5. Summary

In the growing field of Autonomous transportation, safety still remains an important issue to be addressed. This work focuses on developing a system to improve safe door operation in autonomous shuttles. The proposed door safety control system uses the LiDAR data from the LiDAR sensors that are already installed on the shuttle to determine the safety of door operation. The proposed door safety control system was developed and tested on the TalTech ISEAUTO shuttle.

The oor safety control system is designed to have two main functional blocks, LiDAR point cloud processing and the door safety service. The LiDAR point cloud processing involves processing raw LiDAR data from the LiDAR sensors by performing various operations on them to extract useful data that can be used as input for the door safety service. The system uses the Robot Operating System (ROS) implementation of the Point Cloud Library (PCL) for processing LiDAR point cloud. PCL serves as a powerful tool in converting the raw data captured by the LiDAR sensors into meaningful information that the system can interpret. By utilizing PCL's functionalities, such as point cloud filtering and feature extraction, the system can effectively analyze the surroundings of the shuttle in real-time.

The door safety service is developed within the ROS framework to enable seamless integration and communication with the shuttle's autonomous stack, which is also ROS-based. The system uses various ROS components like topics, nodes, and services. In order to determine safety for door operation, different safety zones are defined around the shuttle. The safety logic is present inside a ROS service and every time there is a request for door operation, the service gets called. The service then analyses the safety zones to determine whether it is safe enough to perform the door operation, then gives a corresponding response.

During the initial stages of development, the door saety control system was tested using ROS bag files by simulating LiDAR data and commands from vehicle controller. After the development process, the system was tested and validated on the shuttle using real-time LiDAR data. The testing process included demonstrating various scenarios using a real person and then observing the output from the system. The system was able to accurately determine the safety for each scenario and provide the correct response. The test results prove that the proposed door safety control system is able to perform in a efficiently and reliably.