

AI-ROX

The enhancement of the A-ROX system with computer vision sensors including AI algorithms



Advanced Navigation Solutions

Application

The AI-ROX system is based on the A-ROX system and extended with a powerful 128-channel LiDAR and a stereo camera, enabling SLAM-based localization for GNSS-denied environments or fully/ partially indoor environments for example. It can be used for ADAS and autonomous vehicle testing, survey and mapping, georeferencing of cameras, and LiDAR sensors, logging of parameters during vehicle tests and machine automation.

Technology

The patented **tightly coupled** sensor fusion algorithms integrate **survey-grade GNSS** raw measurement data (multi-constellation, multi-frequency), **RTK and PPP** (HAS and terrestrial) correction data, **inertial sensor** data (FOG-grade MEMS IMU), **odometry** data, **LiDAR** data and **camera** data for a highly accurate position, velocity and attitude solution, even in challenging GNSS environments. AI based algorithm supports the localization solution for a unique positioning performance.

A powerful forward-backward post-processing engine is available to further enhance the accuracy of the position, velocity and attitude solution with all recorded sensor raw data.

System configuration

The AI-ROX system is built on a new modular hardware platform, delivering improved processing capabilities and upgraded interfaces. The system is configured with three GNSS antennas. The processing units, including two embedded GPU units, are part of the AI-ROX system. A powerful configuration and visualization software is implemented as a **web app**, easily accessible from different kinds of devices, including laptops and tablets. It is directly hosted on the system with no need for installation of software on your device. On top of the local app, a cloud-based fleet management feature is available for controlling all your AI-ROX devices and accessing all sensor data from anywhere.

Interfaces

The AI-ROX system comes with an integrated **5G** module, providing access to RTK and PPP correction data and enabling remote view and system configuration very user-friendly. Further interfaces are Wi-Fi, Gigabit Ethernet, USB-C and up to 4 CAN -FD channels. Trigger events, like wheel ticks, can be fed through the GPIOs into the sensor fusion framework. There are several output formats available with a maximum rate of 200 Hz (1000 Hz optional): ROS 2, NMEA, ACOM and CAN.



Why choose the AI-ROX system?

1 cm

Position

0.01 km/h

Velocity

0.05°

Heading

0.02°

Roll and Pitch



Highly Accurate Navigation

Highly accurate position, velocity and attitude information for ground truth data generation.



AI Inside

Extended accuracy with AI-based algorithms using computer vision sensors to support the localization in GNSS-denied environments.



RTK-PPP Handover

Seamless handover between both technologies depending on available correction source.



HAS + OSNMA Technology

Uses Galileo HighAccuracy Service (HAS) + OSNMA for Precise Point Positioning (PPP) and Integrity.



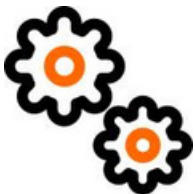
Web App

Web-based user interface for configuration, test-control, fleet management and post-processing.



Easy System Integration

Out-of-the-box working, without measuring lever arms of the system and without the need for additional hardware thanks to integrated 5G modem and NTRIP client v2.



ROS 2

Solution output and interfaces to all GNSS receivers, IMU, vehicle, LiDAR and camera data with ROS 2.



ACOM Data Stream

Compatible with NCOM, fits directly to the OxTS toolchain. Your toolchain does not need to be changed.



Minimal Warm-up Time

1-2min, no dynamic run-in procedure required.



Made in Germany

Development, production, support and repair service in Germany.

Technical Specifications

SENSOR FUSION PERFORMANCE

Accurate RTK Positioning* (1 σ)

Horizontal accuracy	0.006 m $\pm$ 1 ppm
Vertical accuracy	0.010 m $\pm$ 1 ppm

Accurate PPP Positioning* (1 σ)

Horizontal accuracy	0.20 m $\pm$ 1 ppm
Vertical accuracy	0.40 m $\pm$ 1 ppm

Accurate Attitude* (1 σ)

Without dynamic pre-calibration
(2m antenna spacing)

Roll and Pitch	0.100°
True Heading	0.100°

With dynamic pre-calibration

Roll and Pitch	0.020° 0.050° 0.03
True Heading	m/s RMS 1 μ s RMS

Velocity Accuracy

Time-Stamp Accuracy

Solution Output-Rate

up to 200 Hz (1000
Hz optional)

RTK Initialization*

Initialization Time	< 7 s
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PPP Initialization*

Initialization Time	< 4 min
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Slip angle accuracy*

0.15°

FOG-GRADE MEMS IMU FEATURES

Accelerometer

Dynamic range	$\pm$ 10 G
Misalignment	0.01°
Bias Initial Error	2 mG
Bias Repeatability	2 mG
Bias Instability	12 μ G
Bias Velocity Random Walk	0.023 (m/s)/ $\sqrt$ hr
Bias Noise Density (RMS)	60 μ G/ $\sqrt$ Hz

Gyroscope

Dynamic range	$\pm$ 450 °/s
Misalignment	0.01 °
Bias Initial Error	0.1 °/s
Bias Repeatability	0.01 °
Bias Instability	0.8 °/h
Bias Angular Random Walk	0.06 °/ $\sqrt$ hr
Bias Linear Acceleration Eff.	0.005 (°/s)/G
Bias Noise Density (RMS)	0.0013 (°/s)/ $\sqrt$ Hz

GNSS FEATURES

Constellations

Galileo, GPS, Beidou, Glonass
SBAS (EGNOS, WAAS, GAGAN)

Concurrently used Constellations

All

Bands

GPS: L1C/A, L1C, L1PY, L2C, L2P, L5
GAL: E1, E5a, E5b, E5 AltBoc, E6
BDS: B1I, B1C, B2a, B2I, B3
GLO: L1CA, L2CA, L2P, L3
QZSS: L1C/A, L1C, L2C, L5, L6

Channels	448
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GNSS data rate	up to 100 Hz
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Jamming detection	Yes
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Dual/Triple Antenna	Yes
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LIDAR FEATURES

Type: Ouster LiDAR

Model: Ouster (OS1-128, REV7)

Measurement Range:	Mid-range (max. 200 m)
Vertical Resolution:	128 channels
Horizontal Resolution:	512, 1024, or 2048
Rotation rate:	10 or 20 Hz
Field of View (Vertical):	45° (+22.5° to -22.5°)
Field of View (Horizontal):	360°
Angular Sampling Accuracy:	Vertical: $\pm$ 0.01° Horizontal: $\pm$ 0.01°
Range Resolution:	0.1 cm
Operating Temperature:	-40°C to 60°C
Ingress Protection:	IP68 & IP69K

* Depends on environment and used GNSS-Antenna

Technical Specifications

CAMERA FEATURES

Type: Stereolabs ZED GMSL2
Model: ZEDX

Description: A GMSL2 global shutter wideangle stereo - camera with high-performance IMU, external synchronization and integrated depth estimation, localization and object detection features.

Output Resolution: 2x (1920x1200) @60fps,
2x (960x600) @120fps, etc.
Baseline: 120mm
Image Sensor: Size 1/2.6", Global Shutter
IMU: 400Hz 16-bits Acc. and Gyro
Ingress Protection: IP67
Operating Temp.: -20°C to 55°C

GPU UNIT PERFORMANCE

CPU: 12-core Arm Cortex-A78AE v8.2
64bit CPU 3MB L2 + 6MB L3
GPU: 2048-core NVIDIA Ampere arch.
GPU with 64 Tensor Cores
Memory: 64GB 256bit LPDDR5 204.8GB/s
Storage: 64GB eMMC 5.1 + M.2 SSD-
Storage with 2 TByte
OS: Linux / NVIDIA JetPack SDK

Description: Used to interface camera and LiDAR sensors and as high-throughput data storage. Enables real-time processing, for object detection, semantic segmentation and SLAM for example.

INTERFACES

Output Format

Standardized NMEA format, ROS 2
Proprietary ANavS binary format, ACOM

Storage 32 for A-ROX,
2x 2TB for GPU units

Communication

Gigabit Ethernet
Wi-Fi
4G or 5G 2x2 MIMO cellular network
Up to 4 CAN-FD channels
USB 3.1
4 GPIO, PPS and Sync-in

Powering

Variable input voltage

PHYSICAL & ENVIRONMENTAL

Dimension 784x858x323 mm
Weight 8.5 kg

Input voltage
Nominal 12 - 24 V

Power Consumption
Peak 60 W
Average 30 W

Operating Temperature -20 to 65°C
IP-Rating IP65