

GyrAnt Application Note

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1. Overview

GyrAnt combines the Inertial Measurement Unit (IMU) and the GNSS antenna. IMU consists of three gyro sensors, three accelerometers oriented in mutually orthogonal axes, all placed in the water resistant aluminum antenna housing. IMU provides measurements of angular velocity and acceleration. The system improves standalone position and velocity measurements of the GNSS receiver and provides the attitude.

The accelerometers used are: biaxial XY SCA-1000 and biaxial ZY SCA-1020, only Z-axis is used.

The gyroscopes are Analog Devices ADXRS 613. IMU has also a power supply circuitry, ADC, and a processor controlling inertial data sampling and sending the measurements through RS-422 and CAN ports. The compensation of temperature zero drift, scale factors, and calibration of the sensor axis misalignment are implemented in IMU.

Sampling rate is 100 Hz.

2. Interface

Sensor's measurements transmit via the CAN port with 500 kbit/s rate and via the RS-422 port with fixed baud rate 115200 bit/s simultaneously. M12 connector pinning is shown in the Table1.

Table1

Pin #	Signal Name	I/O	Description
1	PWR	I	+10 to +40 VDC Power Input
2	GND		Power Ground
3	TXDD+	O	RS-422 port TXD+ line
4	TXDD-	O	RS-422 port TXD- line
5	RXDD+	I	RS-422 port RXD+ line
6	RXDD-	I	RS-422 port RXD- line
7	CANH	I/O	CAN port CAN-H line
8	CANL	I/O	CAN port CAN-L line

The IMU's axes of sensitivity form an orthogonal coordinate frame as it is shown in the Figure 1.

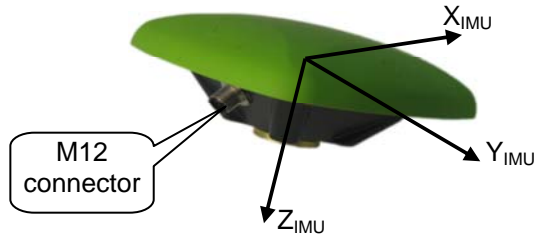


Figure 1

Inertial measurements transmit via the RS-422 port with GREIS [1] standard message 'MI' of the following structure

[MI] Measurements Inertial

```

struct MI {
    u2 ax; /*** Acceleration along XIMU axis
    u2 ay; /*** Acceleration along YIMU axis
    u2 az; /*** Acceleration along ZIMU axis
    u2 wx; /*** Angular velocity around XIMU axis
    u2 wy; /*** Angular velocity around YIMU axis
    u2 wz; /*** Angular velocity around ZIMU axis
    u1 cs; /*** Checksum
};

```

WARNING: Not to loose calibration parameters, do not disassemble GyrAnt.

3. Installing GyrAnt

Fix GyrAnt firmly on the vehicle body and connect the antenna cable and the communication cable to a GNSS receiver, see Figure 2. The GyrAnt's X-Y plane must be parallel to the floor plane of the vehicle. The GyrAnt's X-axis (X_{IMU}) must be parallel to the longitudinal axis of the vehicle as accurate as possible and oriented in the nose direction of the vehicle, the angle of misalignment must be less than 2 deg. Mount GyrAnt at the places where the vibration is minimal.

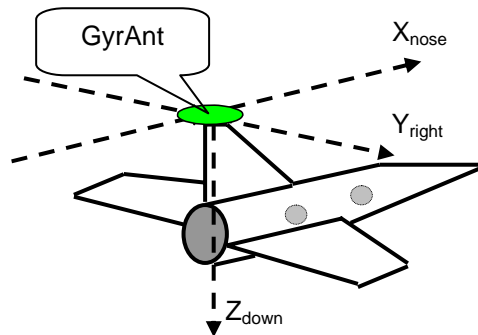


Figure 2

4. JGNSS receiver setting for integration with GyrAnt

The following settings must be sent to the receiver to configure the CAN port for reception of inertial measurements from GyrAnt:

set,/par/dev/can/a/rate,500

to set the baud rate,

set,/par/dev/can/a/imode,cmd

to set the 'command' input mode. If the port /par/dev/can/b is used for communication the commands must be changed accordingly.

In case of use of RS-422 port , send the commands:

set,/par/dev/ser/<port>/rate,115200

to set the baud rate,

set,/par/dev/ser/<port>/imode,jps

to set the 'jps' input mode.

The integration of the inertial measurements with the positioning measurements starts automatically after the GyrAnt is connected to the receiver and the port is set. The following settings are used to control the integration:

set,/par/pos/ins/subst,[on|off], on by default,

to instruct the receiver if the integrated position and velocity must be substituted for the standalone position and velocity.

set,/par/pos/ins/txtr,T

where T is the maximum allowed extrapolation time in seconds. It takes values from the range [0..900], 60 by default.

5. Accuracy degradation

Degradation of accuracy for attitude, position, and velocity caused by outages of GNSS measurements, estimated for noise-like GNSS errors and errors of initial conditions for GyrAnt working in autonomous mode, is shown in the Table 2.

Table 2

Time outage [sec]	Velocity vector degradation [m/sec]	Horizontal position degradation [m]	Vertical position degradation [m]	Roll degradation [degree]	Pitch degradation [degree]	Heading degradation [degree]
5	0.4	0.9	0.2	0.1	0.1	0.2
15	1.2	8.5	1.1	0.2	0.3	0.5
60	6.5	170.0	16.0	0.5	0.6	0.8

Here the average data of degradation are obtained as a result of tests on an airplane.

6. References

[1] GNSS Receiver External Interface Specification (GREIS), <http://www.javad.com>