufacturer or specialized companies can provide calibration data or algorithms and systems to perform calibration.
 - Dynamic calibration often associated with data fusion

Why data fusion is needed ?

- Accelerometers: mix of gravity and acceleration
 - Magnetometers: hard iron, soft iron effects depending on orientation
 - Gyroscope: dynamic drift, noise
- increase accuracy, resolution, stability and response time in advanced motion-based applications
- new dimensions: absolute orientation of the device, linear acceleration...



- HREF8500 known issues

- Magnetometer hard iron due to loudspeaker
 - Android data fusion may be not functional
- Sensor libraries: issue with delays requested by Android application
 - Wrong if several applications requests different delays
 - May be solved in latest delivery
 - Solved by disabling screen rotation feature
 - Jitter on sensor data acquisition

- HREF9540 known issues

- Magnetometer soft iron (cause unknown)
 - Magnetometer data out of bounds when device placed with the screen facing up
 - Android data fusion may be not functional
 - May be solved by calibration algorithm
- Sensor drivers: data ready feature activated, data not released if not ready independently from requested acquisition rate → blocking behavior
 - Solved by applying the relevant patches