TU Delft

IN4387 Project

Railway Crossing System Validation

Template Report

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September 9, 2016

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1 | Introduction

With renewable energy rapidly becoming more and more important, future cars will see a major overhaul. An increasing amount of cars become hybrid or fully electric. To become familiar with this development a R/C car is modified to become smart and 'green'. KITT, as the R/C car is called, features a wireless charging system, an anti-collision system and is able to autonomously drive in a x,y- plane while avoiding obstacles and other cars. Certain requirements are to be met regarding these properties. The aim is to optimize every property and preferably exceed the requirements.

For the final competition we have to deal with a set of challenges. When KITT leaves the charging station, the station has to switch off automatically (over-current protection). For the first challenge KITT has to drive to a specific point in the field. When KITT reaches the destination it must stop and the PC must give a signal. In the second challenge KITT has to drive from the starting point to a specific point in the field over specified way-points. The third challenge is practically the same as the second, except that in challenge three there will be obstacles on the route that we need avoid. In the last challenge the car needs to drive to a specific point while avoiding an other car.

In the first chapter we will briefly discuss our wireless charging system and give results regarding the efficiency of the charging system. Following, in the second chapter, we will talk about how we handled the communication of the system. Here we will give some system parameters. Then we will explain how we obtained our state-space model and the controller design is discussed. After that, in the localization chapter, we will discuss our matched filter and the script used for the localization will be explained. Lastly, in the final chapter, we disclose how we integrated the different subsections and combined it all into one system; KITT.

2 | Conclusion

The wireless charging system works as intended since it can fully charge the capacitor bank and goes to over-voltage protection when being overcharged. Also, when the car is removed from the charging spot, the charger goes into over-current protection, which indicates a solid resonance.
During the mid-term we successfully made use of the sensors to come to a standstill in front of a wall. The car has an emergency stop feature in case of an obstacle however during the final challenge we haven't made use of the sensors as we didn't reach the third challenge.
The designed matched filter works well and produces notable peaks allowing for good estimation of the TDOA.
Finally, we managed to implement localization mainly using our own algorithm. It proved itself to work well as we were able to track our location with an accuracy of about 5 cm. In case of trouble we could fall back on the second algorithm which is slightly less accurate.
At the final challenge our car drove in the wrong direction which we can attribute to an unfortunate misplaced minus sign.
All in all the produced system works rather well and we feel like it would've been better in case we had more time to test KITT.

Appendix A | Test