Ellipse AHRS & INS

Use in marine applications

Operating handbook

Document ELLIPSEOHSEA
Revision Nov 8, 2018

Support

EMEA +33 1 80 88 43 70
support@sbg-systems.com

Americas: *+1 (657) 549-5807*
support@sbg-systems.com

SBG SYSTEMS

This operating handbook aims to guide Ellipse users during sensor installation and configuration in marine environments.

You don't need to use the sbgCenter to configure the products.

Mechanical installation

When used in marine application, the Ellipse performs some velocity assumptions: No high dynamics are involved, but you still need a good sensor installation to get best results.

Vibrations

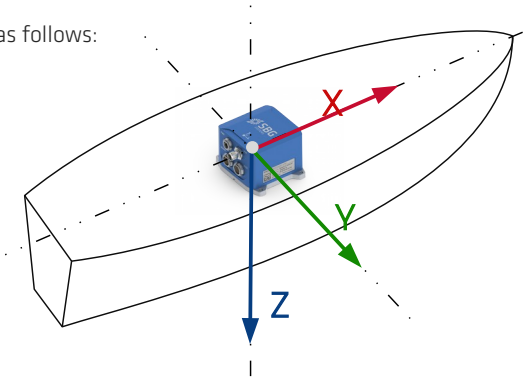
Ellipse is designed to handle vibrations. Nevertheless in case of highly vibrating environment, an efficient mechanical vibration isolation is required for proper operation. Silicon dampers can be used for that purpose.

Ellipse placement in the vessel

The vessel coordinate frame is defined as follows:

- X points to the front (bow)
- Y points to the right (starboard)
- Z points the bottom (keel)

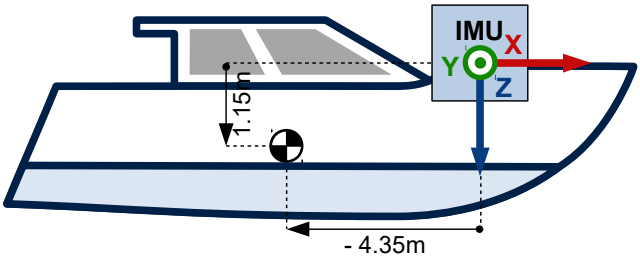
The Ellipse MUST be mechanically aligned with the vessel coordinate frame, as explained in the following diagram. **Alignment accuracy should be better than 1°.**



Note: If a correct mechanical alignment is not possible, then a software alignment can be used. Please refer to the Ellipse User Manual for such operation.

If the Ellipse is GPS aided, it can be placed anywhere in the ship. If you are using the Ellipse as an AHRS only (without any GPS aiding), you should place the device close to the center or rotation to ensure the best accuracy.

Once installed, you can enter a primary lever arm to deport velocity, position and heave outputs. It must be measured in the vessel coordinate frame **FROM** the Ellipse **TO** the center of rotations.



Note: Deported heave accuracy is decreased as the lever arm becomes longer, due to orientation accuracy. Accuracy decreases of roughly 0.1 cm each meter. A 10 meters lever arm will therefore lead to 1 cm additional error on deported heave output.

Magnetic environment

If magnetometers are used for heading observation, user should also consider the magnetic environment.

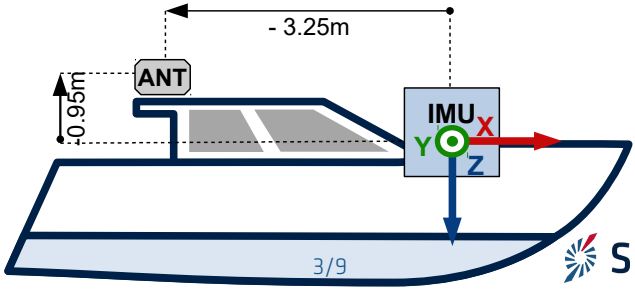
The Ellipse **magnetometers require**, for good operation, a **clean magnetic field**. The sensor should be placed away from any magnetic interference such as: DC motors, radios, strobe lights, power supplies etc.

Single GNSS Antenna placement

GNSS antenna must be fixed with respect to the Ellipse. It should have a clear view of sky.

The GNSS lever arm is the signed distance, expressed in the vehicle coordinate frame, from the Ellipse center of measurements, to the GNSS antenna.

In addition, this lever arm should be lower than 10m for best performance.



SBG SYSTEMS

Dual GNSS Antenna placement

Dual antenna systems installation will require special care in order to obtain optimal performance:

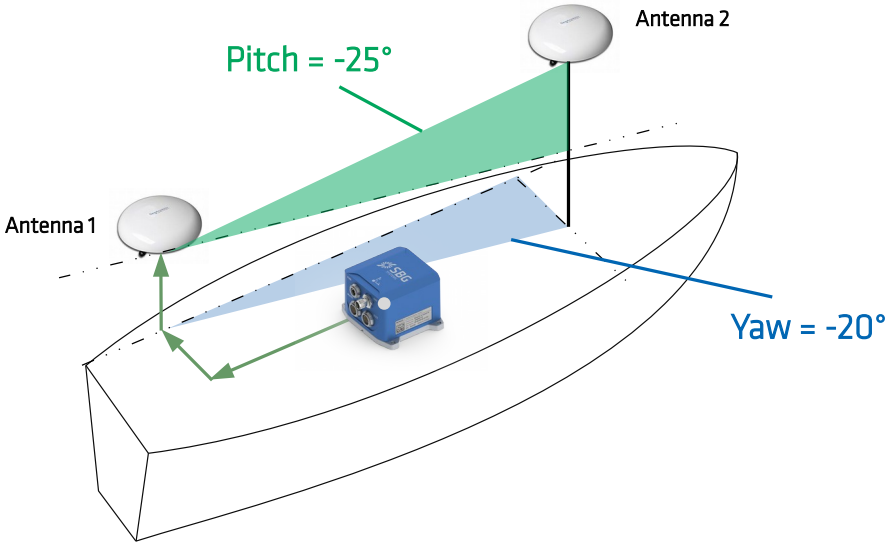
- Maximum separation between two antennas should not exceed 3 meters on Ellipse-D. For external GPS receivers, please conform to Manufacturer guidelines
- Same antenna type, same cables with identical lengths must be used for both antennas. No signal splitter should be used.
- Both antennas must be turned the same way (connectors oriented in same direction)
- Both antennas must have the same view of sky when mounted on the vessel.

Once installed, the GNSS lever arm must be measured. It is the signed distance, expressed in the vehicle coordinate frame, from the Ellipse center of measurements, to the main GPS antenna. It must be measured within 5cm accuracy.

Then, the absolute distance between main and secondary antennas should be measured.

Finally, the alignment angle between the antennas and the vessel coordinate frame must be **accurately measured within 0.5°**.

The following diagrams show two typical installations. The first one with the GPS antennas installed with a zero angle offset, and the second one, with a -90° installation:



Software configuration

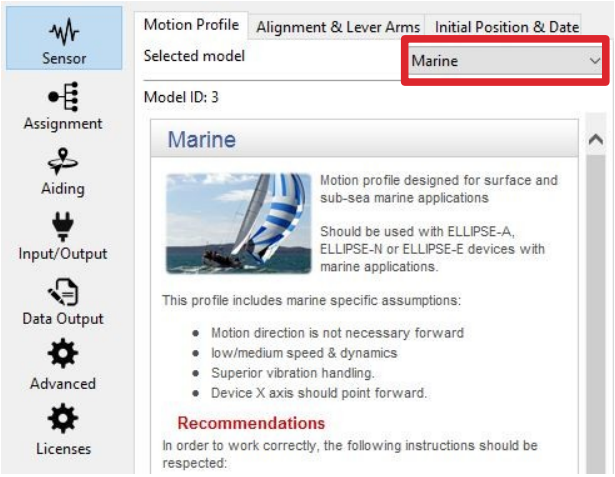
All Ellipse configuration is done through the sbgCenter interface, or using low level communication protocol.

Note: At the first access or if the device firmware has been updated, the Ellipse will have its default configuration. This configuration should be used it you want to send logs to Support. Don't hesitate to contact the Support Team for help.

Sensor

Motion profile

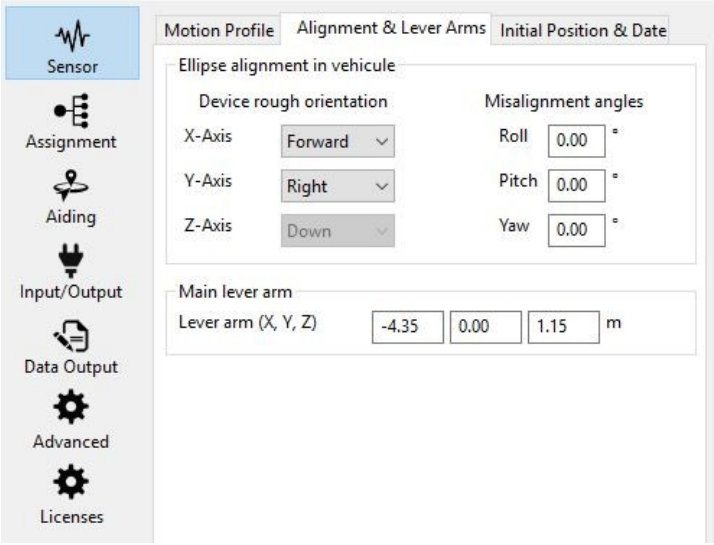
All marine and subsea applications should use the “Marine” motion profile.



Alignment and lever arm

Here you have to configure the device alignment in the vehicle and its lever arm in regard to the center of rotation of the car (rear axle).

On the alignment settings you only need to set up the first two axis, then the third one will be automatically computed.



Initial Position and Date

This parameter will matter if you do a 2D magnetic calibration.

Using magnetometers is not recommended for automotive applications, but in case you use them a magnetic calibration is mandatory. Then if a 2D calibration is preferred over a 3D one. In this case, the initial position and date will be used by the magnetic calibration to ensure nominal performance.

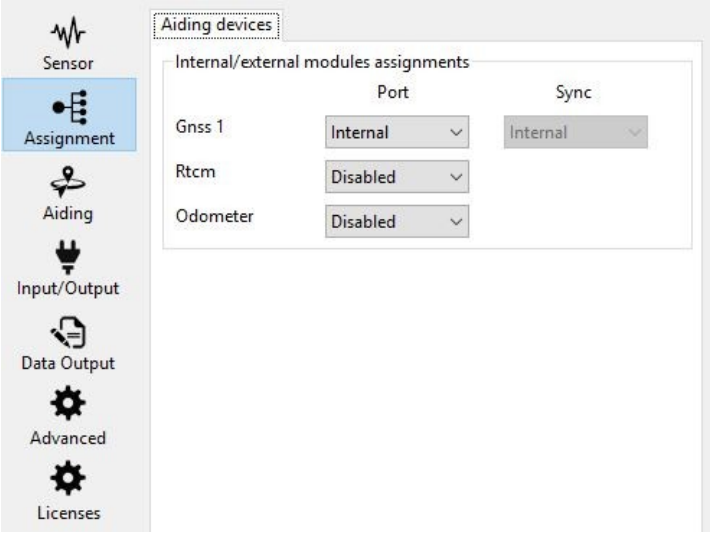
Assignment

Ellipse N and D GNSS assignment

The Ellipse N and D GNSS is automatically set to “Internal”. User can also set an RTCM corrections input if needed.

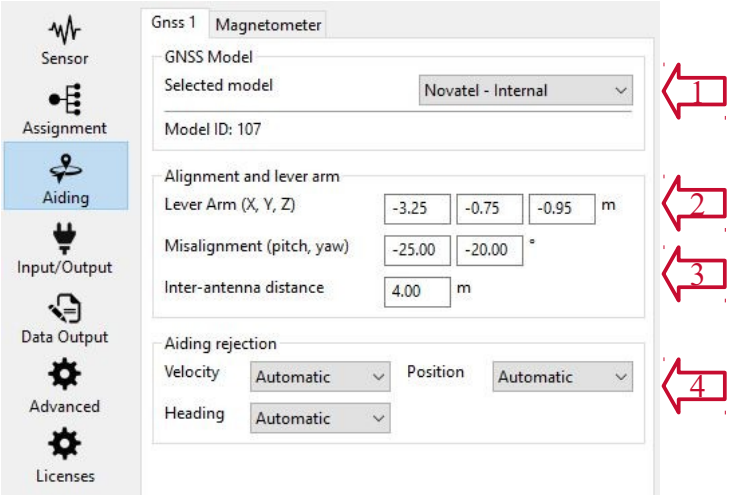
Ellipse E GNSS assignment

You can enable a GNSS on the serial port you need.



Aiding

GNSS Configuration



Please check following point at the GPS configuration level:

1. Choose this parameter depending on the GPS you are using (NMEA, Ublox or Novatel)
2. Set up the lever arm of the GPS depending on its position on the car (Single GNSS Antenna placement).
3. If two antennas are used you have to define here the distance between antennas and the antennas misalignment with respect to the vehicle coordinate frame.
4. Automatic rejection mode is advised for each parameter, except GPS Course which must be disabled. Automatic mode automatically detects the confidence so the Kalman filter knows it can rely more on a parameter or less on an other.

Magnetic calibration in marine applications

When magnetometers are used as heading, a **magnetic calibration is mandatory for normal sensor operation.** Different calibration methods are provided, depending on accuracy or ease of use requirement.

Large ship calibration

In case the boat is a heavy ship and it is not possible to move it by hand, it will be necessary to calibrate the magnetometers while cruising. The goal will be to collect data in every direction, so you will have to make a 360° with the ship (the turn radius and speed does not matter).

You should perform a 3D calibration in most cases as your boat as a good chance to heel (except heaviest ones).

The following procedure should be followed for good performance:

1. Install the sensor as described in previous sections, and place the whole system **away from external magnetic disturbances** (buildings, other vessels, etc).
2. Press "Start acquisition" button on sbgCenter calibration window
3. Navigate in an 8 shaped path, so you will be able to capture points in the Y-axis while heeling slightly on both sides. It doesn't need to be a critical angle, 20° would be enough for instance, it has to be representative of the usual behavior of the ship.
4. Check that the 3d method is used (In case of very large ship, or when the roll/pitch angles could not be changed significantly during calibration, a 2D method can be used), press "**Calibrate**" and check calibration results. Press "**OK**" to finalize calibration procedure.
5. Power cycle the sensor if you need immediate operation after calibration.

Light boat calibration (USV/ROV/AUV)

As long as a boat is light enough to be held by a few persons (especially unmanned vehicles), a 3D calibration, made on the ground is to be preferred. The basic procedure remain the same, and you should just rotate the system in as much orientations as possible.