Axes of tag used in ot_AHRS.m

Note that this is different from what is printed on the board, because they are rotated for typical positioning of potted tag during deployment.

This follows the 'NED' orientation, with X facing North at 0 degrees, Y facing east at 90 degrees, and Z pointing down. Positive rotations follow the right hand rule, where you point your thumb along the positive axis, and your fingers curl in the direction of positive rotation.

For example, a rotation about the z-axis to + 90 degrees, would yield the following:

In the Euler plots, the rotations about each axes are described by Phi (rotation about x-axis: roll), Theta (rotation about y-axis; pitch), and Psi (rotation about z-axis; yaw).

Using ot_AHRS.m

ot_AHRS.m is an example m-file for loading OpenTag .dsg files, plotting them, and calculating Euler angles using the Madgwick algorithm, which uses quaternions to determine rotation. See the file help for details about the algorithm.

Unzip folder and add all folders to your MATLAB path.

From MATLAB:

>ot_AHRS

You will be prompted to select a .dsg file.

The data will be loaded into the INER structure, which will have accel, mag, and gyro members.

These data will be plotted as they are stored on the tag, using the orientation of the sensors on the board.

The data will then be changed to the orientation for the potted OpenTag shown above and stored in Accelerometer, Magnetometer, and Gyroscope, and replotted in a new figure.

If a magnetometer correction (magoffset) is present, it will be subtracted from the data.

The quaternion calculations will be performed, and the Euler angles will be computed and plotted from those.

Using ot_magcal.m

ot_magcal.m is used to calculate offsets in the magnetometer readings, which can lead to errors in heading. The offset is affected by the local magnetic field, so if you are going to be attaching the tag to something with metal in it, this calibration should be done in that situation.

1. Make a recording from OpenTag at a high sample rate (e.g. 100 Hz) while rotating the tag around all axes.

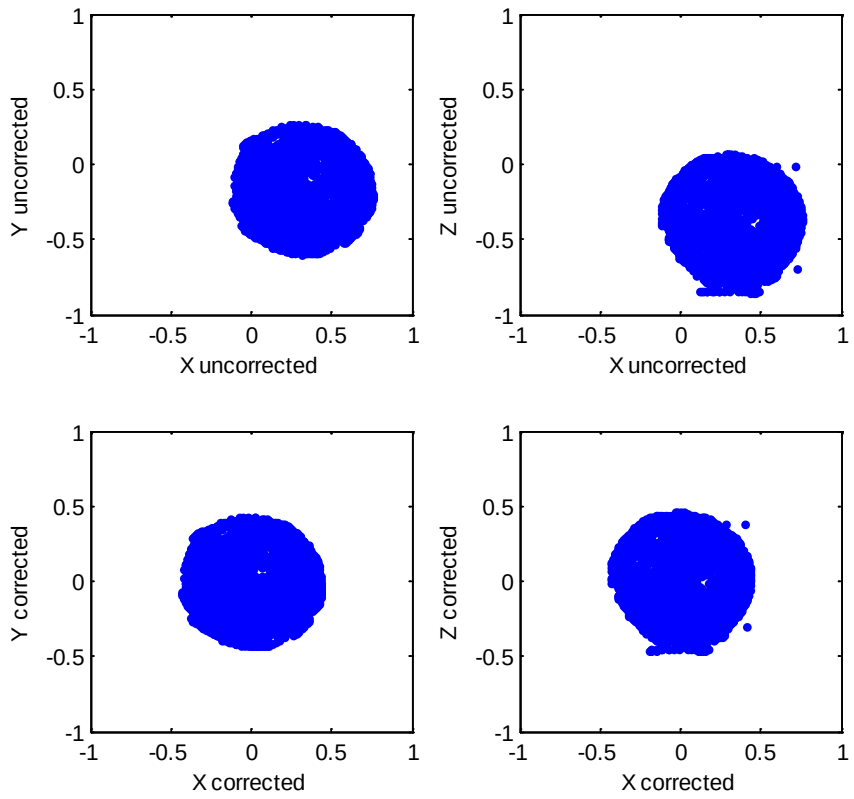
2. Run ot_magcal.m and select this file.

The data will be plotted in uncorrected and corrected forms.

You should see circles in the plots of X vs Y, and X vs Z. The software corrects for the offset by calculating the minimum and maximum of each axes and centering it. It does not correct for offsets that distort the field (you would see ellipses in the plots).

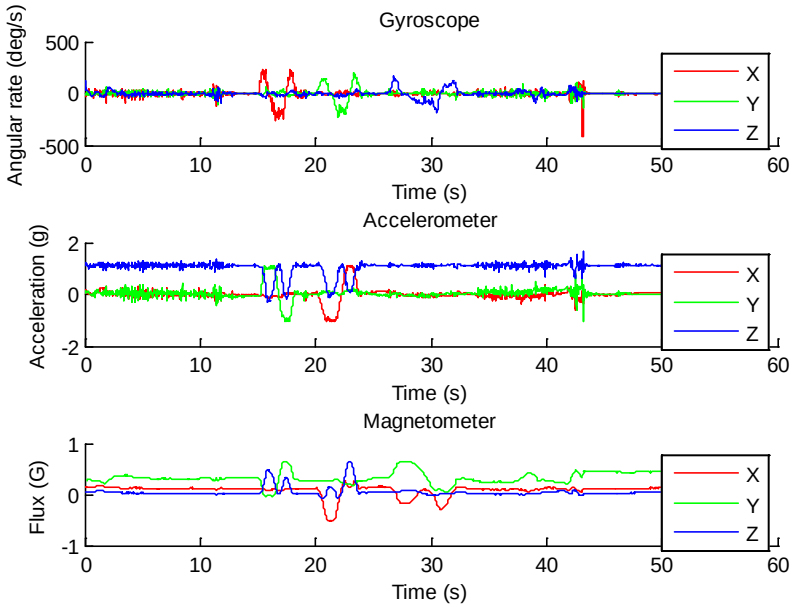
The offsets are stored in the variable 'magoffset', which is then used by ot_AHRS.m.

Note that this can be saved in a .mat file, and then reloaded prior to running ot_AHRS.m.

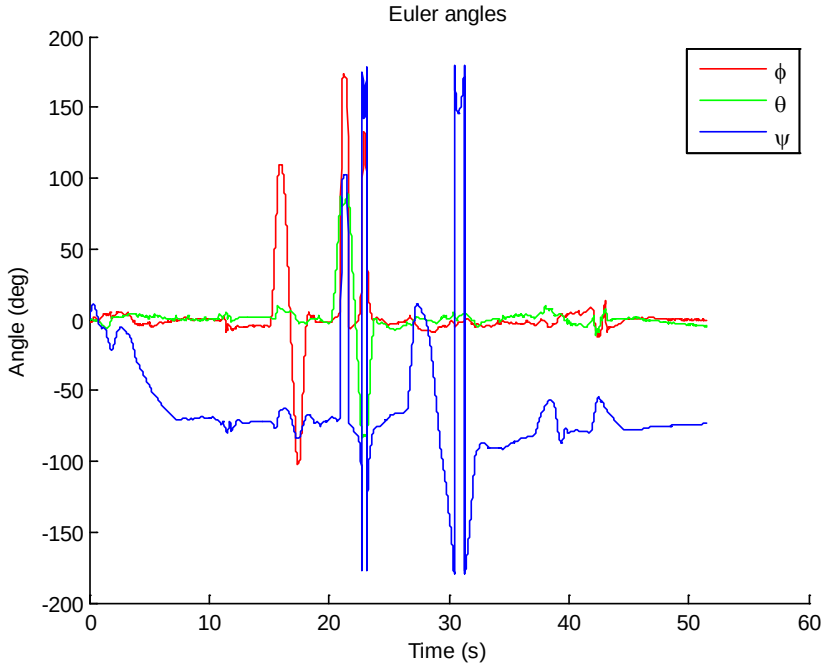


Example: Sequential rotation about X, Y, and Z axes (90 degrees positive, then 90 degrees negative) while pointing North. Euler angles calculated with ot_AHRS.m using Madgwick algorithm in MATLAB.

Without Magnetometer Correction



Without Magnetometer Correction: Note error in Psi (Yaw) at about -60 degrees, when should be 0.



With Magnetometer Offset Calibration: