Multiple Future Prediction Leveraging Synthetic Trajectories

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Introduction

- The ability to forecast trajectories is essential to ensure safety in autonomous driving
- Unfortunately, the autonomous driving datasets required to train prediction models are extremely expensive to gather effectively
- We propose a data driven approach based on Markov Chains to generate synthetic trajectories, which are useful for training a multiple future trajectory predictor.
- We define a trajectory prediction model and we show that combining synthetic and real data we obtain prediction improvements, obtaining state of the art results.

Trajectory Generation

- Markov Chain whose parameters are estimated from real data
- Chain states correspond to vehicle position offsets from one timestep to the next

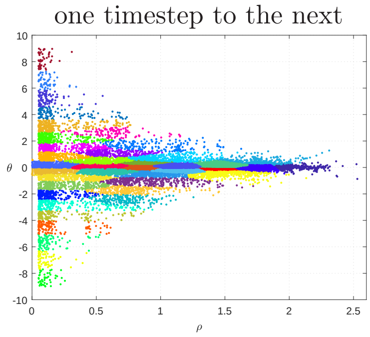

Figure 1: Clusterized offsets from the KITTI dataset in polar coordinates (ρ,Θ) .

Model

We developed a model specifically tailored to exploit synthetic samples with multimodal ground truth futures. The architecture is based on an encoder-decoder structure, which takes as input past trajectories and outputs multiple futures.

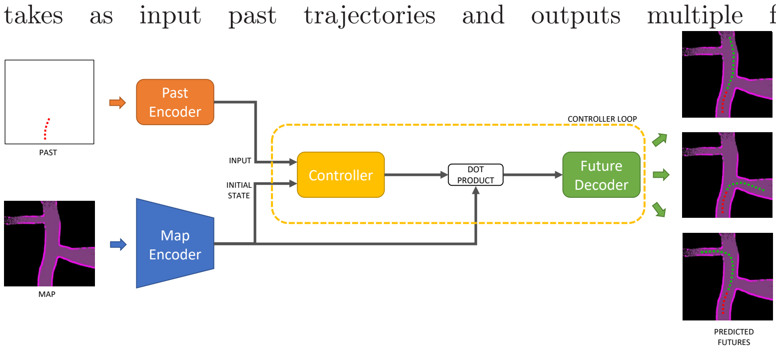

Figure 2: Architecture overview. Past trajectory and context map are encoded separately and used as input and initial state of the controller. The controller loops K times and at each iteration performs an attention with the map encoding via dot product. The resulting vector is fed to the decoder which emits a prediction. A diverse future is obtained for each iteration of the controller

Results

We trained three different variants of our method, varying the source of data: only real trajectories from KITTI, only synthetically generated trajectories, both real and synthetic trajectories. All variants are tested on the test set of KITTI, i.e. on real data.

Method	ADE@4s	FDE@4s
Kalman	3.03	7.41
Linear	1.64	4.73
MANTRA	0.94	2.48
Ours (Synthetic data)	1.31	3.44
Ours (Real data)	1.24	2.95
Ours (Mixed data)	**0.89**	**2.27**

Table 1: Average Displacement Error (ADE) and Final Displacement Error (FDE) in meters, computed for predictions at 4 seconds.

Using synthetic data, along with a model specifically tailored for multimodal predictions, has led to state of the art results on the KITTI dataset.

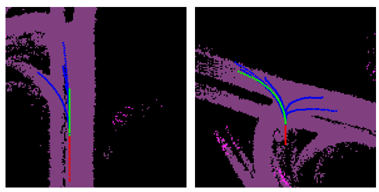

Figure 3: Predictions on real data. Green: GT, blue: predictions.

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