External Localization System based on Galvanometer-Laser-Scanning for numerous Mobile Tags (GaLocate)

Jan Kokert, Fabian Höflinger and Leonhard M. Reindl
Department of Microsystems Engineering - IMTEK
University of Freiburg, Germany

Abstract

Automation in production has increased significantly in recent years. Indoor localization of autonomous transport vehicles (ATVs) operating in production areas is more complex than operation in high rack storages. Commonly ATVs localize themselves using laser line scanners and mapping-algorithms (SLAM). Difficulties occur in either highly dynamic or very regular environments and self-localization always implies high costs for each robot.

In this paper we present a new external localization system based on galvanometer laser scanning. The main purpose of the system is to provide two dimensional localization data pure optically for each robot at low cost and low set-up efforts. Consequently the robots are equipped with small retro-reflective tags which are detectable to a laser scanner mounted on the ceiling of the production hall (a).

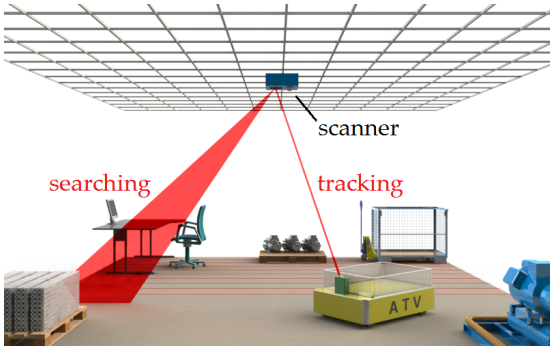
The laser beam is moved by two galvanometers in a fixed pattern through the hall by default. The angles of the laser beam deflection are transmitted via high-speed infrared communication to all mobile tags. Once the scanner receives a reflection from a tag, it scans this area again with maximum resolution. In the center of the reflector is a small photo diode which is read-out by a high-speed burst mode amplifier. During the scanning process this photo diode will determine the exact point in time of laser beam crossing and hence links the infrared position data to the tag.

All key components of the system were tested successfully. The galvanometers achieve 60,000 ILDA patterns per second. The detection of sub-microsecond pulses of modulated laser light was validated. Furthermore the infrared communication meets the speed requirements and reaches a distance of 10 meters. For demonstration a small receiver tag with an LCD displaying the localization data was built (b).

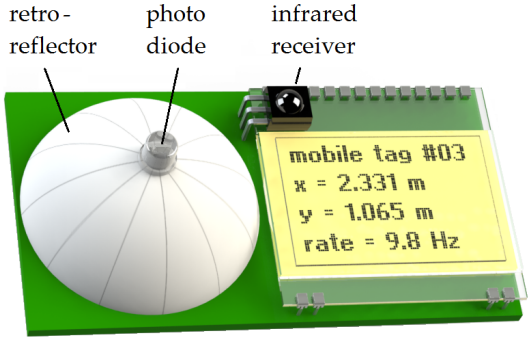
As a result searching for new tags and tracking of known ones enables external laser localization at maximum performance. Due to high precision galvanometers and small photo diodes the system resolution exceeds to several hundred micron.

Keywords

External localization system, multi-target, laser-scanning, burst mode receiver



(a) GaLocate in a production hall



(b) Mobile tag for demonstration