Application
The A-ROX GNSS-INS tightly coupled positioning is the real-time ground truth measurement equipment for dynamic automotive, railway and maritime applications. It is used for ADAS and autonomous vehicle testing, endurance tests, fleet tests, survey and mapping from land, water and air, georeferencing of cameras, lidars and radar 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) and odometry data for a highly accurate position, velocity and attitude solution, even in challenging GNSS environments. A smart handover from RTK to PPP technology, based on the reception of correction data, provides 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 raw sensor data.

System configuration
The A-ROX system is built on a new modular hardware platform, delivering improved processing capabilities and upgraded interfaces. The system can be configured with single, dual or triple GNSS antenna(s). The processing unit is part of the A-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 A-ROX devices and accessing all sensor data from anywhere.

Interfaces
The A-ROX system comes with an integrated 5G module, providing access to RTK and PPP correction data and enabling remote view and system configuration user-friendly. Further interfaces are WiFi, 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 outputs available with a maximum rate of 200 Hz (1000 Hz optional): ROS 2, NMEA, ACOM and CAN.
Why choose the A-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.

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

Easy System Integration
Out-of-the-box working without the need for additional hardware thanks to integrated 5G modem and NTRIP client v2.

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

Breakthrough Pricing
Best value for your money in its class.

RTK-PPP Handover
Seamless handover between both technologies depending on available correction source.

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

ROS 2
Solution output and all GNSS, IMU and vehicle sensor raw data are accessible with ROS 2.

Minimal Warm-up Time
1-2 min, no dynamic run-in procedure required.

Made in Germany
Development, production, support and repair service in Germany.
## SENSOR FUSION PERFORMANCE

### Accurate RTK Positioning* (1σ)
- Horizontal accuracy: 0.006 m ± 1 ppm
- Vertical accuracy: 0.010 m ± 1 ppm

### Accurate PPP Positioning* (1σ)
- Horizontal accuracy: 0.20 m ± 1 ppm
- Vertical accuracy: 0.40 m ± 1 ppm

### Accurate Attitude* (1σ)
- 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°
  - True Heading: 0.050°

### Velocity Accuracy
- 0.03 m/s RMS

### Time-Stamp Accuracy
- 1 µs RMS

### Solution Output-Rate
- up to 200 Hz (1000 Hz optional)

### RTK Initialization*
- Initialization Time: < 7 s

### PPP Initialization*
- Initialization Time: < 4 min

### Slip angle accuracy* 0.15°

## FOG-GRADE MEMS IMU FEATURES

### Accelerometer
- Dynamic range: ±10 G
- Misalignment: 0.01°
- Bias Initial Error: 2 mG
- Bias Repeatability: 2 mG
- Bias Instability: 12 µG
- Bias Velocity Random Walk: 0.023 (m/s)/√hr
- Bias Noise Density (RMS): 60 µG/√Hz

### Gyroscope
- Dynamic range: ±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 °/√hr
- Bias Linear Acceleration Eff.: 0.005 (°/s)/G
- Bias Noise Density (RMS): 0.0013 (°/s)/√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

### GNSS data rate
- up to 100 Hz

### Jamming detection
- Yes

### Dual/Triple Antenna
- Yes

## PERFORMANCE SPECIFICATION WITHOUT GNSS AFTER 60 sec

### Real-time
- Horizontal accuracy (RMS): 1.00 m
- Vertical accuracy (RMS): 1.50 m
- Roll & Pitch (1σ): 0.04°
- True Heading (1σ): 0.20°
- Velocity (RMS): 0.10 m/s

### Postprocessing
- Horizontal accuracy (RMS): 0.10 m
- Vertical accuracy (RMS): 0.20 m
- Roll & Pitch (1σ): 0.03°
- True Heading (1σ): 0.10°
- Velocity (RMS): 0.07 m/s

* Depends on environment and used GNSS-Antenna
## Technical Specifications

### INTERFACES

<table>
<thead>
<tr>
<th>Output Format</th>
<th>Standardized: NMEA format, ROS 2</th>
<th>Proprietary: ANavS binary format, ACOM</th>
</tr>
</thead>
<tbody>
<tr>
<td>Storage</td>
<td>32 GB, expandable up to 2 TB</td>
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</table>

#### 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

### PHYSICAL & ENVIRONMENTAL

<table>
<thead>
<tr>
<th>Dimension</th>
<th>200 x 123 x 60 mm</th>
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<tbody>
<tr>
<td>Weight</td>
<td>1.2 kg</td>
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#### Power Connector
- LEMO connector
- USB-C Power Delivery (12-20V/3A)

#### Input voltage
- Absolute: 9 - 36 V
- Nominal: 12 - 24 V

#### Power Consumption
- Peak: 20 W
- Average: 13 W

### ADDITIONAL HIGHLIGHTS

- **Highly adaptive and flexible** for different needs due to its modular, M.2 card-based configuration structure
- **GNSS Sensors:**
  - Up to 3 Survey-Grade GNSS receivers for precise Attitude Determination
  - Raw data available of all receivers (with up to 100 Hz)
  - PPS Signal available
- **GPIOs**
  - 4 configurable inputs or outputs to read in additional sensors, use event trigger or output status information
  - Wheel tick input (odometry) for improved sensor fusion performance
- **Precision-Time-Protocol (PTP)** PTP-Master time server to synchronize all your systems in your network
- **NTRIP** Already included NTRIPv2 Client to stream RTK (RTCM 3, OSR) or PPP (RTCM3, SSR) correction data
- **DAkkS calibration** Supplied with dynamic DAkkS calibration
- **No cable chaos** One unit - all functions ready
- **ITAR-free** Not export restricted by US ITAR regulations
- **Intuitive and simple handling** No modems or other external devices required

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DS-AROX-2024-05-21