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Active Optical Positioning

Indoor Positioning of Vehicles using an Active Optical Infrastructure

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ABSTRACT

Indoor positioning is an enabling technology for advanced intra-logistic applications that employ tracking and tracing of goods and vehicles. For these applications, a positioning technology must offer a sufficient trade-off between accuracy, range, and costs. In this paper we present a novel 4-degree-of-freedom (4-DOF) positioning system based on optical technologies that is designed for tracing vehicles in a logistic environment. The major innovations of the system are an active optical infrastructure allowing absolute positioning without any other data source, and, on the receiver side, a hybrid data processing approach that combines signal and image processing. Using these optical technologies, a high accuracy can be achieved at lower costs compared to other approaches.

The positioning system consists of an active optical infrastructure and multiple mobile receivers. A network of beacons transmits position signals via infrared channel to the mobile receivers. The position signals carry both the absolute beacon position and the transmit direction related to the beacons. The mobile receiver detects the contents, transmission direction and angle of arrival of the position signals utilizing a hybrid photo detector and image sensor device. Given two beacons within line of sight, the receiver can autonomously derive the absolute pose in a global coordinate system.

We determined the accuracy of the positioning system in both the static and dynamic case. For accuracy measurements we utilized a programmable robot that controls the receiver´s pose, movement and acceleration. The static positioning error is below 0.1 m while the dynamic error highly depends on the velocity and acceleration profile used. These dynamics can be handled by using a dynamic model of the vehicle and Kalman filtering.

The active optical positioning approach joins signal and image processing technologies to a low-cost and high accuracy system. While designed for intra-logistic applications the technology can be adopted other fields such as building and shop-floor navigation.

KEYWORDS: Optical Positioning; Active Infrastructure; Data Transmission; Signal Processing; Image Processing