KOZUMA Lab

Research for Non-GPS Navigation

Quantum Navigation Unit

www.qnav.iir.titech.ac.jp/en/

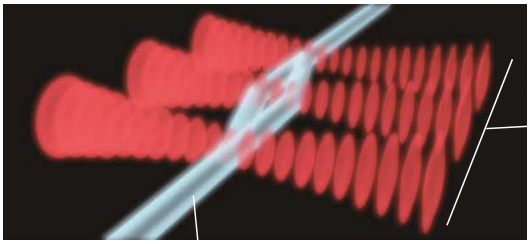
- quantum navigation
- inertial quantum sensor
- quantum electronics

The introduction of satellite navigation, particularly GPS, has resulted in the stabilization of ship and aircraft operations for marine vessels, public shipping devices, and all land-based traffic systems. However, the navigation precision under the ground or water is much worse than the case on the ground level since we can not utilize the satellite positioning system. Even on the ground surface, there are various problems such as jamming or spoofing, threatening our safety and security. This research unit develops and implements cutting-edge technology covering classical to quantum areas and aims to establish revolutionary navigation technology to expand the human being's active region to the underwater or deep space. Furthermore, cutting-edge navigation technology is fully utilized and pioneered for examining the inner regions of the Earth, thereby assisting in the prevention and reduction of the effects of natural disasters and developing new applications for the practical use of navigation sciences.

Research for Non-GPS Navigation Underwater, Underground, and Outer Space Regions

Inertial navigation using accelerometers and gyroscopes is a typical example of a non-GPS navigation. Currently, the precision of inertial navigation is limited by the performance of the gyroscope. The ultra-precise gyroscope can be developed using a quantum interferometer, where three optical standing waves are used to split, reflect and combine a cold atomic beam.

atom interferometer gyroscope



Cold atomic beam

Three optical standing waves