

Ground Vehicle Navigation

INTO 2019

JUSSI COLLIN – NORDIC INERTIAL

29 NOVEMBER 2019

Definitions

Navigation

- Determining position and velocity
- Planning and maintenance of a course from A to B
 - Avoid traffic

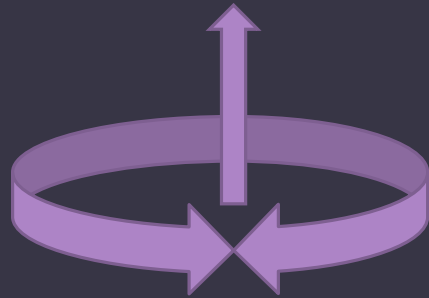
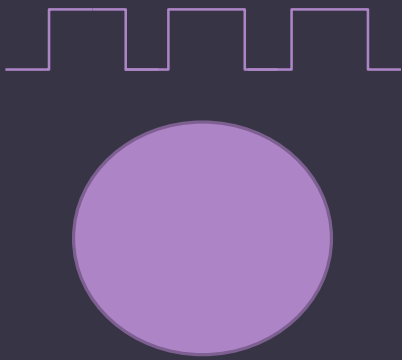
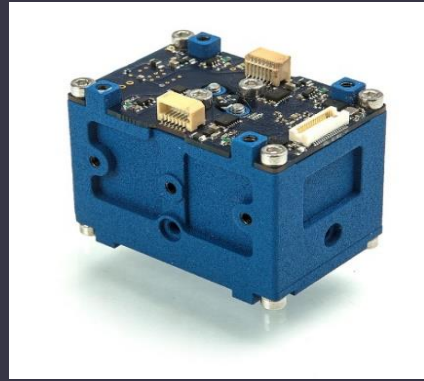


Ground Vehicle

- Vehicles that are supported by the ground
 - Not water or air
 - Typically at least two contact points
 - Tracked / wheeled



Position and Velocity I – Built In



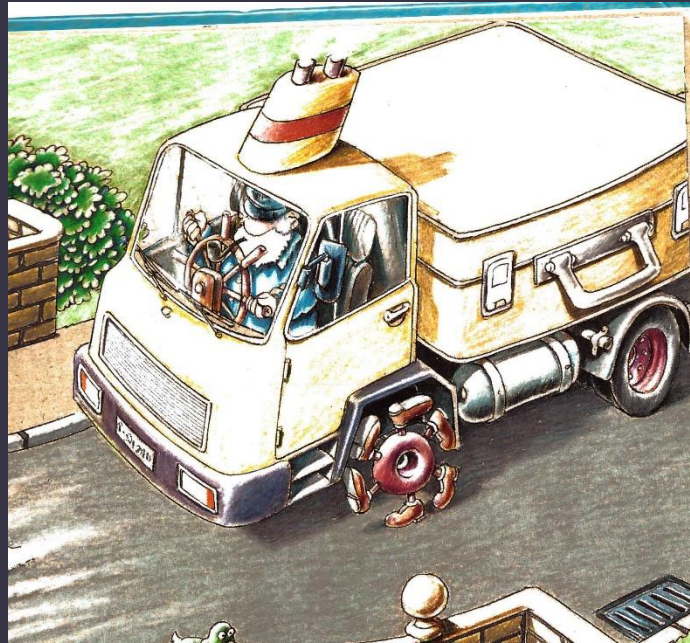
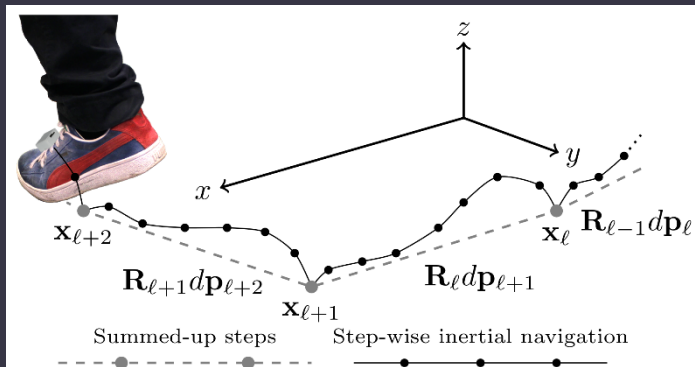
Position and Velocity II – On Top



Position and Velocity III – Wheel Mounted



Wheel-Mounted INS



Gyroscopes are self-calibrated by wheel rotation

Wheel contact point gives the speed to the filter

Completely independent of vehicle – INS of its kind

History

2013



↑
First "soldered on-the-knee" unit

2015



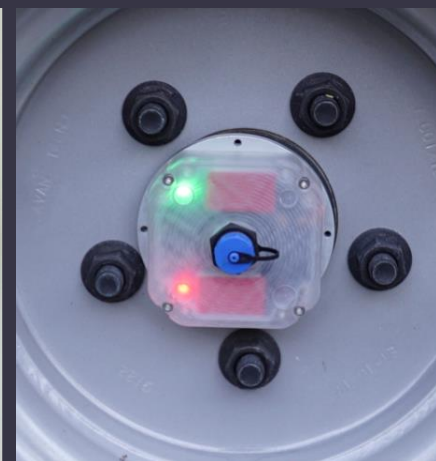
↑
First wireless unit with charging capability

2017



↑
The "horse-shoe" design for 2-wheel vehicles

2019



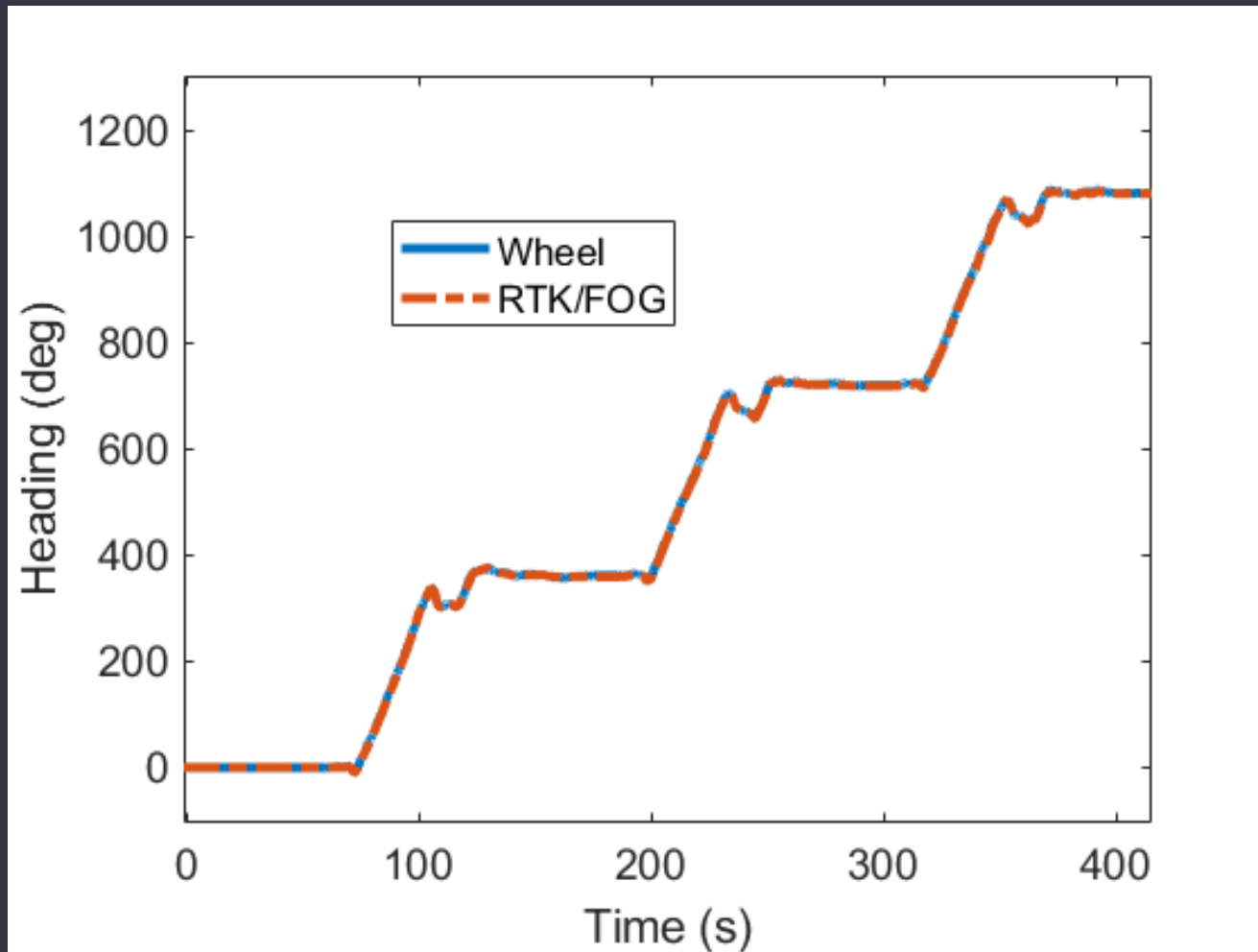
↑
Real-time operating unit, BT connectivity, hi-rate data logging to embedded SD card

2020

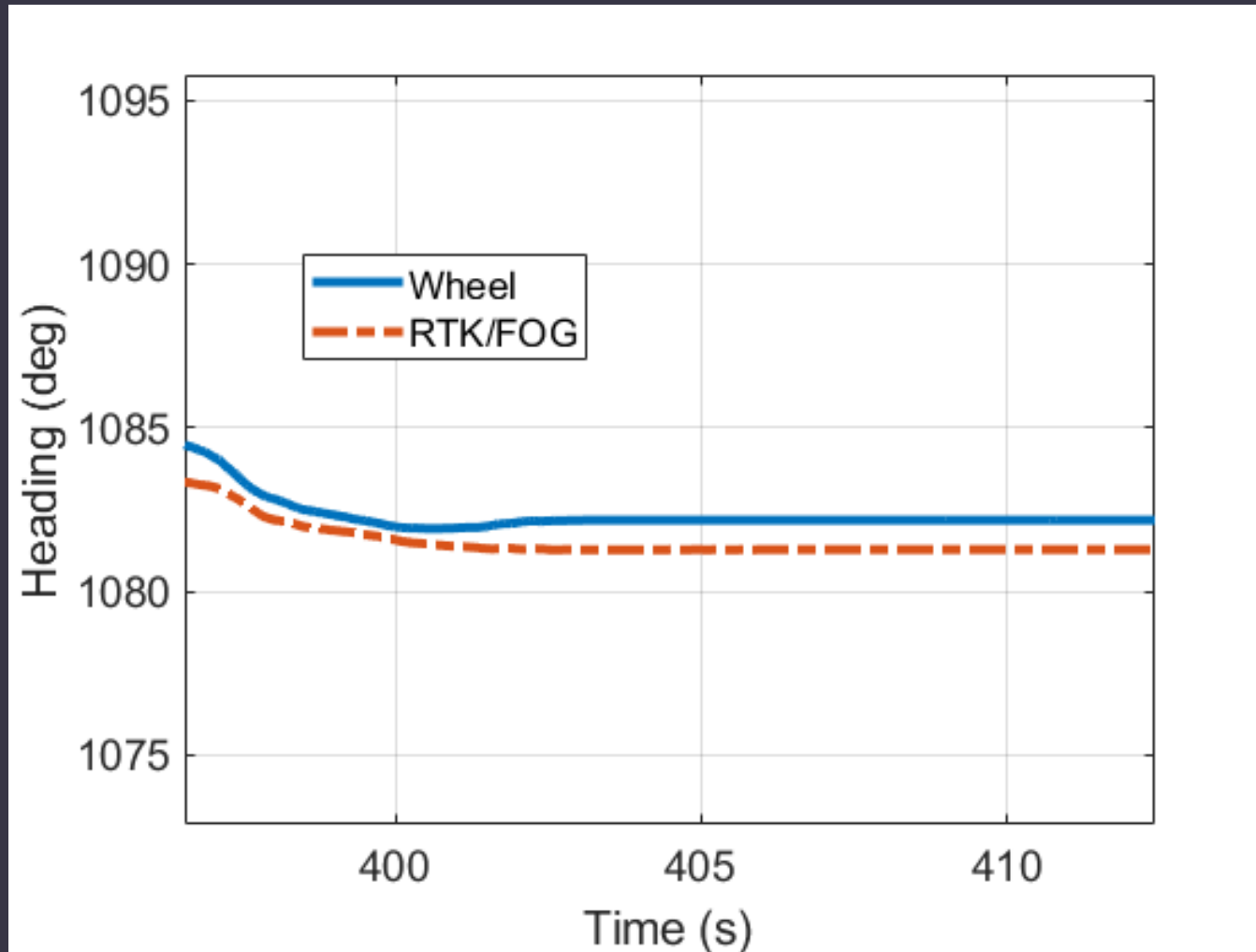


↑
Rugged, 1 month battery

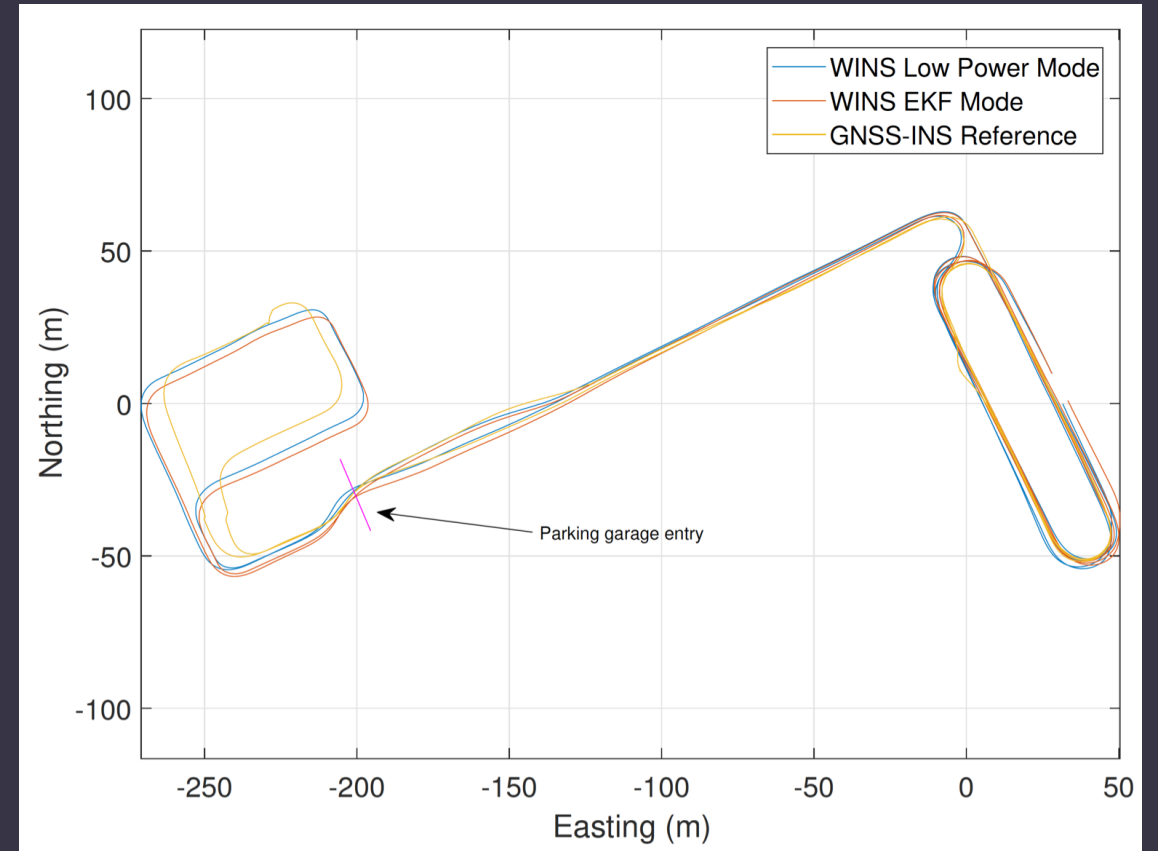
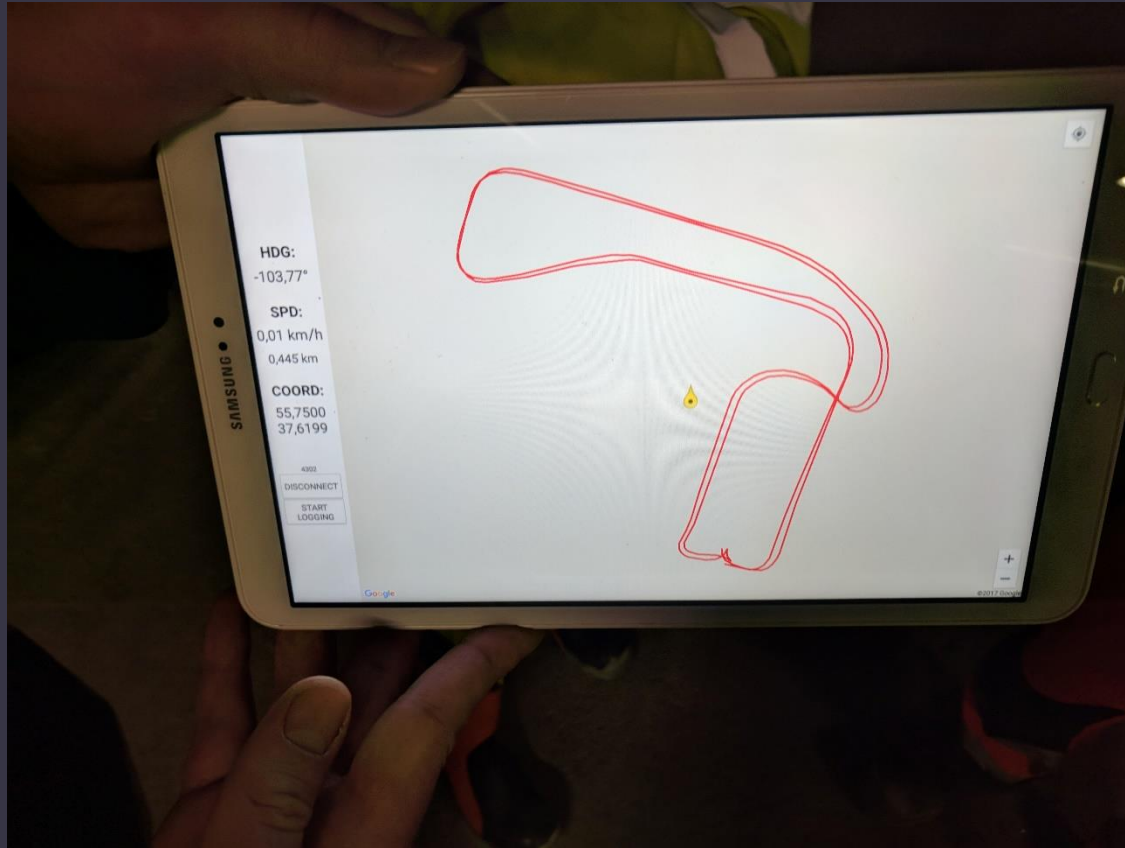
Performance



Performance

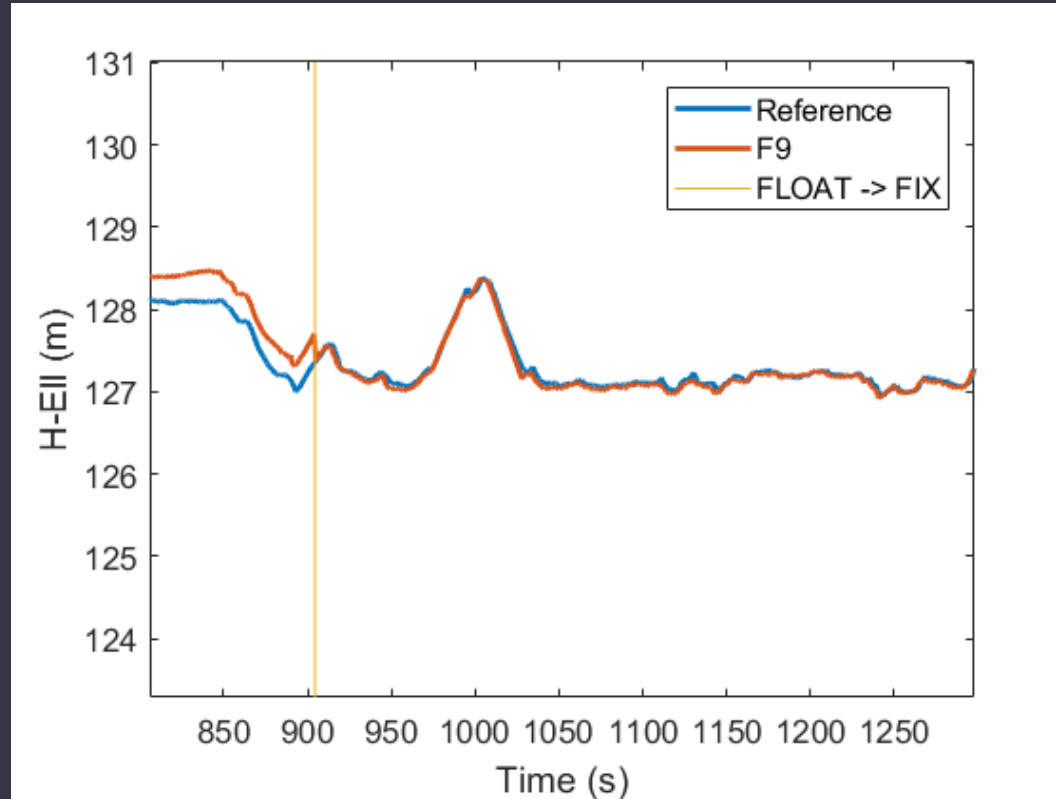
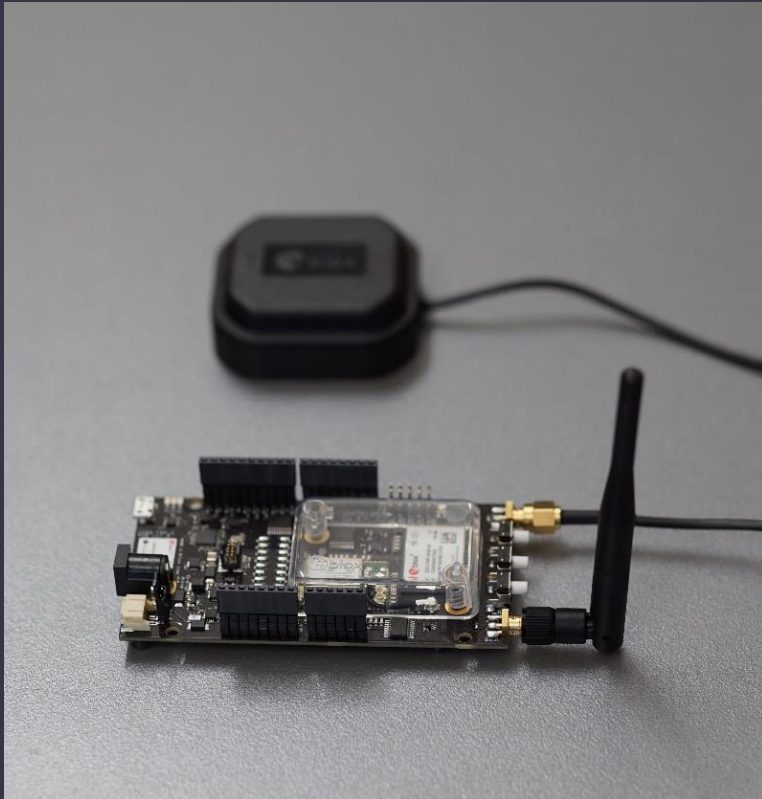


Performance



Compares to standalone GPS for 15-30 minutes

GNSS Integration – u-blox F9P



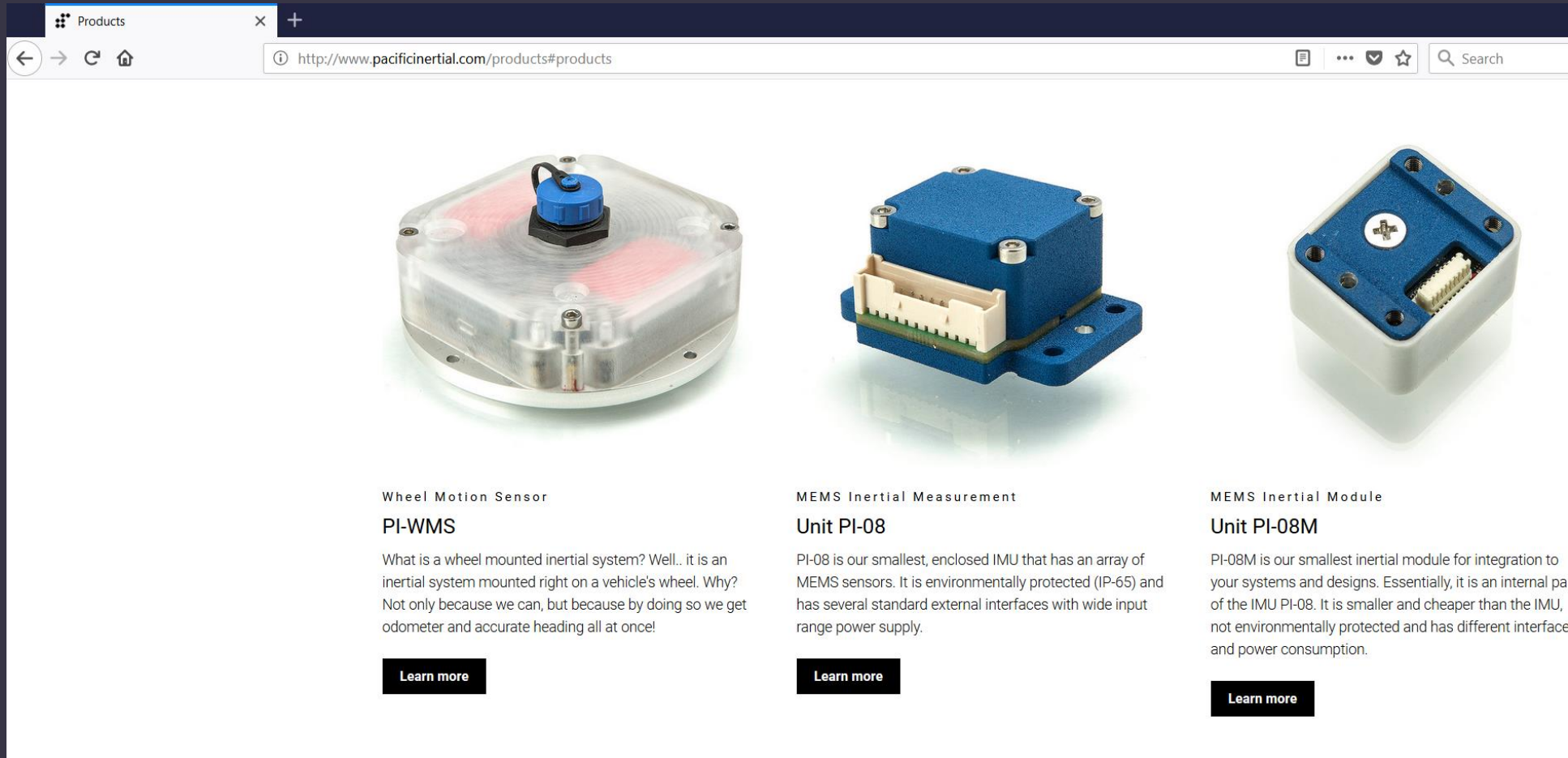
- Fast convergence
- 2-5 cm in Fixed mode
- Low-cost

GNSS Integration – Inertial Explorer



Devices available – Easy to try!

1 day battery, 1 month battery coming soon



The screenshot shows a web browser window with the URL <http://www.pacificinertial.com/products#products>. The page displays three product listings:

- Wheel Motion Sensor PI-WMS**: A clear, square-shaped sensor with a blue cap and red internal components. Description: "What is a wheel mounted inertial system? Well.. it is an inertial system mounted right on a vehicle's wheel. Why? Not only because we can, but because by doing so we get odometer and accurate heading all at once!"
- MEMS Inertial Measurement Unit PI-08**: A blue, rectangular sensor with a white connector. Description: "PI-08 is our smallest, enclosed IMU that has an array of MEMS sensors. It is environmentally protected (IP-65) and has several standard external interfaces with wide input range power supply."
- MEMS Inertial Module Unit PI-08M**: A blue and white rectangular sensor with a white connector. Description: "PI-08M is our smallest inertial module for integration to your systems and designs. Essentially, it is an internal part of the IMU PI-08. It is smaller and cheaper than the IMU, not environmentally protected and has different interface and power consumption."

Each product listing includes a "Learn more" button.

Videos & Questions

YouTube Links

<https://www.youtube.com/watch?v=TPZxIgu3wyw> Wheel Inertial

<https://www.youtube.com/watch?v=npOar7MrRDM> 3D map-matching

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Image sources:

2 https://en.wikipedia.org/wiki/Traffic_congestion#/media/File:Moscow_traffic_congestion.JPG

3 <https://www.amazon.com/Car-Antenna-Shark>

[https://en.wikipedia.org/wiki/Anti-](https://en.wikipedia.org/wiki/Anti-lock_braking_system#/media/File:ABS_Sensor_GM_IMG_0557.JPG)

[lock_braking_system#/media/File:ABS_Sensor_GM_IMG_0557.JPG](https://en.wikipedia.org/wiki/Anti-lock_braking_system#/media/File:ABS_Sensor_GM_IMG_0557.JPG)

www.pacificinertial.com

<https://www.u-blox.com/en>

4 uber test car

6 openshoe.org

Butschkow, Ralf, Da stimmt doch was nicht, Baumhaus Verlag GmbH, 2011

12 Google Earth

Others JC Inertial Oy (Nordic Inertial)

