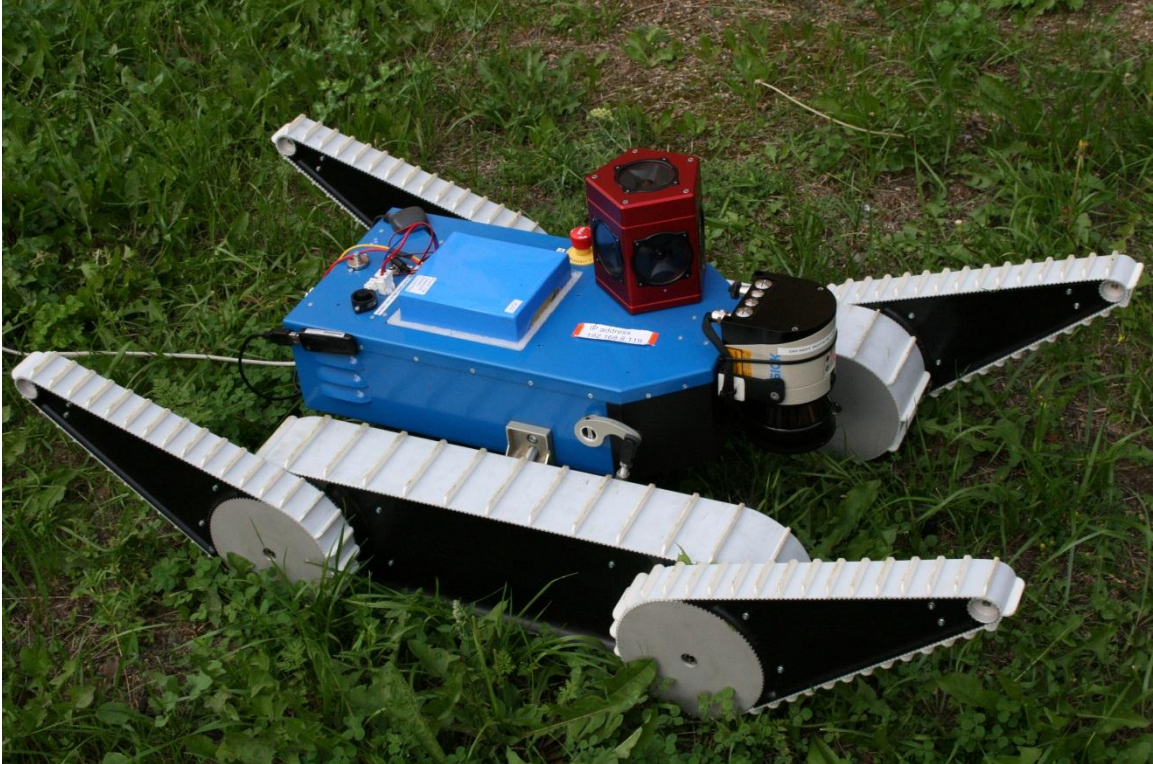


# INSO Overview

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## Introduction

Inso node is a *nifti\_vision* stack node. Its purpose is to evaluate position, attitude and velocity of the NIFTi robot in space. This is done by processing inertial and odometry data using an Extended Kalman filter.

Inso node should be launched using "*roslaunch inso inso.launch*" command since all parameters available are set by this launchfile. The launchfile does not start any other node but inso node. Nodes providing necessary topics for inso to run are "*xsens mtig*" node and "*nifti\_robot\_driver nifti\_robot\_node*". Both are launched by the "*ugv.launch*" file located in "*nifty\_drivers\_launchers*" node.

The inso node subscribes to these topics:

- */imu/data* (specific forces and angular rates)
- */fix* (GPS)
- */odom* (odometry)
- */tracks\_vel* (velocities of both robot tracks)

The inso node provides its results in these three topics:

- */imu\_odom*
  - main output topic to be used, ROS native *nav\_msgs::Odometry* messages
- */mechanization\_output\_inso*
  - position, velocity and attitude in Euler angles, all expressed in North East Down coordinate system (inso native coord. frame)
  - this topic is intended for tuning purposes and experimental verification, it might not be included in further versions
- */mechanization\_output\_inso\_aiddebug*
  - position and velocity indicated by processed odometry, for debugging purposes, it WILL NOT be included in further versions

## Output topics in detail

This chapter describes contents of published topic messages.

Topic `/imu_odom` is the main output topic that should be used. Messages in this topic are standard `nav_msgs::Odometry` messages:

```
Header header
  uint32 seq
  time stamp
  string frame_id
  string child_frame_id
geometry_msgs/PoseWithCovariance pose
geometry_msgs/Pose pose
  geometry_msgs/Point position // covariance mtrx available
    float64 x
    float64 y
    float64 z
  geometry_msgs/Quaternion orientation //covariance mtrx diagonal constant
    float64 x
    float64 y
    float64 z
    float64 w
  float64[36] covariance
geometry_msgs/TwistWithCovariance twist
geometry_msgs/Twist twist
  geometry_msgs/Vector3 linear // covariance mtrx available
    float64 x
    float64 y
    float64 z
  geometry_msgs/Vector3 angular //covariance mtrx diagonal constant
    float64 x
    float64 y
    float64 z
  float64[36] covariance
```

Inso node fills all the variables including covariance matrices. Note that in position covariance matrix, a 3x3 submatrix corresponding to orientation is constant diagonal with 0.2 on the diagonal. Attitude is not processed by Kalman filter, thus, this submatrix is not updated. The same applies for the 3x3 submatrix corresponding to angular twist covariance. Angular rates indicated in the message are a raw copy of the inertial sensor data. Indicated variances are based on the manufacturer specifications and they are not updated.

Topic ***/mechanization\_output\_inso*** is intended for a quick visual verification of the node performance. It uses a non-standard message *inso::inso\_output*:

```
inso/Vector3 position
  float64 x
  float64 y
  float64 z
inso/Vector3 velocity
  float64 x
  float64 y
  float64 z
inso/Vector3 euler
  float64 x      //roll
  float64 y      //pitch
  float64 z      //yaw
```

Note that these coordinates are expressed in NED coordinate frame (y and z axes are inverted).

Topic ***/mechanization\_output\_inso\_aiddebug*** is a temporary debug topic and will be removed from the node.

## Log file structure

The inso node (depending on the parameters set in the launchfile) creates up to 5 distinct log files containing all relevant data inso node works with. File names follow this scheme:

*inso\_gps\_day\_month\_year\_time.csv*

*inso\_mech\_day\_month\_year\_time.csv*

*inso\_odometry\_day\_month\_year\_time.csv*

*inso\_tracks\_day\_month\_year\_time.csv*

*inso\_vpa\_day\_month\_year\_time.csv*

These files are created each time inso node is launched (under condition that logging is permitted by corresponding ros parameter.) The log file structure is as follows:

### GPS log file

One record in the GPS log file is are these two text lines:

```
seconds
latitude longitude altitude
```

### TRACKS log file

This log file records track speeds in this one-line-per-record format:

```
seconds left_track right_track
```

### ODOMETRY log file

Odometry log file provides record of the robot\_driver\_node odometry (one record per 5 lines):

```
seconds
x y z // position
x y z w // attitude quaternion
vx vy vz // velocities
wx wy wz // angular rates
```

## MECHanization log file

This log file contains data relevant to attitude determination. Depending on the "inso\_InternalLogged" parameter, attitude angles determined by the xsens inertial unit are either included into a log record or not:

seconds, acc<sub>x</sub>, acc<sub>y</sub>, acc<sub>z</sub>, gyr<sub>x</sub>, gyr<sub>y</sub>, gyr<sub>z</sub>, roll<sub>inso</sub>, pitch<sub>inso</sub>, yaw<sub>inso</sub>, pitch<sub>xsens</sub>, roll<sub>xsens</sub>, yaw<sub>xsens</sub>

## Velocity Position Attitude log file

This log file contains position, velocity and attitude with variances and aiding vectors values (one record ~ one line):

seconds, v<sub>x</sub>, v<sub>y</sub>, v<sub>z</sub>, var<sub>v<sub>x</sub></sub>, var<sub>v<sub>y</sub></sub>, var<sub>v<sub>z</sub></sub>, x, y, z, var<sub>x</sub>, var<sub>y</sub>, var<sub>z</sub>, roll, pitch, yaw, var<sub>roll</sub>, var<sub>pitch</sub>, ...  
...var<sub>yaw</sub>, aid<sub>v<sub>x</sub></sub>, aid<sub>v<sub>y</sub></sub>, aid<sub>v<sub>z</sub></sub>, aid<sub>x</sub>, aid<sub>y</sub>, aid<sub>z</sub>

where *var* stands for variance = standard deviation squared. Aid stands for aiding vectors used by the Kalman filter as measurements.