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Yaw calibration

In order to achieve accurate angle control, you need to know the current orientation (yaw) of the robot. One way get this information is through vision. The camera's record all footage of the robots, which is then converted to velocity and position information. Unfortunately, it takes approximately 50 ms before the information is received by the robot, making the yaw data fairly old. However, there is another way to know the robot's yaw. This is by means of the XSens chip. This chip has an accurate gyroscope on board and can measure for example the rate of turn of the robot. You can also directly request its Euler angles (roll, pitch, yaw). This data is fresh and 100 times per second available (hopefully 400 times by now?) . The only disadvantage we experienced, is that it seems to drift a lot. This might be due to the way the XSens calibrates itself. When you first turn on the robot, it stands still for 6 seconds and sets the rate of turn bias to zero. This might not happen or 6 seconds might be not long enough. Also, the XSens has 5 different filters with each a different dependence of the magnetic field. That is, for some filters, the yaw is calibrated internally such that it aligns with the earth's magnetic field. Magnetic fields inside inside the robot might disturb this, but that has not been proven yet. The 5 different filters are:

- General
- High magnetic dependence
- Dynamic
- Low magnetic dependence
- Vertical Reference Unit general

A brief explanation from the user manual:

The **general** filter profile is the default setting. It assumes moderate dynamics and a homogeneous magnetic field. External magnetic distortions are considered relatively short (up to ~20 seconds). Typical applications include camera tracking (e.g. TV cameras), remotely operated robotic arms on ROV's etc

The **high_mag_dep** filter profile assumes homogeneous magnetic field and an excellent Magnetic Field Mapping. This filter profile heavily relies on the magnetometer for heading. Dynamics of the motion are relatively slow. Typical applications are navigation of ROV's or the control of small unmanned helicopters.

The **dynamic** filter profile assumes jerky motions. However, the assumption is also made that there is no GPS available and/or that the velocity is not very high. In these conditions a 100-series MTi may be a better choice. The dynamic filter profile uses the magnetometer for stabilization of the heading, and assumes very short magnetic distortions. Typical applications are where the MTi is mounted on persons or hand-held (e.g. HMD, sports attributes etc.).

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The **low mag_dep** filter profile assumes that the dynamics is relatively low and that there are long-lasting external magnetic distortions. Also use this filter profile when it is difficult to do a very good Magnetic Field Mapping (MFM). The use of the low_mag_dep filter profile can be useful to limit drift in heading whilst not being in a homogenous magnetic field. Typical applications are large vessels and unmanned ground vehicles in buildings.

The **VRU_general** filter profile assumes moderate dynamics in a field where the magnetic field cannot be trusted at all. It is also possible to use this filter profile in situations where an alternative source of yaw is available. Yaw from the VRU is unreferenced; note however, that because of the working principle of the VRU, the drift in yaw will be much lower than when gyroscope signals would be integrated. Typical applications are stabilized antenna platforms mounted on cars of ships and pipeline inspection tools. This filter profile is the only one available for the MTi-20 VRU.