

Automated Driving on a Skid Road with a Forwarder in a CTL Logging Process

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ABSTRACT

In a fully mechanized Cut-to-Length (CTL) logging process, a harvester fells the trees and cuts them into logs of specific length according to the log quality. In the subsequent process step, a forwarder loads the logs and moves them from the logging area to a forest road. This step shows a huge potential towards automation. Within this paper, a method is presented for driving a forwarder automated on a skid road based on environmental recognition, avoiding the disadvantages of gps-based systems and their lacking accuracy under tree canopy. The presented method exploits the process flow of a CTL process, as a Lidar is mounted on the harvester, which delivers a highly accurate point cloud of the environment and works well regardless of the lighting conditions.

Applying the SLAM-algorithm ‘Google Cartographer’ on the collected point cloud data of the 3D-LIDAR from the Harvester creates a map, on which an offline path planning is performed. This map results firstly in a 2D occupancy grid map, showing which areas contains objects and which areas are free space. The data in the map is further processed by identifying trees using a clustering algorithm on the object points. After receiving such a simplified map, the subsequent path planning consists of two steps due to the articulated steering of the forestry machine. In the first step, a guiding path for the skid road is created by using gradient descent after creating an artificial potential field with a high potential for areas containing trees. In the second step, this path is recalculated with a simplified kinematics model of the vehicle, avoiding collisions of the forwarder with the trees adjacent to the skid road. Furthermore, the calculated path contains the steering and heading angles of the vehicle. Based on this information, the necessary steering angle of a vehicle on the map can be calculated online and sent to the machine control.

The presented method was proven simulation-based with measurement data recorded at real logging sites during thinning and will be tested under real working conditions for an 11-ton forwarder in near future. Thereby, a stump detection based on a Convolutional Neural Network resulting in an online obstacle avoidance system will be implemented by mounting an additional depth camera on the Forwarder.