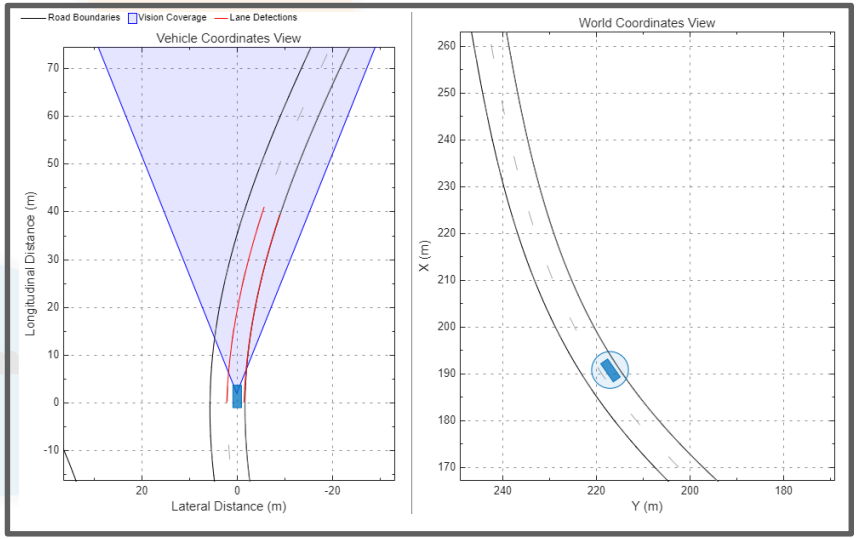
Name: Molnár Zétény Márton, BSc student, fifth year

Project type: thesis project

Topic: An implementation of lane keeping for an autonomous vehicle

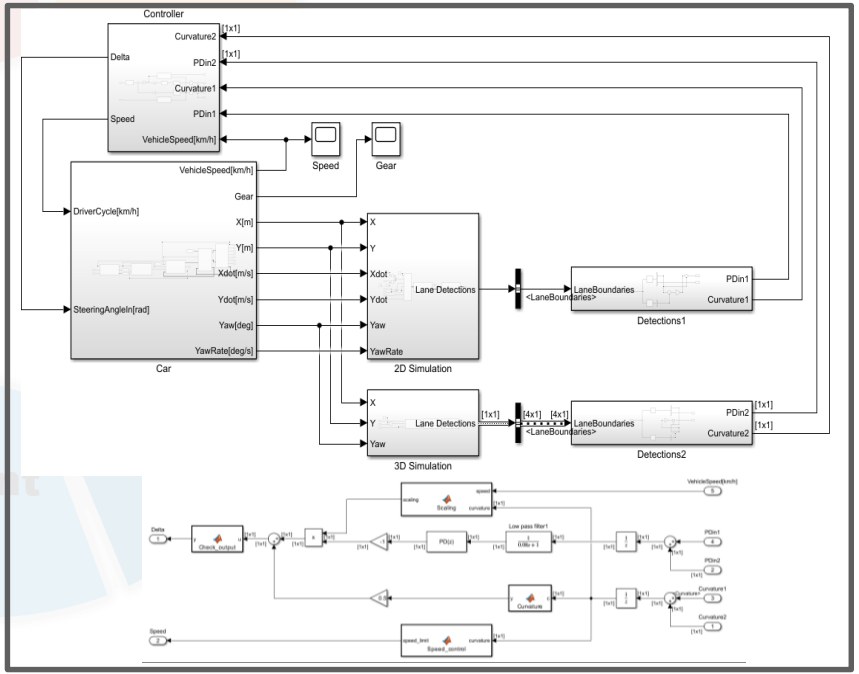
Supervisors: Dr. Pletl Szilveszter

- Advanced driver assistance systems (ADAS), including lane keeping (LKA), are now available in everyday vehicles
- An autonomous vehicle must reliably stay within lane boundaries to ensure safety and comfort
- This work focuses on designing and implementing a lane keeping system in a simulation environment, aiming to keep an autonomous car centered in its lane using a detailed vehicle model
- The system was developed and tested in MATLAB/Simulink, using a simulation environment based on Unreal Engine



Experiments

- The project began with the development of a detailed vehicle model using MATLAB's Vehicle Dynamics Blockset, including components such as the Driver, Motor, Driveline, Wheels & Brakes, and Vehicle Dynamics
- The test track was created using MATLAB's Driving Scenario Designer
- Lane information - such as curvature and lateral offset from the lane boundaries - is detected by a virtual camera mounted on the vehicle's windscreen
- A preprocessing system receives the raw signals and prepares the inputs required by the control system
- The control system computes the lateral control signal using a PD controller, taking road curvature into account. The longitudinal control signal is calculated using a custom MATLAB script
- Controller parameters were fine-tuned through multiple simulations to ensure stability and accuracy across varying speeds and driving conditions



Results & future work

- The developed vehicle model realistically approximated real-world vehicle behavior, with its dynamics capturing both longitudinal and lateral motion components
- The implemented system achieved a stable lane-keeping controller, capable of maintaining the vehicle near the lane centerline with minimal error, even at varying speeds
- The controller assigned higher speeds on straight road segments and reduced the speeds in curves, which the vehicle followed accurately

Future work:

- Improve robustness by integrating **sensor fusion** (e.g., combining camera, LiDAR, and radar data)
- Replace the PD controller with a more advanced **Model Predictive Control (MPC)** strategy to enhance tracking performance
- Further refine the **vehicle model** to better reflect real-world dynamics, including the vertical dynamics