

Modeling, state estimation and control of tractor-trailer vehicles during aggressive maneuvering

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1 Background

This is a great opportunity if you are interested in doing your master thesis abroad and get to know one of the most technologically innovative areas in the world. Embark Trucks Inc is a 3 year old startup working on the vision of achieving full level 4 autonomous driving for semi-trucks operating on the bigger freight routes on the US highway system. Currently, Embark is operating a small fleet of prototype vehicles along the I10 highway between Ontario, California to Phoenix, Arizona. The main office for development is located in downtown San Francisco where major players in the autonomous space are also operating. A big challenge in the full automation of semi trucks is the modeling and control of the trailer. In normal highway conditions, controllers based on simple kinematic models and conservative trajectory generation gives good tracking performance. However, when performing more aggressive maneuvers or in strong winds the dynamics of the trailer and especially the shift of the center of mass due to trailer roll becomes more prominent and more advanced modeling is needed.



Figure 1: Embark Trucks tractor-trailer vehicle used as test platform.

2 Problem description

This thesis will explore the modeling of the dynamics of the trailer system and investigate if controller design using more advanced trailer models can achieve more robust and precise tracking when performing more aggressive maneuvers. First the important trailer states for achieving good control should be identified from modeling and simulations and later when the system is better understood, experiments on a test track with a full size semi-truck will be performed. There are three main components in this work:

- Investigation of dynamic models for tractor-trailer systems
- State estimation for important vehicle states
- Controller design

3 Benefits

Living in San Francisco can be expensive so the candidate will get suitable compensation and help in the process of getting a J1-intern visa. Other benefits include free breakfast, lunch and dinner and a huge snack supply. Working with a well funded team where potentially needed hardware can quickly be acquired.

4 Who are you?

We are looking for two motivated students with strong academic results from the program Applied Physics and electrical engineering. The applicants should have a strong background and interest in control and sensor fusion and be excited about spending 5-6 months abroad in the US working with state of the art equipment in the autonomous driving space. Programming experience in C/C++ is a plus.

5 Application

For application or details, contact Oskar Ljungqvist (oskar.ljungqvist@liu.se), Niclas Evestedt (niclas@embarktrucks.com) or Daniel Axehill (daniel.axehill@liu.se).