Ellipse Series

Use in automotive applications

Operating handbook

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SBG SYSTEMS

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

We recommend using the sbgCenter to configure the products, but this is also possible by using our sbgECom C library.

Mechanical installation

When used in automotive application, Ellipse performs some velocity assumptions: No lateral velocity is allowed and therefore, a good sensor installation is a key point to follow.

Vibrations

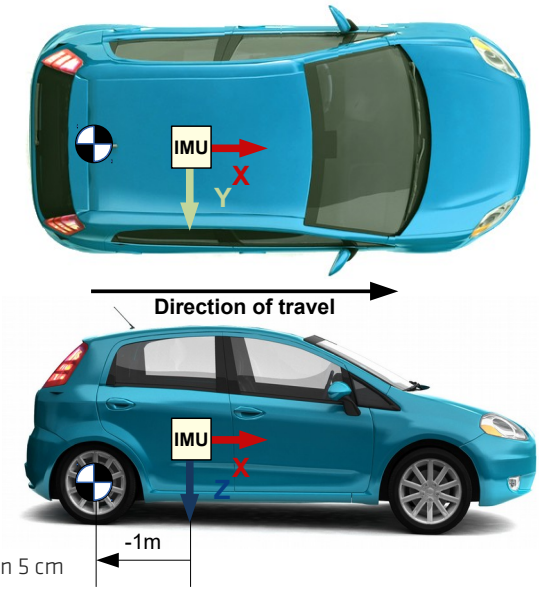
Ellipse is designed to handle vibrations. Nevertheless in case of highly vibrating environment, or vibrations above 1kHz, an efficient mechanical vibration isolation is required for proper operation. Silicon dampers can be used for that purpose.

Ellipse placement in the vehicle

The vehicle coordinate frame is defined as follows:

- X axis points to the front of the car
- Y axis points Rightward.
- Z axis points downward.

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



The main lever arm is the signed distance, expressed in the vehicle coordinate frame, **FROM** the Ellipse center of measurements **TO** the vehicle center of rotations.

The vehicle center of rotation is located on the rear axle for conventional cars.

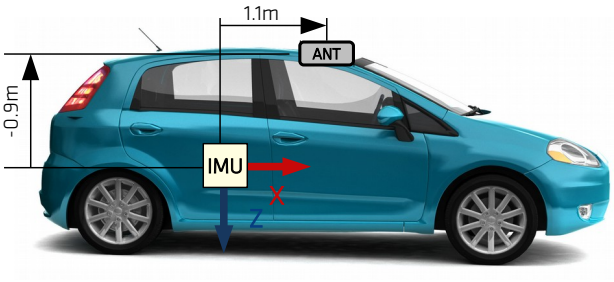
The main lever arm must be measured within 5 cm accuracy.

Note: If a correct mechanical alignment is not possible, then a software alignment should be used. Please refer to the Software Configuration part for such operation.

GPS Antenna placement

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

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



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

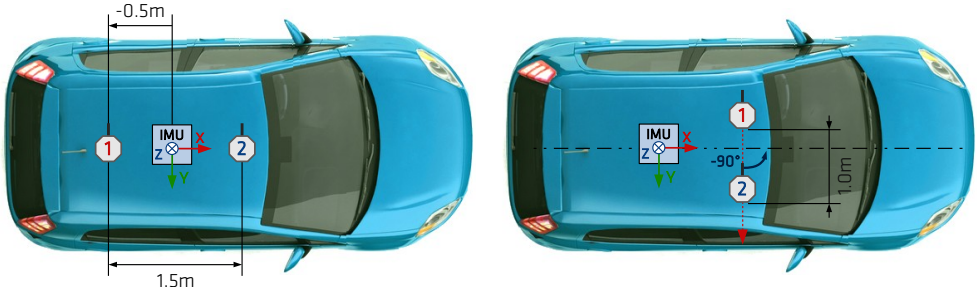
Dual GPS antenna placement

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

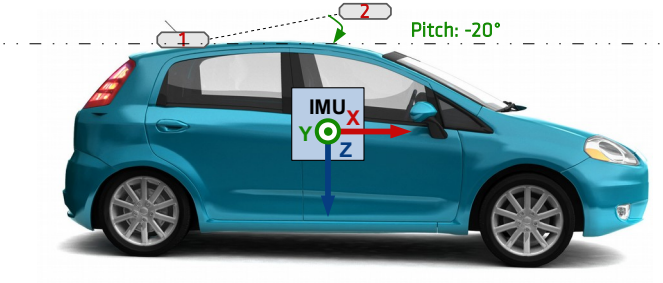
- Maximum separation between two antennas should not exceed 4 meters on Ellipse D. For external GPS receivers, please conform to Manufacturer guidelines
- Same antenna type, same cables with identical lengths must be used for both antennas.
- Both antennas must be turned the same way (connectors oriented in same direction)
- Both antennas must have the same view of sky when mounted on the vehicle.
- Both antennas must be placed on a ground plane (typically the car's roof), more than 10cm away from the ground plane's edges.

Once installed, the main GPS antenna 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 vehicle coordinate frame must be accurately measured. The following diagram shows a typical installation, using a 0° angle offset, and another with a -90° offset:



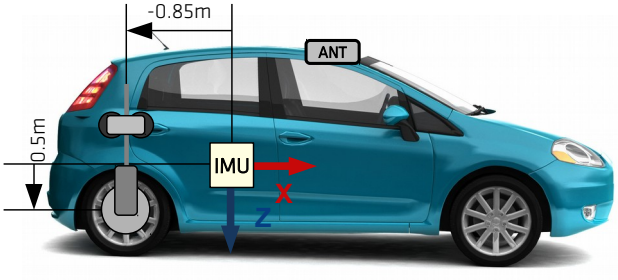
The next example show antennas angles when there is a pitch angle:



Odometer placement

Odometer has to be placed on a **non steering wheel** (rear wheel in most applications).

The Odometer lever arm is the signed distance, expressed in the vehicle coordinate frame, from the Ellipse Center of measurements to the Odometer. It has to be measured with 5cm accuracy, and should be lower than 10m for best performance.



Software configuration

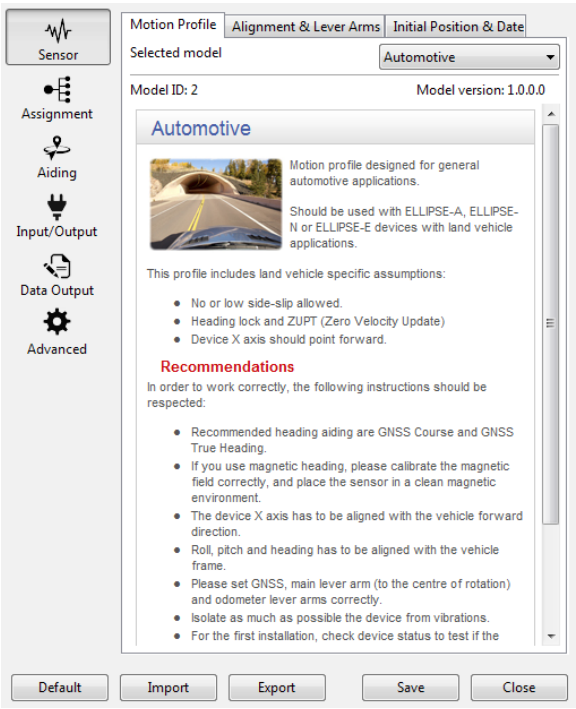
All Ellipse configuration is done through the sbgCenter.

> **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

Conventional vehicles should use the “Automotive” motion profile.

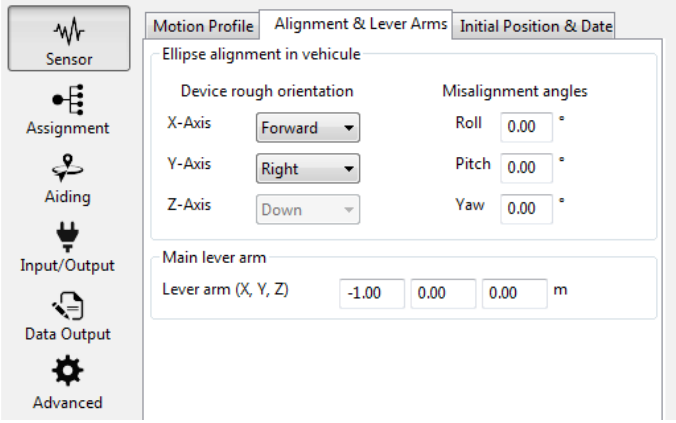


In case the vehicle will have movement on the Y-Axis (drift on a side), the Motion Profile “General Purpose” should be preferred.

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.

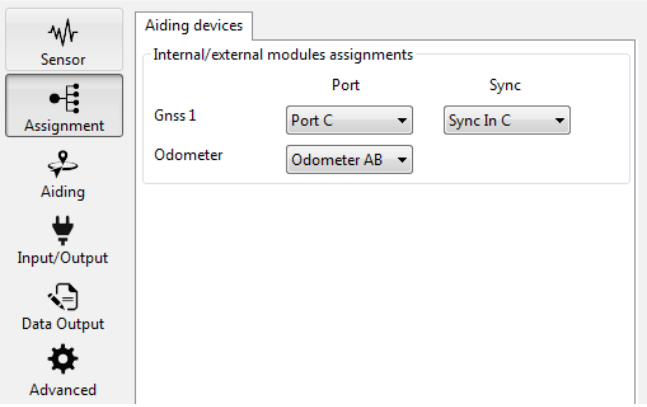
Assignment

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.



Odometer assignment

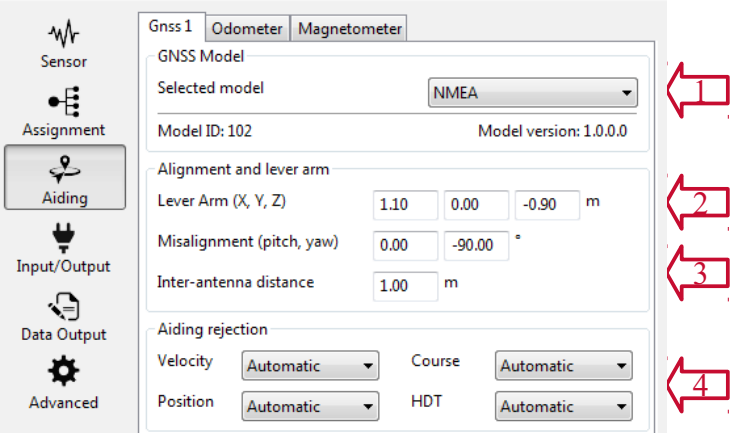
You can also enable or disable the odometer, if you have the opportunity to use one it may significantly improve the dead reckoning performance.

If the Odometer have only one channel for the distance, select Odometer A.

If the Odometer also have the direction on a second channel, select Odometer AB.

Aiding

GNSS Configuration

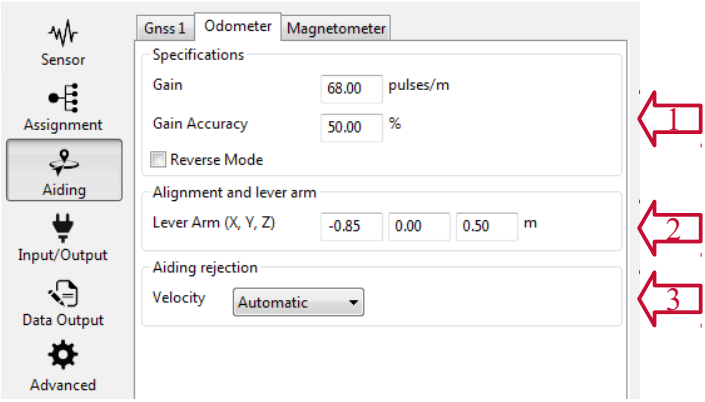


Please check following point at the GPS configuration level:

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 (GPS 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, it automatically detects the confidence so the Kalman filter knows it can rely more on a parameter or less on an other.

Odometer configuration

If you are using an odometer and activated it in Aiding Assignments, you will see a thumbnail called "Odometer" in the Aiding panel.



1. Define here the initial Odometer gain in pulses per meter. This parameter will be then automatically tuned by the Kalman filter to optimize the dead reckoning performance.

   Initial gain error in percent should also be entered in this section: this defines how much the Kalman filter needs to estimate the Odometer's gain. Put 100% if you want it to be completely estimated, or 20% if you find your odometer is very accurate. If you are not sure, 50% is a good default value

   Depending on your hardware configuration, the receive mode can be used to reverse the velocity value in order to fit with an actual velocity direction.

2. Set up here the Odometer lever arm depending on its position (Odometer placement).

3. Auto-rejection is advised so the Kalman filter determines the confidence of this parameter by itself.

Magnetometer configuration

In automotive applications, conventional vehicles should avoid using magnetometers since there is usually a lot of disturbances.

Operation

Initialization

For applications with single antenna GPS receivers, the unit will be able to provide full navigation data once the platform has been moved at higher speed than 15 km/h.

Applications that use a dual antenna GPS system will start providing navigation data as soon as the GPS true heading data is available. For such systems, the unit should be started up in a clear view of sky environment to prevent bad initialization of the GPS true heading.

Self-Calibration

Once the navigation data is initialized, the system will be functional, but will require about 15 minutes to provide full navigation performance. This is required to let the sensors warm up, and to let the Kalman filter self calibrate some parameters, such as GPS lever arm, or sensors bias.

During this phase, some motion is recommended to ensure proper calibration. A good way to do it is driving with left and right turns, accelerations, decelerations and so on. The following picture shows a typical successful calibration path: