UNIVERSITY OF MINNESOTA
Driven to Discover℠

Vision-aided Inertial Navigation System (VINS) for 3D Ground Vehicle Localization (20180123)

IP Status: US Patent Issued, Continuation filed; **Patent, Application #:** 11,940,277, 19/258,726

Accurate 3D ground vehicle localization

A new Vision-aided Inertial Navigation System (VINS) method performs ground vehicle localization in 3D space. This technology allows 3D localization on surfaces for wheeled vehicles such as ground robots and autonomous driving cars. The new VINS method incorporates low-frequency wheel-encoder data that renders the scale observable. A hardware-based processor uses camera image data, inertial measurement unit (IMU) data and odometry data indicative of scale information to estimate the VINS position and orientation.

Significantly higher positioning accuracy

Existing ground vehicle localization methods are restricted to only 2D localization. Attempts to improve accuracy in 3D ground vehicle localization leveraged recent advances in vision-aided inertial navigation systems (VINS). However, the VINS technology suffered unexpected performance degradation due to unobservable directions caused by certain restricted motions of ground vehicles (e.g., straight-line motion or lack of rotational motion). This new technology addresses the degradation issue and improves localization accuracy in 3 dimensions (x,y,z) when applied on ground vehicles. It applies to all VINS estimators that 1) apply a stochastic constraint that constrains motion to a manifold (e.g., a plane) and 2) incorporate odometry information (e.g., wheel encoder data). Using additional sources of information, this system achieves significantly higher positioning accuracy while operating in real-time on a commercial-grade mobile device.

Phase of Development

- Prototype dev. Working prototype demonstrated on commercial-grade platforms tested in both indoor and outdoor environments.

Benefits

- Improved accuracy in 3-dimensions (x,y,z) as compared to standard VINS localization for ground vehicles
- Stochastic constraint robustly compensates for vibrations of robotic platforms
- Achieves significantly higher positioning accuracy
- Operates in real-time on commercial-grade mobile devices

Features

- Vision-aided Inertial Navigation System (VINS)
- Ground vehicle localization in 3D space
- Low-frequency wheel-encoder data renders scale observable
- Hardware-based processor

Technology ID
20180123

Category
Engineering & Physical Sciences/Robotics
Engineering & Physical Sciences/Transportation
Software & IT/Transportation

View online page

Applications

- Robotics, ground robots
- Autonomous vehicles
- Module on mobile device/robot

Desired Partnerships

This technology is now available for:

- License
- Sponsored research
- Co-development

Please contact TLO to share your business' needs and learn more.

Researchers:

Stergios Roumeliotis, PhD, Professor, Computer Science & Engineering

Chao Guo, Google

Georgios Georgiou, Cruise Automation