Designing and Implementing a Model Vehicle Platoon With Longitudinal Control

Axel Keskikangas and Gustav Sällberg

Lund University, Lund
ada09ake@student.lu.se
ada09gor@student.lu.se

Abstract

As environmental concern is growing along with internal combustion engines getting more efficient and harder to improve other means to reduce fuel consumption are desired. One method is platooning where several vehicles are grouped together in a platoon through wireless communication and smart control strategies. This allows vehicles to travel closely together with reduced air drag and lower fuel consumption.

One field where this concept would be well applicable are in long haulage. Scania is currently working on this subject and have requested a desire to be able to demonstrate the workings of a platoon on model scale vehicles. As a result of this, RC controlled models where used to createo a demonstration platoon where the distance can be controlled. The full extent of the project is given in [1].

I. The Model Vehicles

The main difference between this project and other platooning project are the vehicles. Working with small model vehicles, which are made to be used mainly as RC toys, means that there are no existing speedometer or cruise control present as full size vehicles would have. The control of the throttle is also a lot less sophisticated.

Figure 1: Fully modified RC vehicle with added sensors

This meant that the RC vehicles had to be fitted with sensors for speed and distance to other vehicles as well as the throttle of the DC motor powering the vehicles had to be redesigned.

II. Communication

As earlier mentioned platooning is made possible by having some sort of communication between vehicles. When looking at full size vehicles there are specific protocols and wireless standards for this such as WAVE and 802.11P. In our case the vehicles were to be driven in an indoor environment where regular WiFi was accessible and used as communication method.

The communication between vehicles is done by each vehicle communicating its data to all other vehicles, which in their turn are listening for incoming data as well as sending their own. This was deemed to be the best strategy during an evaluation performed in the project. The effects of lost communication was also looked into where it could be concluded that the loss rate of a normal WiFi network is far from high enough to cause any problems to the control of the platoon.

III. Control

In order to control the distance of the vehicles engaged in the platoon different control algorithms were designed and tested.

First a cruise controller was designed to be able to automatically control the vehicle's speed. This system is considerable different from that of a real vehicle as the inertia of a real size vehicle would make it a slower system.

With the cruise control finished the project moved on to design the distance control. Here two different approached were tried out. First each vehicle would measure its distance to the vehicle in front, compare it to the reference distance it is supposed to keep and the calculate whether it should go faster or slower than the vehicle in front and by how much. Finally this data is combined with the measured speed of the vehicle in front and the reference speed is set. The other approach were to combine all measured distances and speeds in the platoon to calculate the optimal speed for each individual vehicle based on desired speed and distance.

IV. Results

With all implementations in place a physical model vehicle platoon of two vehicles were presented. The distance were controlled fairly well and any response to a change in the reference distance to be kept was fast.

In the comparison between the two distance control strategies no major difference were noted on two vehicles. There was, however, a pattern where the more sophisticated controller taking all vehicles in account would perform better than the simpler approach as more vehicles were introduced to the platoon.

References

[1] Keskikangas, A., Sällberg, G., 2014. *Designing and Implementing a Model Vehicle Platoon With Longitudinal Control*. M.Sc. Lund University.