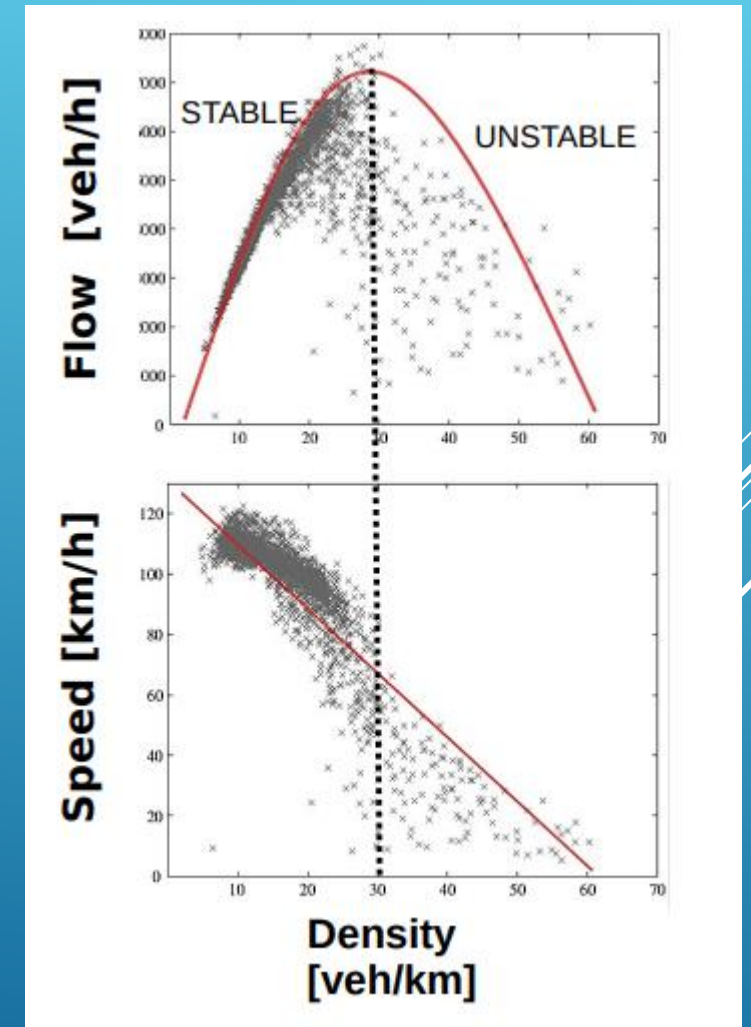# ESTIMATION OF TRAFFIC PARAMETERS WITH THE HELP OF ARTIFICIAL INTELLIGENCE

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INTRODUCTION

- Goal of the thesis project:
    - Utilize AI to estimate the space mean speed of the road around EGO
    - From space mean speed, fundamental diagram could be calculated
- Envisioned roadmap of the project:
    - Generate data to train the AI
    - Building the AI
    - Gather real data to test the AI
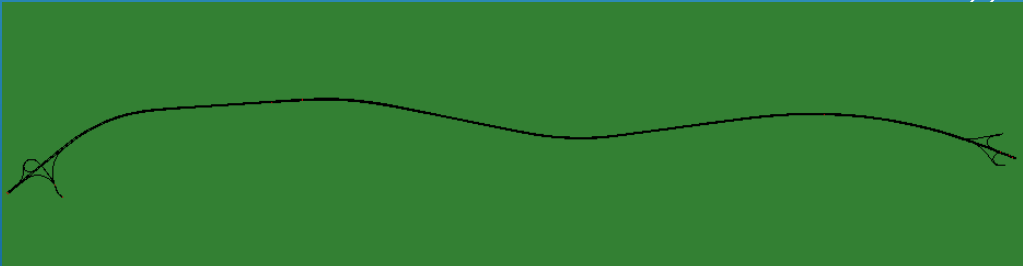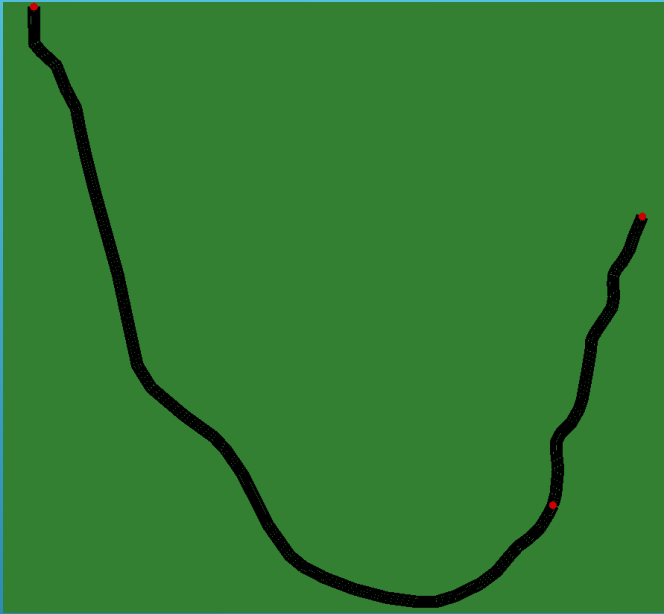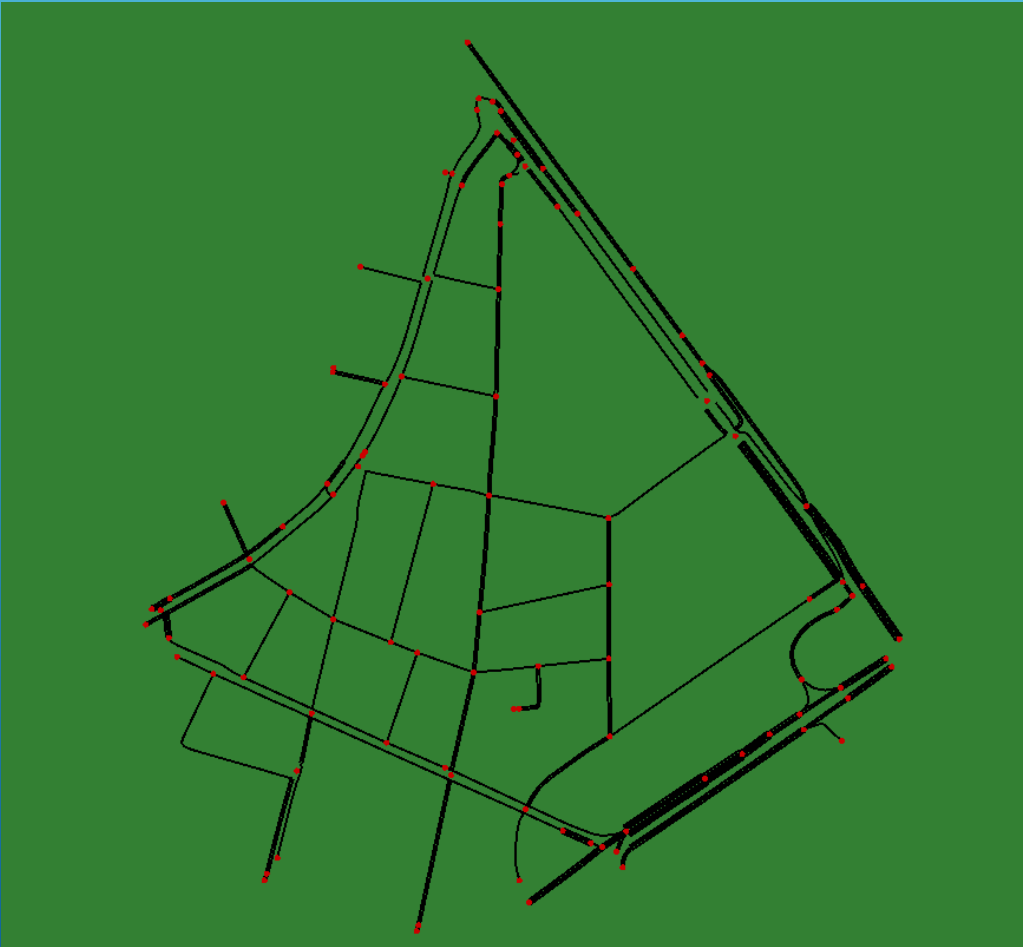
USED TECHNOLOGIES

GENERATING THE TRAINING DATA

- SUMO microscopic traffic simulator
  - Used Python to connect to TraCI
- Built a framework, to generate traffic in large scale and variety
- Inputs
  - Map network (created by user, or generated with OsmWebWizard)
  - Unique participants of the traffic (rest is generated randomly in the script)
  - Desired number and length of generated scenarios
  - Number of vehicles in the scenarios

USED MAP NETWORKS FOR TRAINING

BUILDING THE AI

- Used PyTorch open-source machine learning library for Python
- Two iterations:
    - LSTM + MLP network
    - Convolutional Neural Network

LSTM+MLP RESULTS

- Input is an array of vehicle IDs and velocities
- Tested only on generated data
- LSTM + MLP learning
  - Took 3-4 hours
  - Average test error (squared error) went as low as 1,2 – 2,8 (m/s)2
- Only MLP learning
  - Took 10-20 minutes
  - Error of the test remained the same

TESTING ON REAL DATA

- NGSIM dataset
  - Federal Highway Administration
- From camera image
- Contains numerous parameters:
  - Velocity, x-y position, lane number, vehicle length, vehicle ID, frame ID, etc.
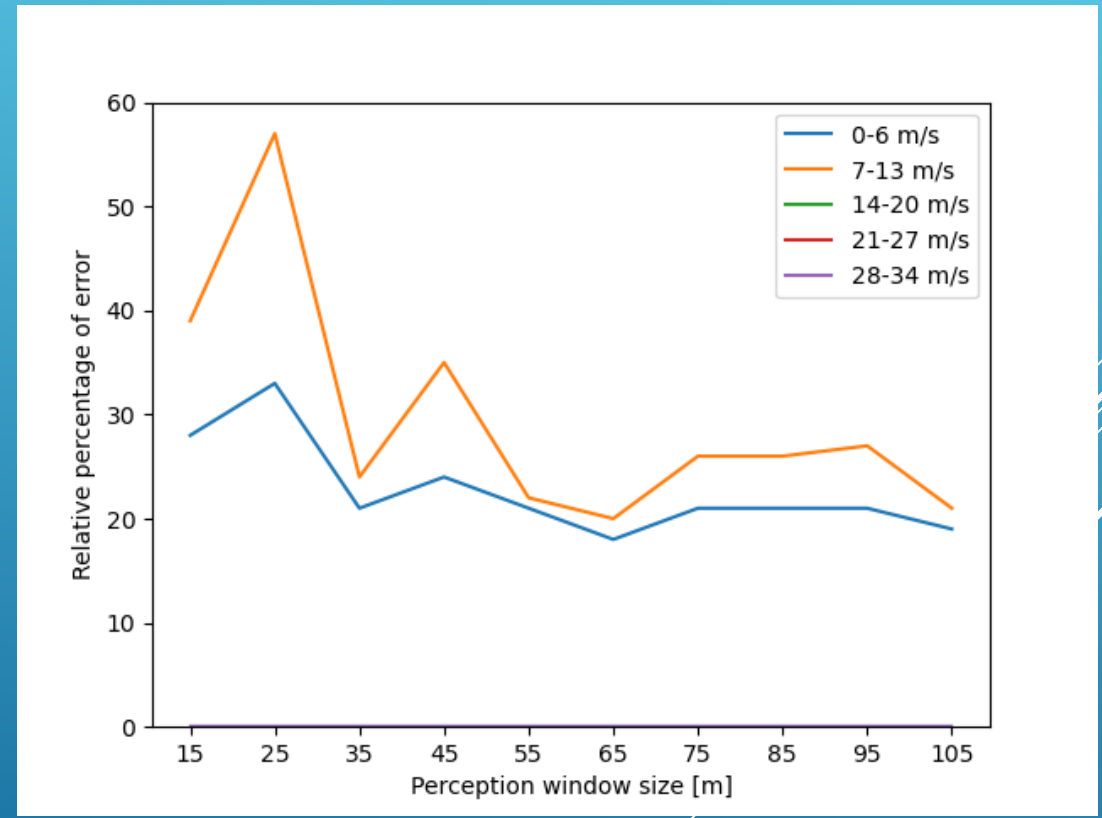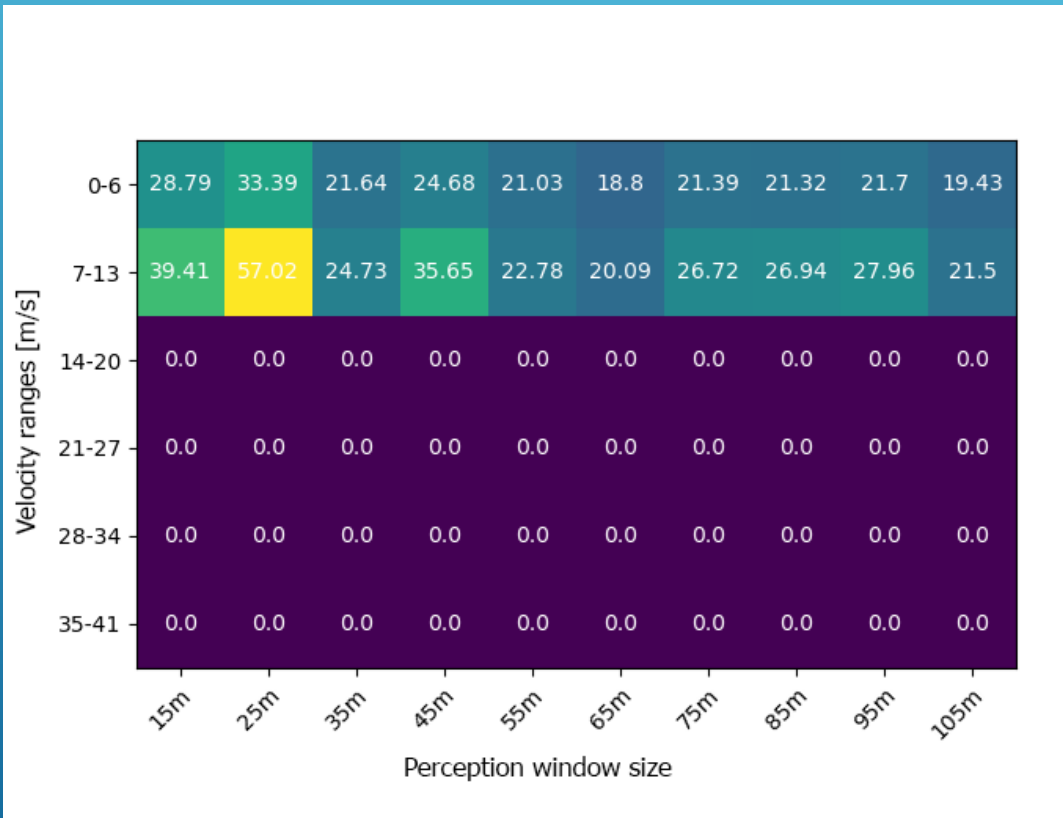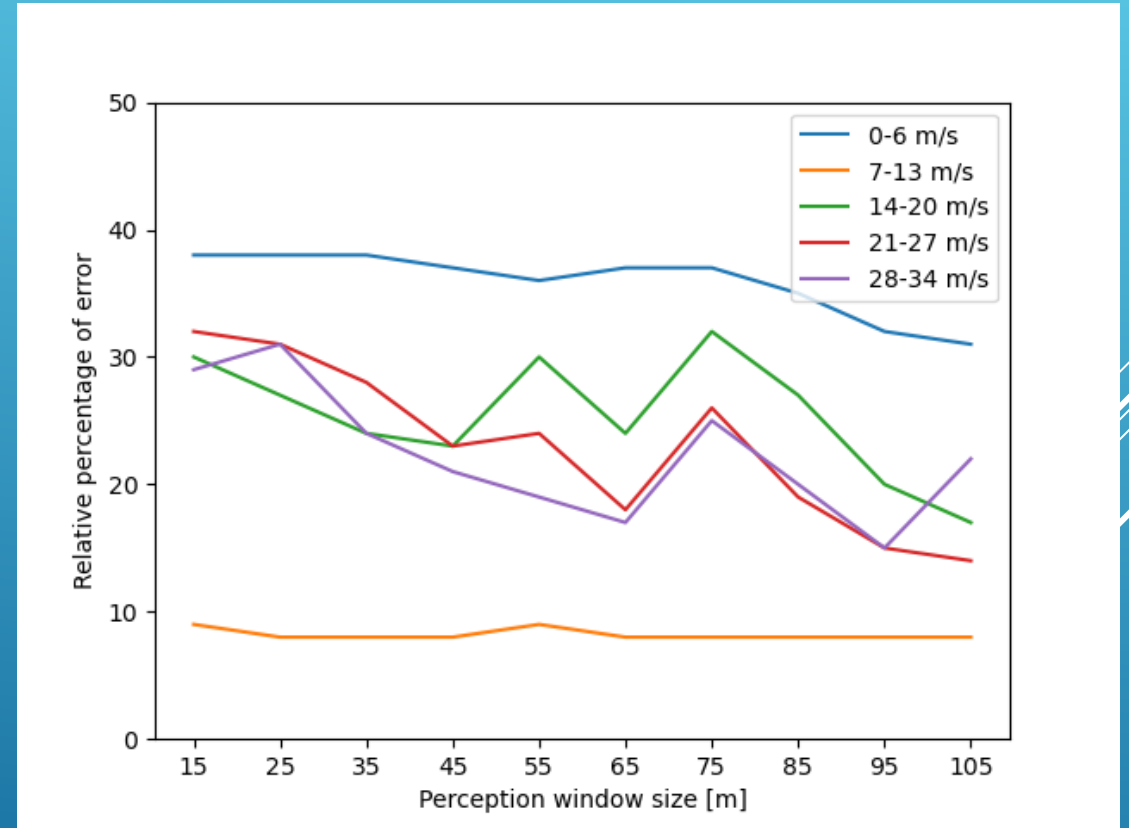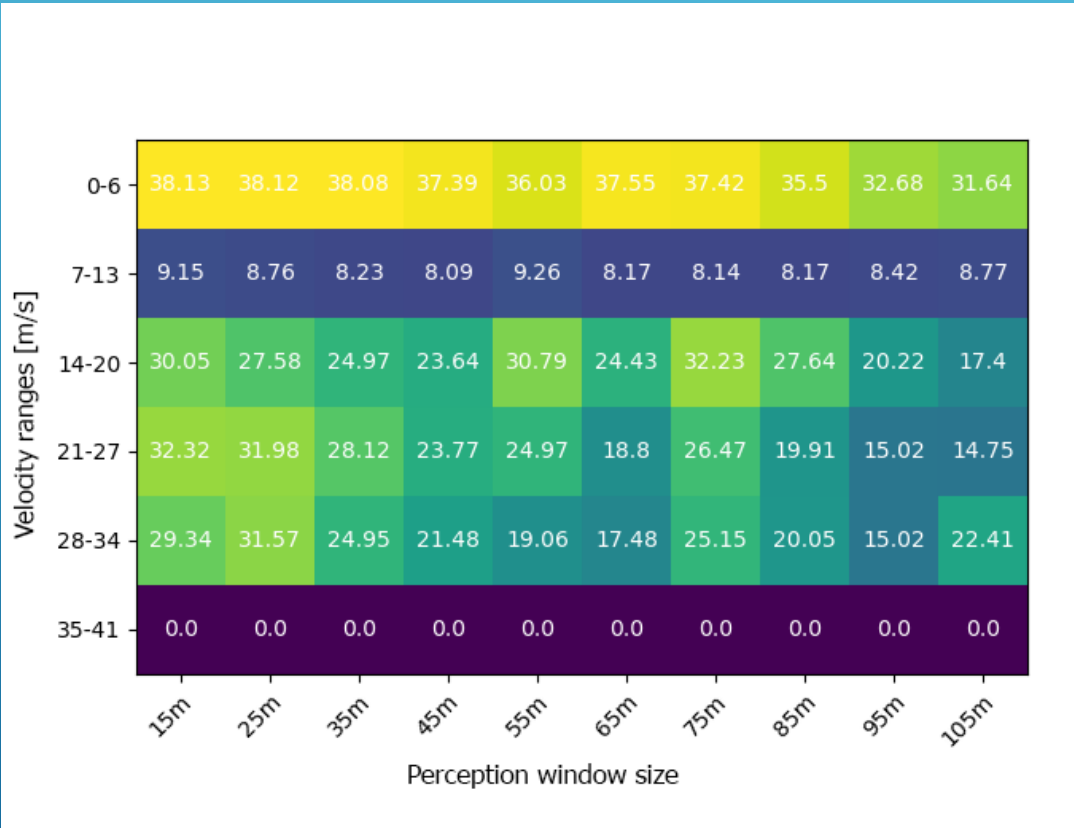- 15 minute long samples
  - > 1 million lines in a sample

CNN RESULTS

- Input is an "image" of the surroundings
  - 105m long and 3 lanes wide perception window, so 21 x 3 "image"
  - Middle cell contains EGO velocity, the other cells the surrounding vehicles
- Created images from the SUMO and NGSIM data for different window sizes, from 3 x 3 to 21 x 3, increasing by 2, to be able to tell how the window size effects the accuracy of estimation
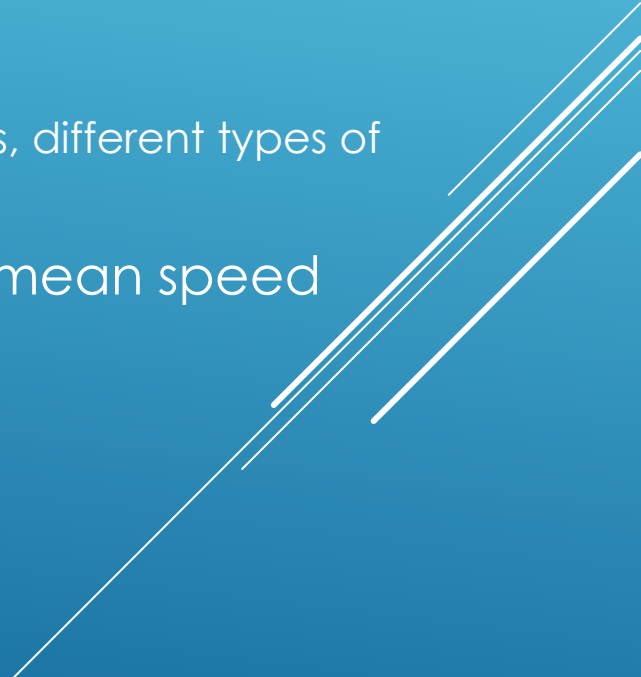
CNN RESULTS – ONLY NGSIM

CNN RESULTS – NGSIM AND GENERATED DATA

CONCLUSION

- Mixed results
  - Did not reach level of accuracy, which could be used in real traffic
  - Learnt that many parameters has effect on the accuracy:
    - Map topologies, traffic speed and density, length of the learning process, different types of neural networks, number of training data
- There are velocity ranges and topologies, where AI based space mean speed estimation could work well

THANK YOU FOR YOUR ATTENTION