Predictive Driver Model

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Motivation

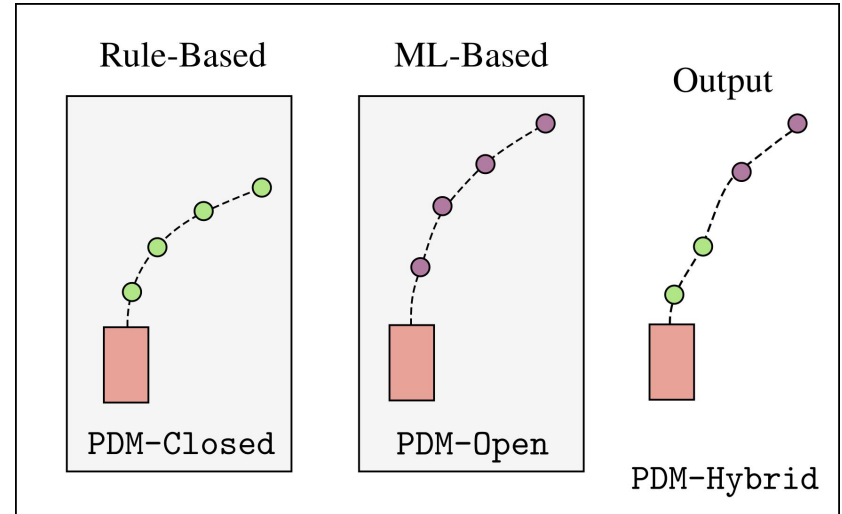| Method	Type	Open Loop Score↑	Closed Loop (non-reactive) Score↑	Closed Loop (reactive) Score↑
UrbanDriver	learned	76	45	44
GC-PGP	learned	**82**	57	54
IDM	rule-based	38	**76**	**77**
Log Replay	GT	100	94	80

*trained and evaluated on the **Val14** Benchmark

- rule-based planners achieve strong closed-loop performance but are inaccurate in open-loop evaluation
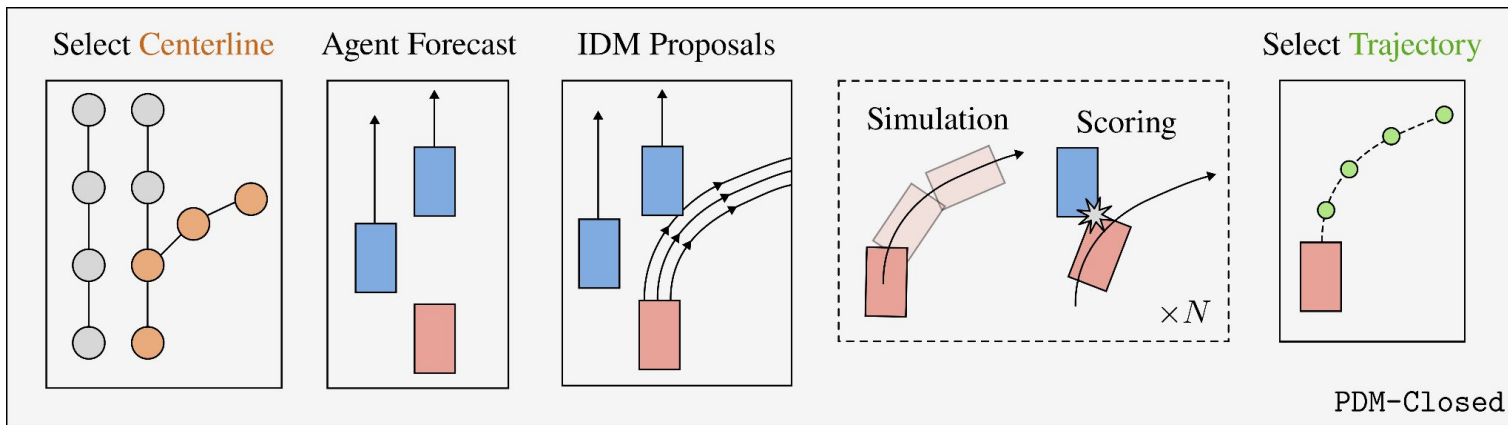- planner needs to compensate for controller drift in closed-loop

Dauner et al. "Parting with Misconceptions about Learning-based Vehicle Motion Planning". arXiv, 2023

Predictive Driver Model (PDM)

Hybrid Planner:

- Short-trajectory with rule-based planning (**PDM-Closed**).

- Long-term correction with learned ego-forecasting model (**PDM-Offset**).

- **Fusion** either by adaptive interpolation or by predicting offsets with PDM-Open
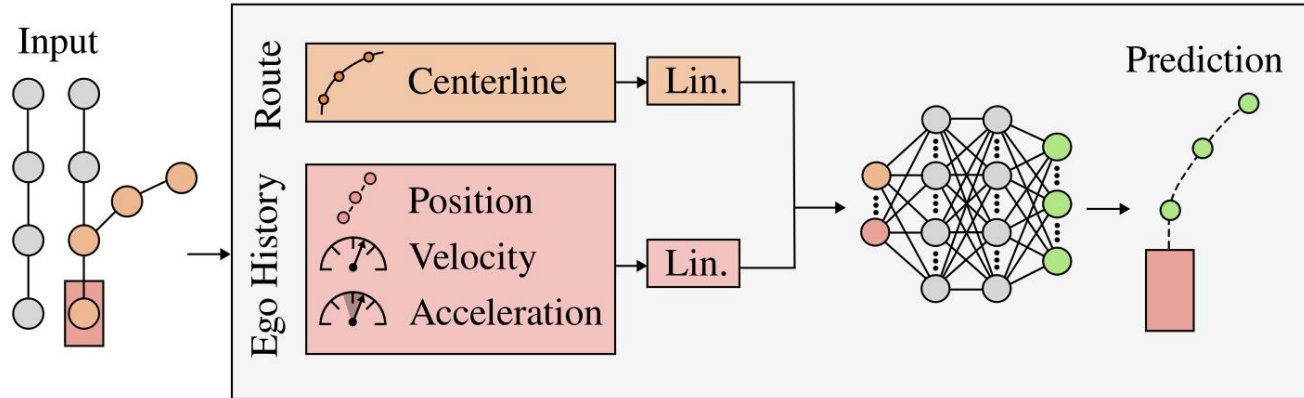

Rule-Based   ML-Based   Output

PDM-Closed   PDM-Open   PDM-Hybrid

Dauner et al. "Parting with Misconceptions about Learning-based Vehicle Motion Planning". arXiv, 2023

Rule-based PDM-Closed

- **Proposals:** 5 longitudinal proposals × 3 offsets from centerline based on constant velocity agent-forecast
- **Evaluation:** scoring of simulation outcome with a cost-function similar to nuPlan metrics

Dauner et al. "Parting with Misconceptions about Learning-based Vehicle Motion Planning". arXiv, 2023

Learned PDM-Open

- Ego-Forecasting (8s) based on **centerline** and ego **history states**

- **Model:** Simple MLP, with two 512-dimensional hidden layers

Dauner et al. "Parting with Misconceptions about Learning-based Vehicle Motion Planning". arXiv, 2023

Results

Method	OLS↑	CLS-NR↑	CLS-R↑	Time [ms]↓
UrbanDriver	76	45	44	64
GC-PGP	82	57	54	100
IDM	38	76	77	27
PDM-Open	**86**	50	54	**7**
PDM-Closed	44	**92**	**93**	91
PDM-Hybrid	84	**92**	**93**	96
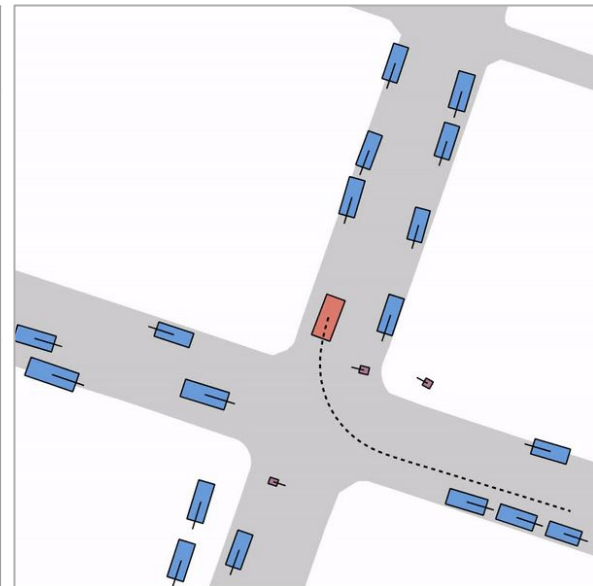
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- **PDM-Hybrid** effectively combines the strong closed-loop capabilities with accurate open-loop forecasts

Dauner et al. "Parting with Misconceptions about Learning-based Vehicle Motion Planning". arXiv, 2023

Find thorough evaluations and detailed ablations

Code

https://github.com/autonomousvision/nuplan_garage

Paper

https://arxiv.org/abs/2306.07962

Parting with Misconceptions about Learning-based Vehicle Motion Planning