Object Detection & Tracking in 4D RADAR for Enhanced Autonomous Vehicle Perception

Presented by Nick Timaskovs

Aims & Objectives

The aim of this thesis is to develop and or implement an **Object Detection** and **Tracking** architecture for 4D RADAR, for enhanced Autonomous vehicle perception.

Create a UI for visualizing the detections during model evaluation.

Preform experiments on various model configurations.

Aims & Objectives

To learn how to use and understand the 4D RADAR point cloud data structure.

Break the barrier to entry, with a plug and play solution improving accessibility.

Contribute to RaTrack with improvements.

Challenges in Autonomous Vehicles

- Sensor Fusion and Perception
- Clutter, Interference and noise
- Detection of Vulnerable Road Users
- Safety and Reliability
- Data Collection and Processing
- Cost and Implementation

Motivations

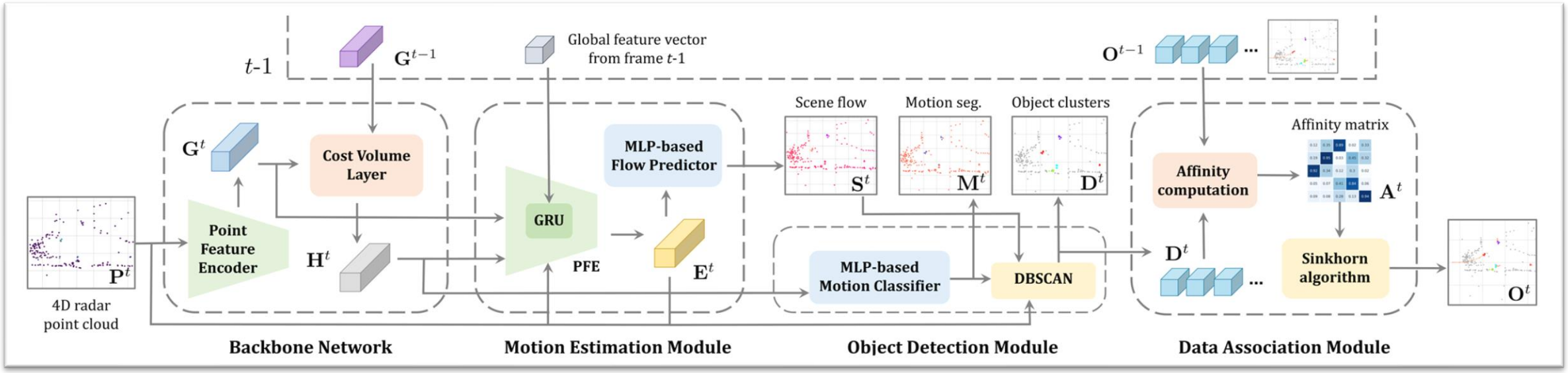
Personal Experience - wanting to improve road safety

Specialize in computer vision & ML to work in this field

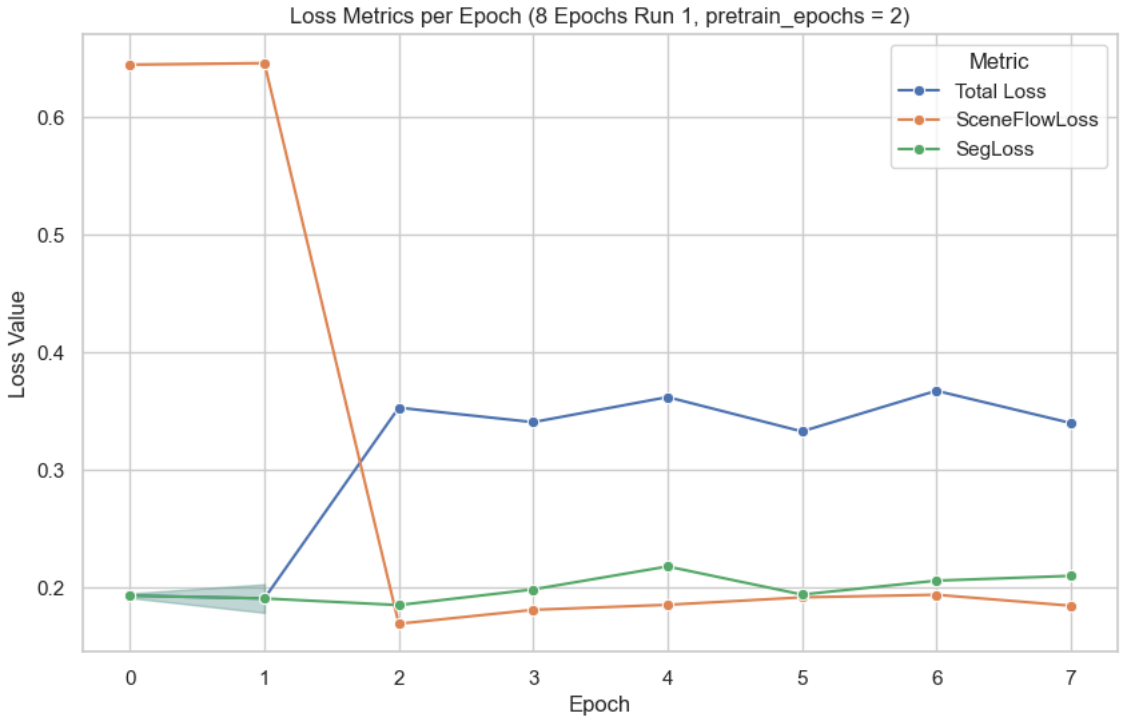
Improve current solutions to help drive innovation in Advanced Driver Assistance Systems (ADAS)

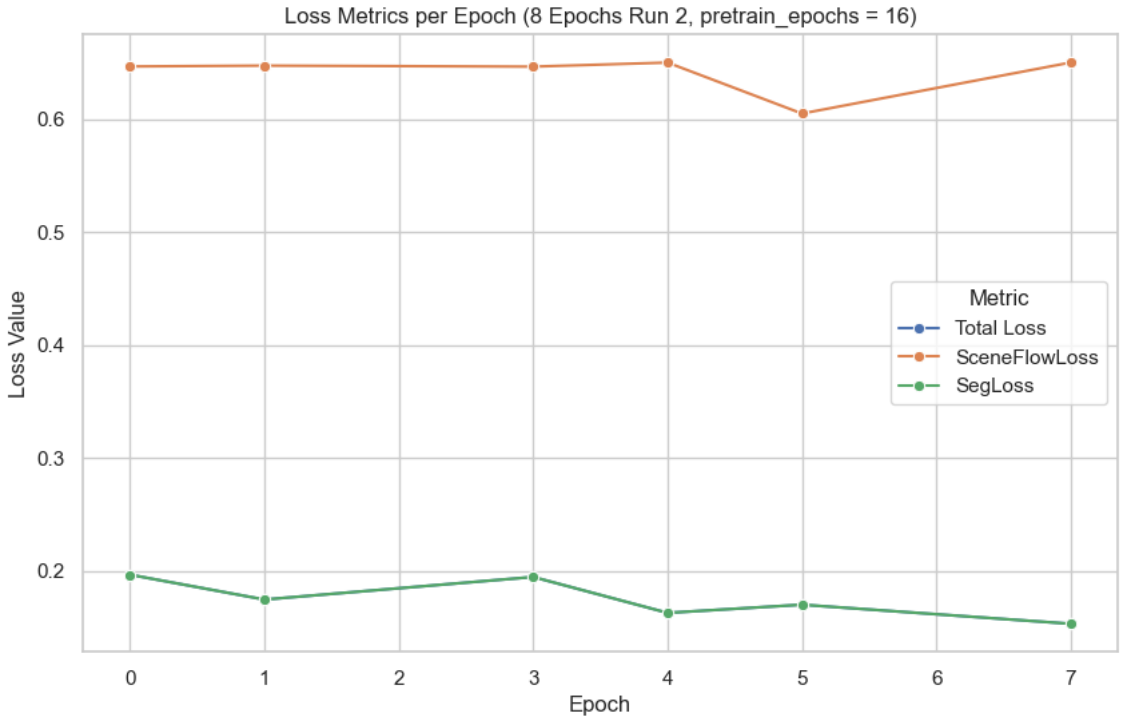
Interest in the automotive industry.

Architecture of RaTrack



Training Results





Evaluation Results on 8 epochs

Segmentation

Metric	Run 1	Run 2	Better Run
Accuracy	0.915624	0.929237	Run 2
MIoU	0.588501	0.610672	Run 2
Sensitivity	0.869579	0.884062	Run 2

Scene Flow

Metric	Run 1	Run 2	Better Run
RNE	0.126901	0.274913	Run 1
SAS	0.996817	0.988114	Run 1
EPE	0.299801	0.648234	Run 1

- Run 1: pretrain_epochs = 2
- Run 2: pretrain_epochs = 16

Comparing 8 vs 10 epochs

Segmentation

Metric	10 Epoch	8 Epoch	Better Model
Accuracy	0.902215	0.929237	Epoch 8
MIoU	0.569491	0.610672	Epoch 8
Sensitivity	0.849747	0.884062	Epoch 8

Scene Flow

Metric	**10 Epoch**	**8 Epoch**	**Better Model**
RNE	0.115484	0.274913	Epoch 10
SAS	0.997415	0.988114	Epoch 10
EPE	0.272903	0.648234	Epoch 10

- 10 Epochs: pretrain_epochs = 2
- 8 Epochs: pretrain_epochs = 16

Challenges Faced

- Dataset Acquisition
- Original implementation was not feasible
- Lack of code standards / bad practices
- Computational Complexity (1hr per epoch)
- Solution Complexity
- Steep Learning Curve

Questions?