Example of ideas for Master Thesis work at NEVS

Vehicle Motion area

- Torque vectoring control development for in-wheel motor driven vehicle: Perform the yaw moment control and wheel torque allocation based on in-wheel motor driven vehicle features. Investigate Energy reduction by power loss minimization through wheel torque allocation in electric vehicles.
- Traction control development for in-wheel motor driven vehicle: Perform wheel slip control and wheel torque allocation during traction with in-wheel motor driven vehicle. (Investigate different options like: PID, SMC, Fuzzy)
- 4WS concept: Investigate the use of MPC and other control methods needed for optimal 4-wheel steering (w.r.t path tracking error and actuator usage) to support autonomous drive.

Autonomous Drive area

- Parametrization and optimization of Autonomous Driving test scenarios using traffic simulations (Eclipse Sumo)
- Develop an evaluation framework for deep learning models to Anonymize the images (faces/license plate) and retain valuable information.
- Design and implement deep learning models (GANs) to enhance object detection performance using synthetic datasets.
- ML/DL-based approach for extrinsic calibration for the multi-lidar multi-camera system. Stretch: Online vs Offline.
- Design a framework for explainable Artificial Intelligence for end-to-end Autonomous Driving
- Trajectory planning approaches for Autonomous Driving, e.g. Inverse Reinforcement Learning, MPC, etc. (Can be combined with traffic simulation)

Contact information

Torbjörn Norlander
Chapter Vehicle Motion Controls Engineering & Artificial Intelligence
+46 739 666 389, torbjorn.nolander@nevs.com

Example of ideas for Master Thesis work at NEVS

Software testing

- **Software testing in local computer vs. cloud**
  Set up a Closed Loop SIL (Software In the Loop) environment with FMUs and perform SIL testing on Simulink based code. The execute should first be done on local computer and then in the cloud. Compare the different environment and investigate different ways to make the test execution more efficient.

- **Optimize Automated Test Process**
  Investigate reasons behind bottleneck/issues in current test process, environment, and tools used for software testing. Propose what can be improved to utilize our current resources, how to increase the test efficiency by introducing new tools/developing a better way of working, what can be done to reduce the test time/cost and optimize the test automation.

Contact information

Veerappa Kaujageri
Acting Deputy Chapter Leader SW/Control System Test
+46 739 665 644, veerappa.kaujageri@nevs.com

Example of ideas for Master Thesis work at NEVS

Vehicle Simulation

- **Implementing Lateral Dynamic models for NEVS custom simulation library in Simulink**

  We at NEVS have an internal library of models in Simulink which we use for performing mostly 1D simulations but also can use the same set of models for software testing purposes. This library is comprising Longitudinal dynamics only at this point of time. We would like to extend the scope of the library to Lateral Vehicle dynamics as well, for which in this thesis the expected outcome will be vehicle models for efficient simulation of Lateral vehicle dynamics.

AD Simulations

- **Generating scenarios for AD simulations**
  - **Option 1 - Functional, Logical scenarios or Concrete scenarios from different sources like ROS bags/Log data/traffic simulations**
  - **Option 2 - Optimizing for finding Critical scenarios from concrete scenarios**

  This work will enable automation of increasing the search space for finding scenarios for testing the AD system.

  Option 1 will allow us to create scenarios that can be simulated in the test environment by extracting data from various sources which can range from real world log data to simulated microscopic agents output.

  Option 2 will allow us to find critical situation which have higher possibility of causing a hazardous situation that an AD vehicle will have to try to navigate safely. This way we can stress the AD system to the limit.

Contact information

Camilla Lindeblad
Chapter Leader SW/Control System Test & Simulation
+46 739 666 489, camilla.lindeblad@nevs.com

Example of ideas for Master Thesis work at NEVS

Traffic Simulation

- **Model calibration and validation**
  An agent-based model has a huge number of parameters which have dependencies with each other and requires intricate calibration setup to ensure that the simulated system in mimicking the real world as close as possible. Even after calibrating we must validate the setup against trustable data. This process is exactly what we are aiming for when we talk about microscopic traffic simulation setup for simulating a city scale traffic movement where there is flow of traffic and demand interacting with the traffic along with NEVS mobility solutions executing their missions in the city. Here we have the task of calibrating flow of traffic in the road network and matching them with the activity of people moving around the city using a well thought of calibration and validation process

- **Implementing co-simulation setup using existing High-Level Architecture (HLA) for Mobility ecosystem simulation setups**
  In an agent-based model environment of simulating the whole of NEVS Mobility Ecosystem (PONS) we are continuously building capability for supporting testing of various components of the mobility ecosystem. Having an interface which allows for connecting production intent solutions with the simulation environment for test and development support is very important for keeping up with the delivery pace, which is what we intend to achieve using HLA, a framework for distributed simulation setup. For e.g. with this setup, we should be able to connect our simulation environment with backend route planning software or swap the backend software with an AD simulation environment co-simulation or have all three environment combined together in one co-simulation.

Contact information

Camilla Lindeblad
Chapter Leader SW/Control System Test & Simulation
+46 739 666 489, camilla.lindeblad@nevs.com