HÖGSKOLAN
I HALMSTAD

Sektionen för informationsvetenskap, data- och elektroteknik

Obstacle Detection for Driverless Trucks in Industrial Environments

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Akademisk avhandling som för avläggande av teknologie licentiatexamen vid Högskolan i Halmstad försvaras offentligt onsdagen den 10 september 2014, kl. 13.15 i Haldasalen, Visionen, Högskolan i Halmstad.

Avhandlingen försvaras på engelska.

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Abstract

With an increased demand on productivity and safety in industry, new issues in terms of automated material handling arise. This results in industries not having a homogenous fleet of trucks and driven and driverless trucks are mixed in a dynamic environment. Driven trucks are more flexible than driverless trucks, but are also involved in more accidents. A transition from driven to driverless trucks can increase safety, but also productivity in terms of fewer accidents and more accurate delivery. Hence, reliable and standardized solutions that avoid accidents are important to achieve high productivity and safety.

There are two different safety standards for driverless trucks for Europe (EN1525) and U.S. (B56.5–2012) and they have developed differently. In terms of obstacles, they both consider contact with humans. However, a machinery-shaped object has recently been added to the U.S. standard (B56.5–2012). The U.S. standard also considers different materials for different sensors and non-contact sensors.

For obstacle detection, the historical contact-sensitive mechanical bumpers as well as the traditional laser scanner used today both have limitations – they do not detect hanging objects. In this work we have identified several thin objects that are of interest in an industrial environment. A test apparatus with a thin structure is introduced for a more uniform way to evaluate sensors.

To detect thin obstacles, we used a standard setup of a stereo system and developed this further to a trinocular system (a stereo system with three cameras). We also propose a method to evaluate 3D sensors based on the information from a 2D range sensor. The 3D model is created by measuring the position of a reflector with known position to an object with a known size. The trinocular system, a 3D TOF camera and a Kinect sensor are evaluated with this method. The results showed that the method can be used to evaluate sensors. It also showed that 3D sensor systems have potential to be used on driverless trucks to detect obstacles, initially as a complement to existing safety classed sensors.

To improve safety and productivity, there is a need for harmonization of the European and the U.S. safety standards. Furthermore, parallel development of sensor systems and standards is needed to make use of state-of-the-art technology for sensors.