

Uncertainty-aware Short-term Motion Prediction of Traffic Actors for Autonomous Driving

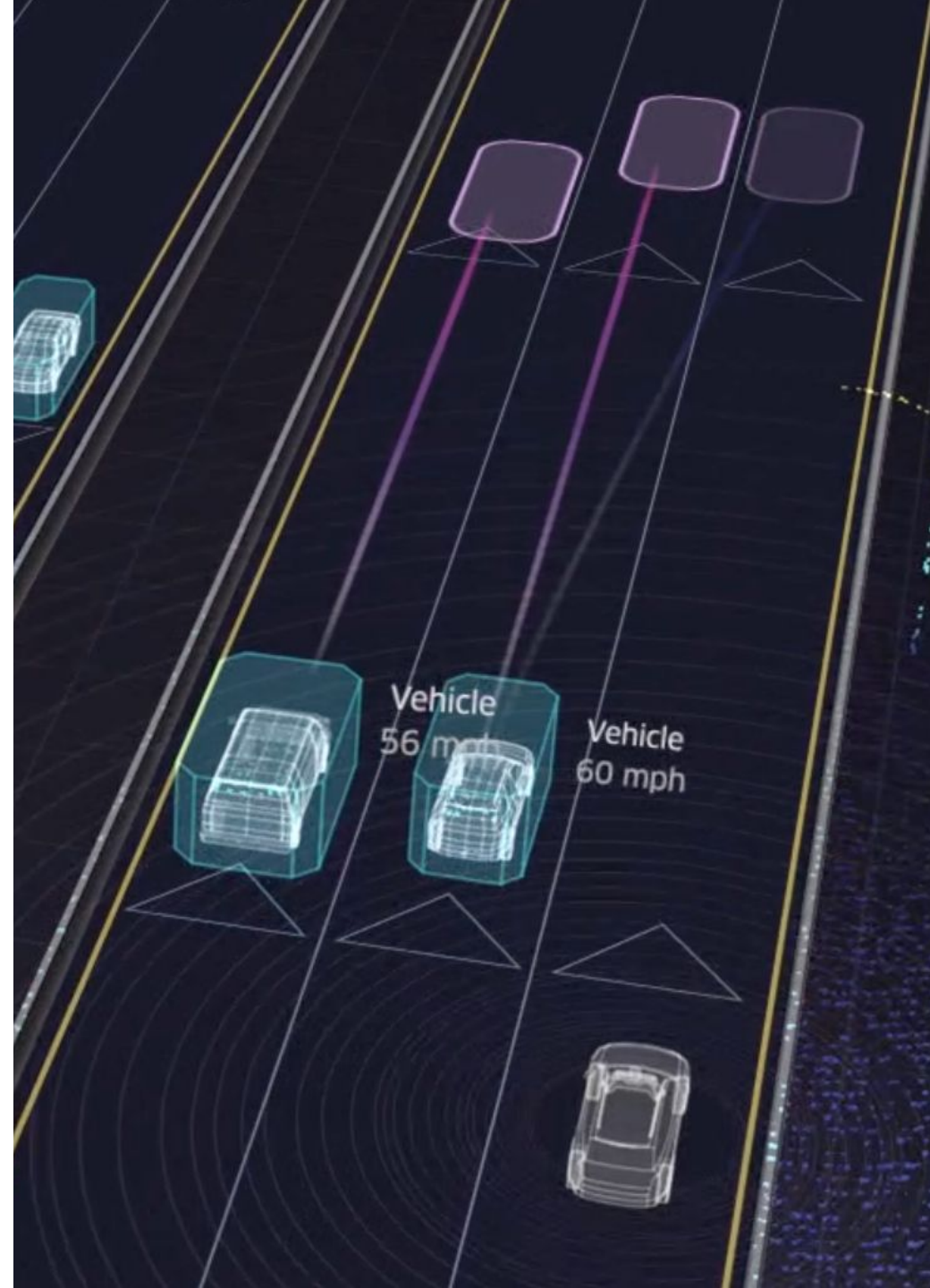
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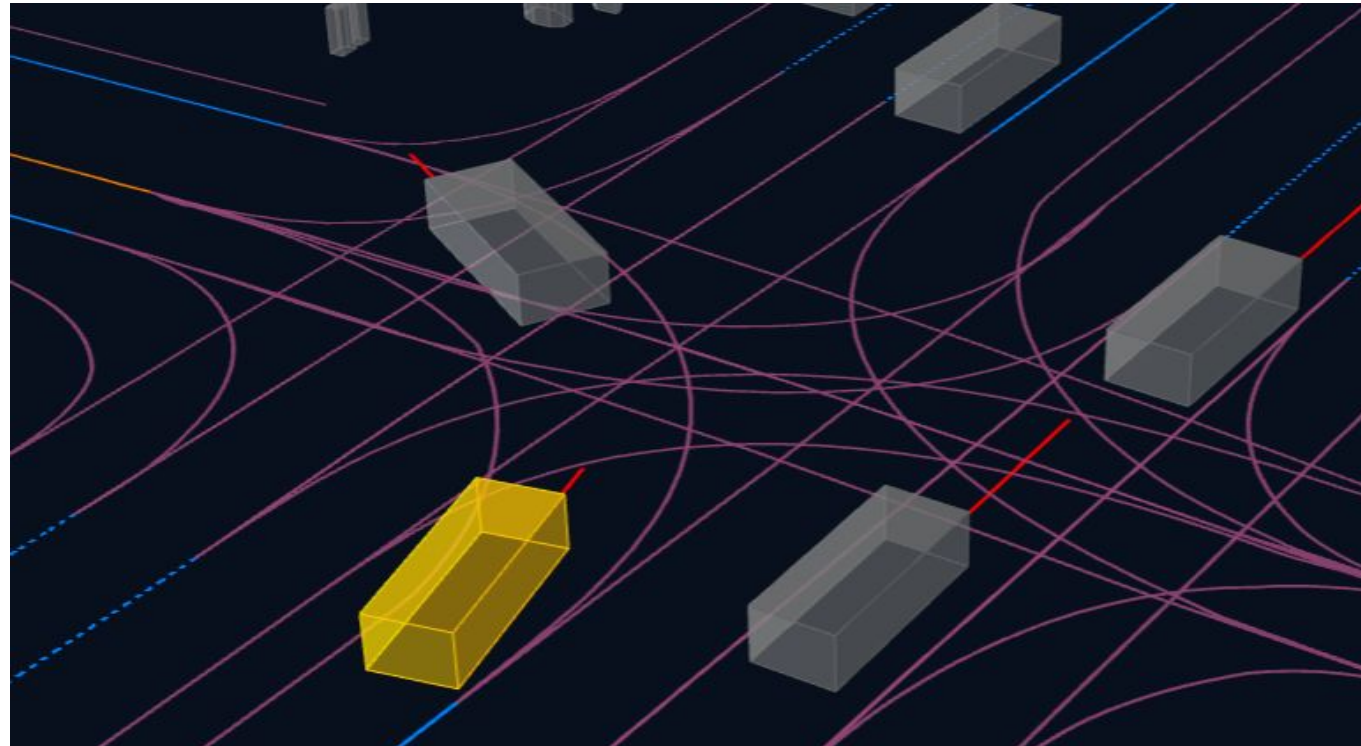
Prediction task

- To ensure safe and efficient operations, an autonomous vehicle needs to accurately predict the future motions of the traffic actors in its surrounding area



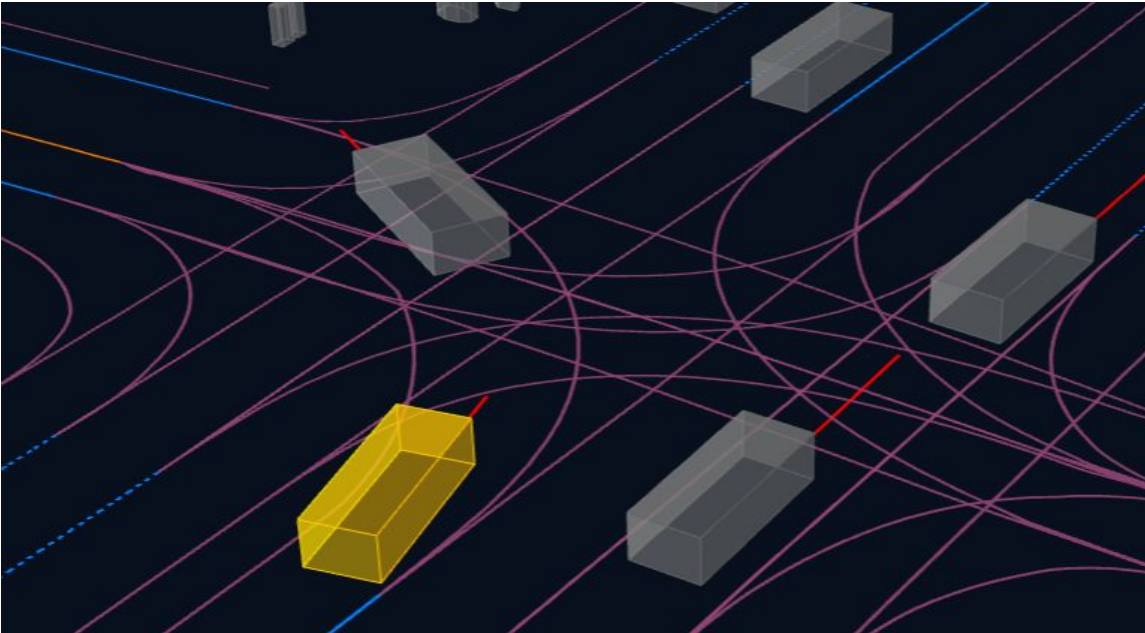
Problem setting

- Model that predicts actor's trajectory should take into account surrounding objects and map constraints
- What is the best way to provide that info to the model?

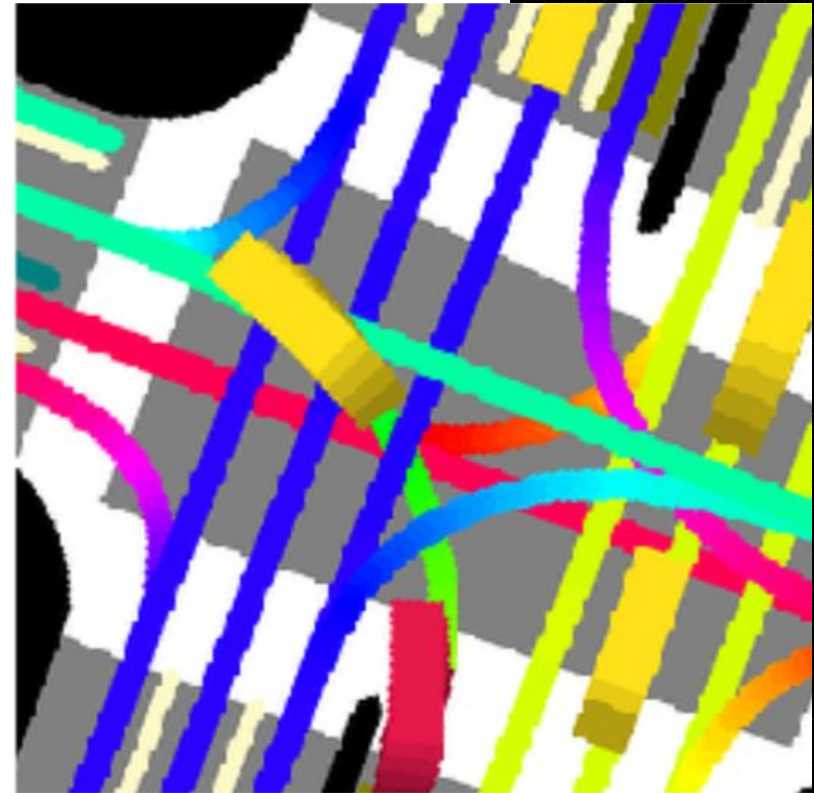


Proposed solution

- Rasterize the tracked actors and the map into a bird's-eye view (BEV) image, to be used as an input to the deep model

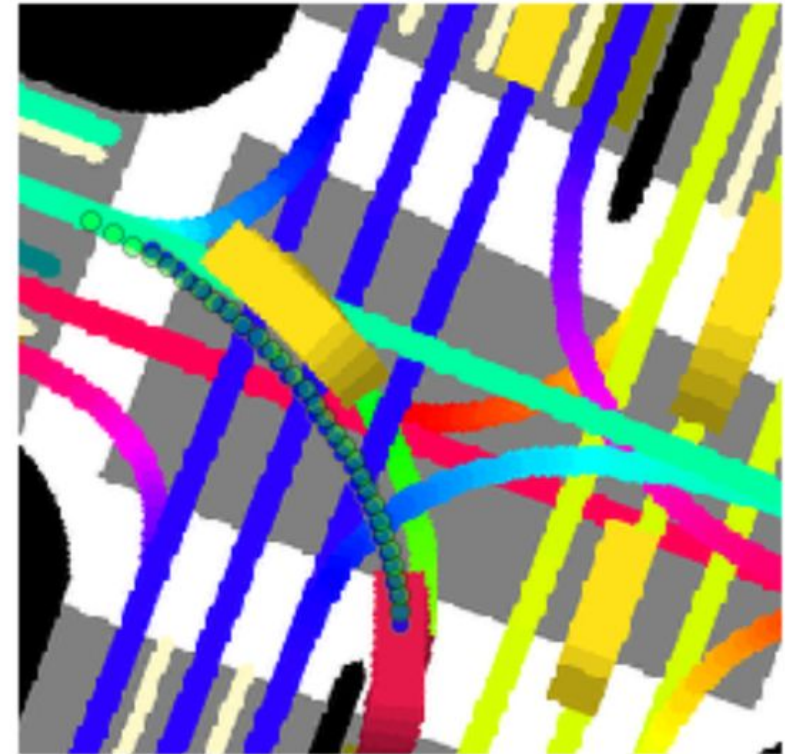
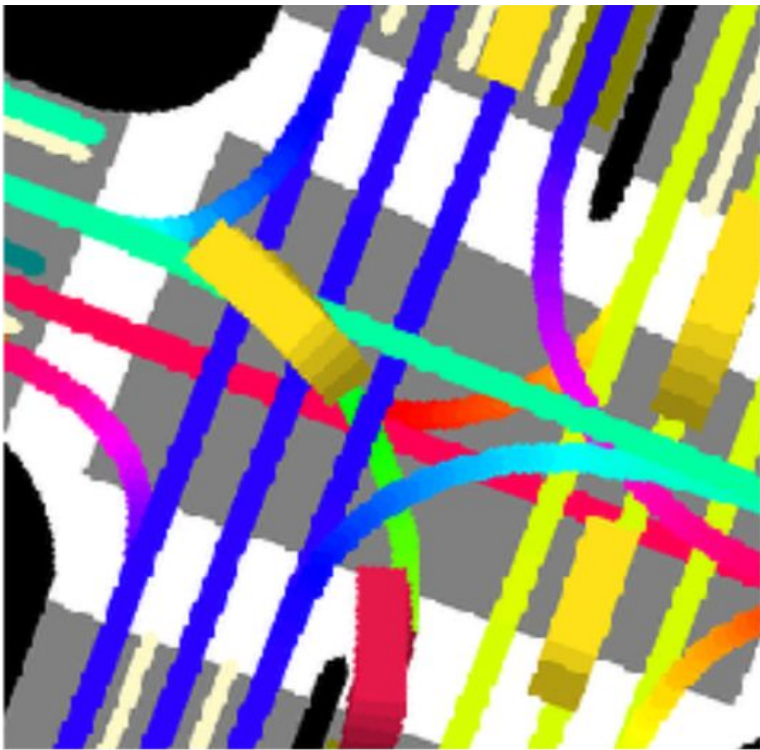


Rasterization



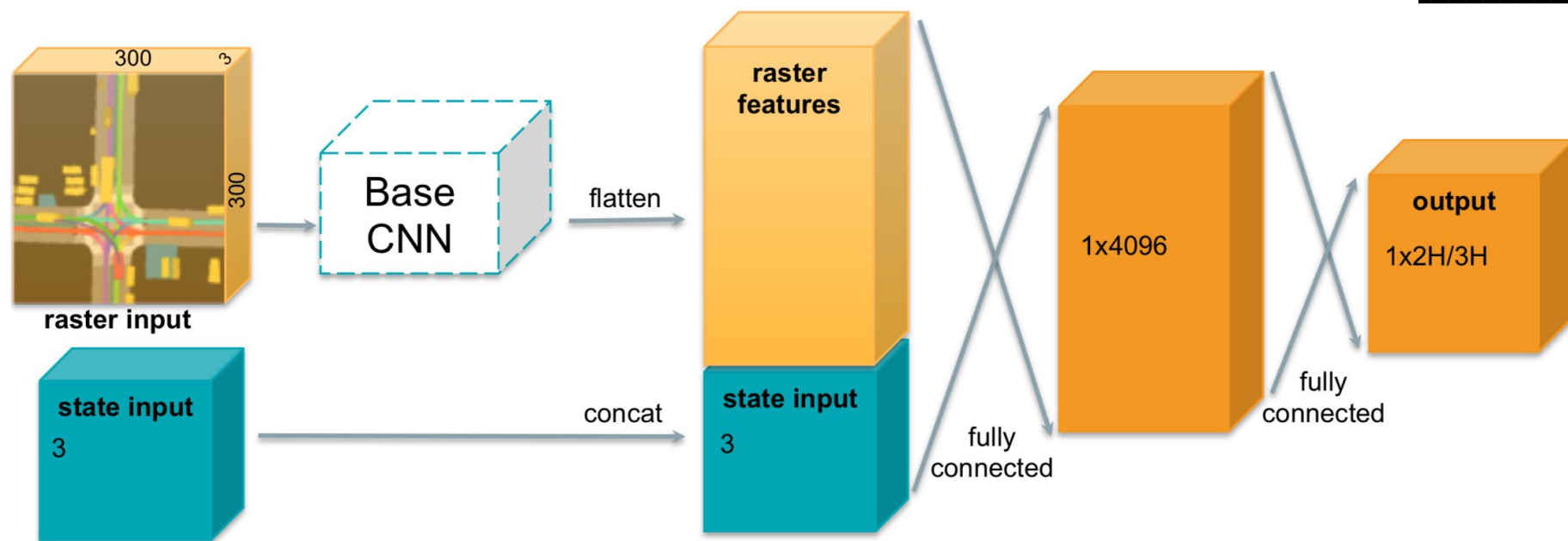
Proposed solution

- Given an input raster, predict actor's future x/y-positions and position uncertainty every 0.1s for a total of 3 seconds



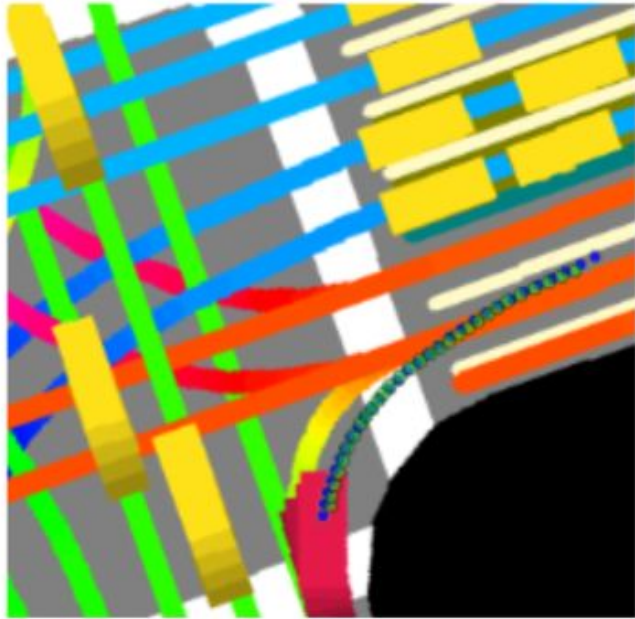
Architecture and loss

- We model each trajectory point as a Gaussian sample, and maximize log-likelihood of the entire trajectory
- We use a CNN model to extract features from the raster, and to output x/y -position and uncertainty for each of H future points every 0.1s for a total of 3 seconds

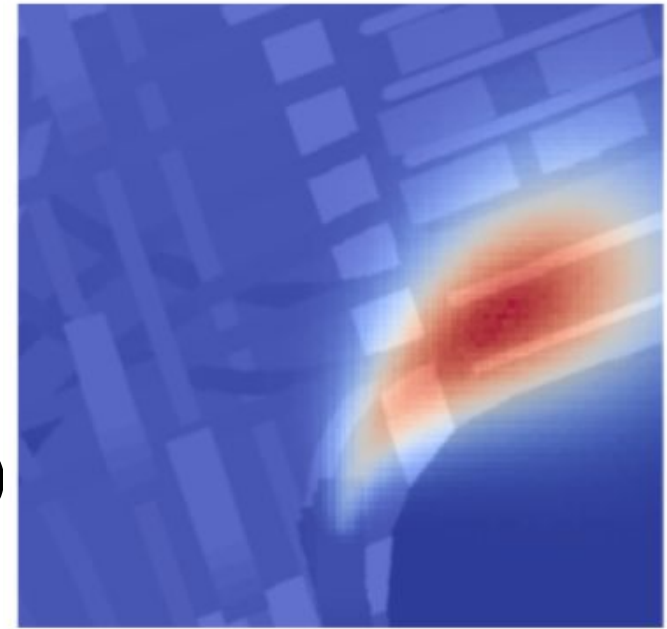


Example output

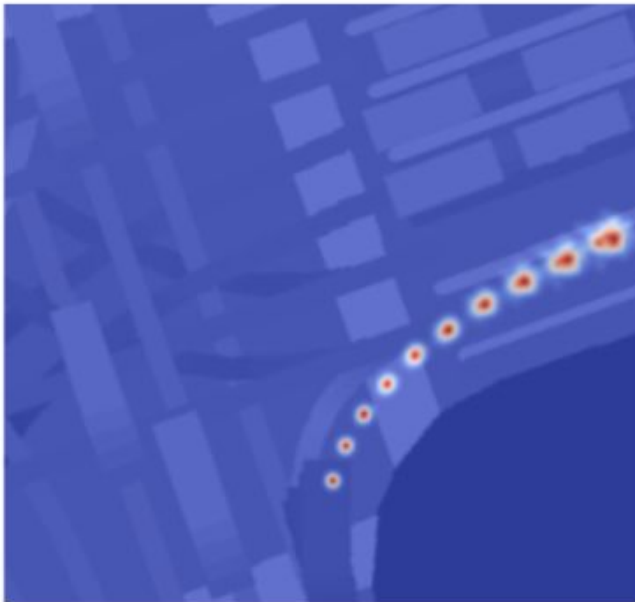
Raster image and output trajectory



Process (aleatoric) uncertainty

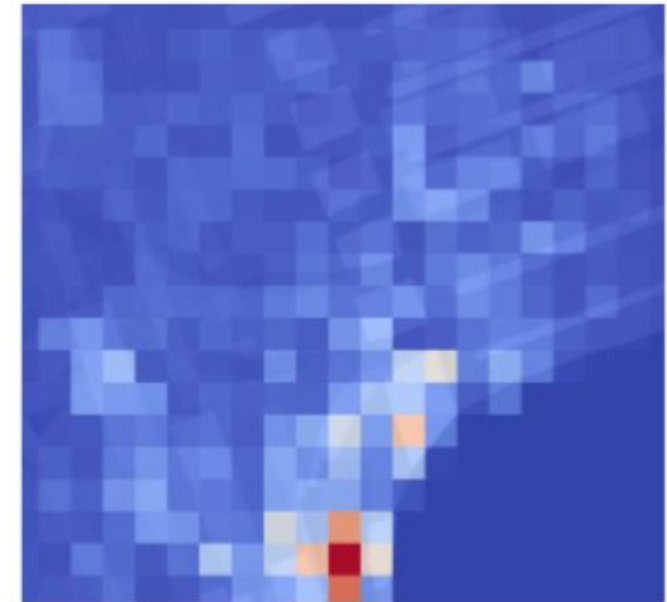


Model (epistemic) uncertainty



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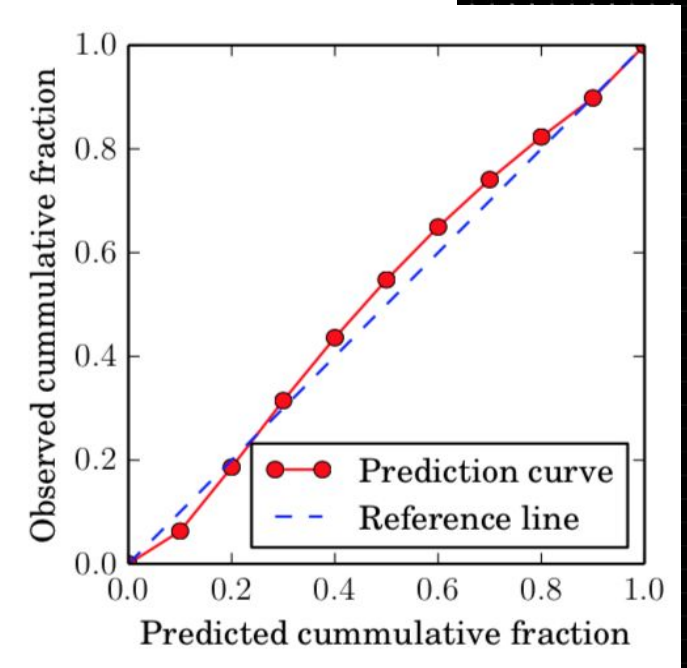
Sensitivity analysis



Results

- In experiments on large-scale, real-world data we show:
 - The inferred ***trajectories are more accurate*** than a number of baselines (see Table)
 - The inferred ***uncertainties are well-calibrated*** (see Figure for 3s-prediction calibration plot)

Method	Raster	State	Loss	Displacement	Along-track	Cross-track
UKF	–	yes	–	1.46	1.21	0.57
Linear model	–	yes	(2)	1.19	1.03	0.43
Lane-assoc	–	yes	–	1.09	1.09	0.19
AlexNet	w/o fading	no	(2)	3.14	3.11	0.35
AlexNet	w/ fading	no	(2)	1.24	1.23	0.22
AlexNet	w/o fading	yes	(2)	0.97	0.94	0.21
AlexNet	w/ fading	yes	(2)	0.86	0.83	0.20
VGG-19	w/ fading	yes	(2)	0.77	0.75	0.19
ResNet-50	w/ fading	yes	(2)	0.76	0.74	0.18
MobileNet-v2	w/ fading	yes	(2)	0.73	0.70	0.18
MobileNet-v2	w/ fading	yes	(5)	0.71	0.68	0.18
MobileNet-v2 LSTM	w/ fading	yes	(5)	0.62	0.60	0.14



Come to poster #411 to find out more!

- ***Paper title:* Uncertainty-aware Short-term Motion Prediction of Traffic Actors for Autonomous Driving**
- **More details at the poster:**
 - **Comparison to other baselines**
 - **Uncertainty calibration plots**
 - **Ablation study of the model**
 - **Further interesting visualizations**
- **Thank you!**