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Decentralized Localization in Asphalt Construction Site – Master Thesis

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Contact: Daniel Nellen
Tel.: +41 62 916 65 05
E-Mail: daniel.nellen@ammann.com

Ammann Schweiz AG | Eisenbahnstrasse 25 | 4901 Langenthal | Schweiz
Tel. +41 62 916 61 61 | Fax +41 62 916 64 02 | info.aag@ammann-group.com

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1 Project Background

The Ammann Group is a worldwide leader in the manufacture of mixing plants, machinery, and services in the construction industry, with core competence in road construction and landscaping as well as in the transport infrastructure. Besides the development and construction of road construction machinery, digital services and software solutions are key in the successful product portfolio of Ammann.

Ammann forms together with other independent industry partners the Autonomous Operations Cluster (AOC), in which the focus lies to develop autonomous and operator assistant functionalities. Autonomous operation of a compaction machine on a road construction gets increased attraction, and several developments are currently being carried out to automate different working tasks in the whole compaction process. To proceed towards autonomous driving the short-term target would be to offer the operator various driving assistants on a road construction site.

The road construction site consists normally of one paver laying out fresh asphalt on the ground, which in the following lines is called leader, and one or multiple rollers carrying out the compaction work behind the paver, called follower unit(s). The roller(s) are driving forth and back multiple times trying to achieve optimal compaction.

One of the driving assistants Ammann is focusing on is the virtual lane assistant. This assistant would consist of autonomously following lanes on an “empty” street without marked lines by using both road borders as reference including obstacle detection.

2 Project Description

Autonomous drive operations these days require multiple sets of sensor data both for sensor validation and accuracy. There exist many different approaches how to collect information about every machine’s environment. Though generally said applying sensor fusion to lidar sensors and cameras provides good precision in terms of environment mapping and object detection / classification. Due to the high economical costs of such sensor groups, that would be required on each machine, it is quite difficult to use such products for driving assistants as a first step for market introduction.

Said this, the project idea would consist of using a larger and complex sensor set on the leader, allowing to acquire the environment and all relevant information at a high detailed level being able to do the global localization. This would allow using a simpler sensor set on the follower(s), which will allow the follower(s) to localize themselves in the map acquired, prepared, and shared by the leader. This localization will allow to enable the virtual lane assistant on the follower(s).

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3 Task Description

Based on already gained experience and available knowledge focus can be laid on different tasks. However, the main goal would be to touch different areas, from HW sensor interface to communication, software programming and localization algorithms. Software programing will be done using ROS2 and C/C++ and python.

- Selection of suitable sensor sets for leader and follower according to available performance and economic criteria
- Positioning of chosen sensor set on machines
- Implementation of data collection and data processing on leader
- Selection of secure data communication channel and definition of machine-to-machine communication
- Implementation of data transfer algorithm and data volume optimization (e.g. data sync at start-up, continuous global map data update)
- Implementation of localization algorithm on follower by using global map / data from leader
- Implementation of SW algorithms on Nvidia Jetson AGX Javier (e.g. Syslogic IPC RxLA3)

4 Your Profile

- highly motivated and excited to work in a multi-domain project
- able to work autonomously
- able to work in a team and goal oriented
- practical experience in programming (C++, python)
- experience with ROS2 / SLAM algorithms or interest in learning and applying it
- practical experience with Linux is an advantage
- interest in mobile machinery and interest in hands-on with hardware and end-product

5 Your Benefits

- introduction of the newest technology into the off-highway sector
- contacts to various project partners within the autonomous operations cluster
- working on a real-life problem and contributing to increased road quality
- hands on a real prototype machine
- support and collaboration with a world-wide operating company
- insights into agile and global software development methods
- technical exchange with an experienced team from company side

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