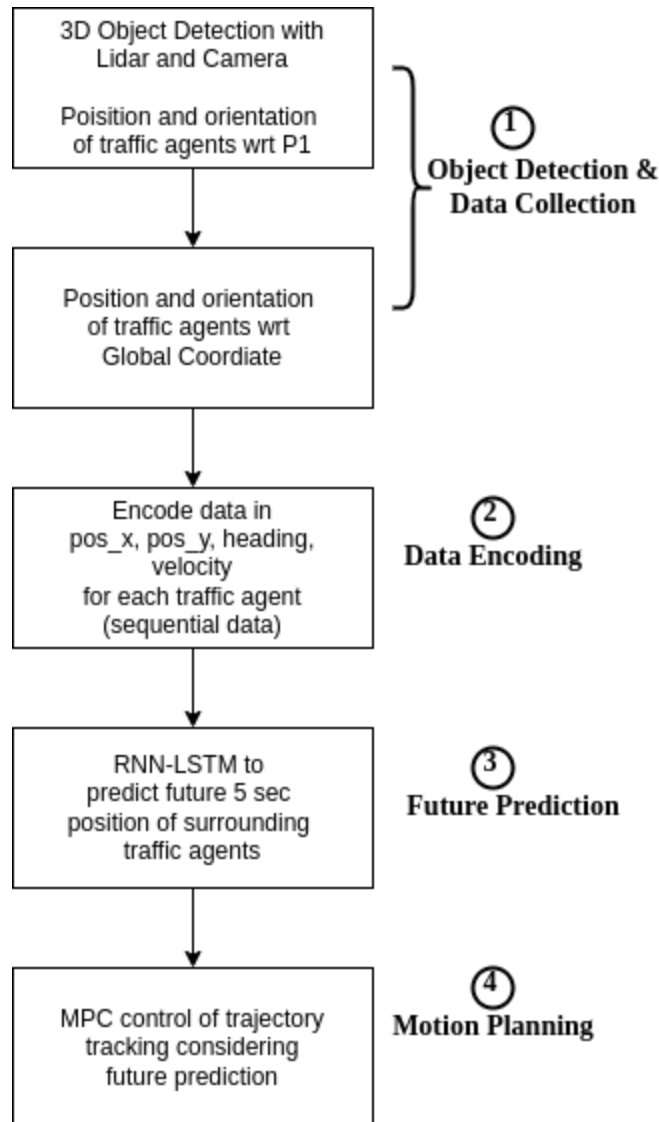


Proposed Concept:



Our aim is to design a motion planner controller for P1 (AV) by considering the predicted future positions of surrounding traffic agents. It can be divided into 4 steps. Present work is at stage 3 where the RNN LSTM model is designed for predicting future 5-sec positions of traffic agents.

Stage 1:

Stage 1 i.e. object detection and data collection can be implemented by P1 present LiDAR and Camera sensors. These sensors will detect the 3D surroundings of traffic agents using a neural network and their position wrt P1.

These positions will be transformed into global coordinates with GPS positioning.

Stage 2:

Collected Data will be encoded in the following format,

frame_id, object_id, pos_x, pos_y, heading, velocity

Stage 3:

Based on the encoded sequential data RNN-LSTM model will predict the future 5-sec sequence of each traffic agent position and heading.

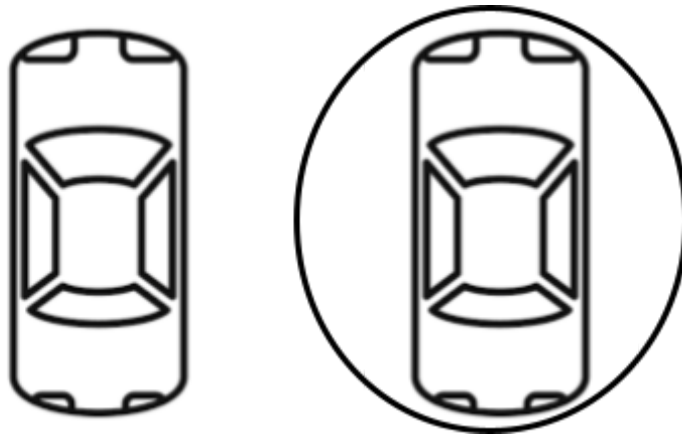
Stage 4:

Predicted future pos of each traffic agent will contribute to MPC to plan the motion of P1. Current PID has no power for generating control considering future states of the environment thus MPC is the only option if such motion control wants to design.

Present Work:

Currently, stage 3 is under work, where we are using the Apollo dataset to create an RNN-LSTM model. The present test model was created after a trial of 20+ different combinations of RNN-LSTM which is giving an R2 score of 0.95 for both pos_x and pos_y while for heading it varies with different conditions from 0.3 to 0.8. The graph of predicted 5 positions of different traffic agents are attached below.

From the current result, the feasibility score of the above concept increases. While accuracy for positions is pretty much good, it is bad for heading. The reasons can be a lack of dataset variations and sharp deflection in values like sharp reverse turn. This heading problem can be solved by considering the sphere of influence for traffic agents, which will decrease inaccuracy in heading prediction.



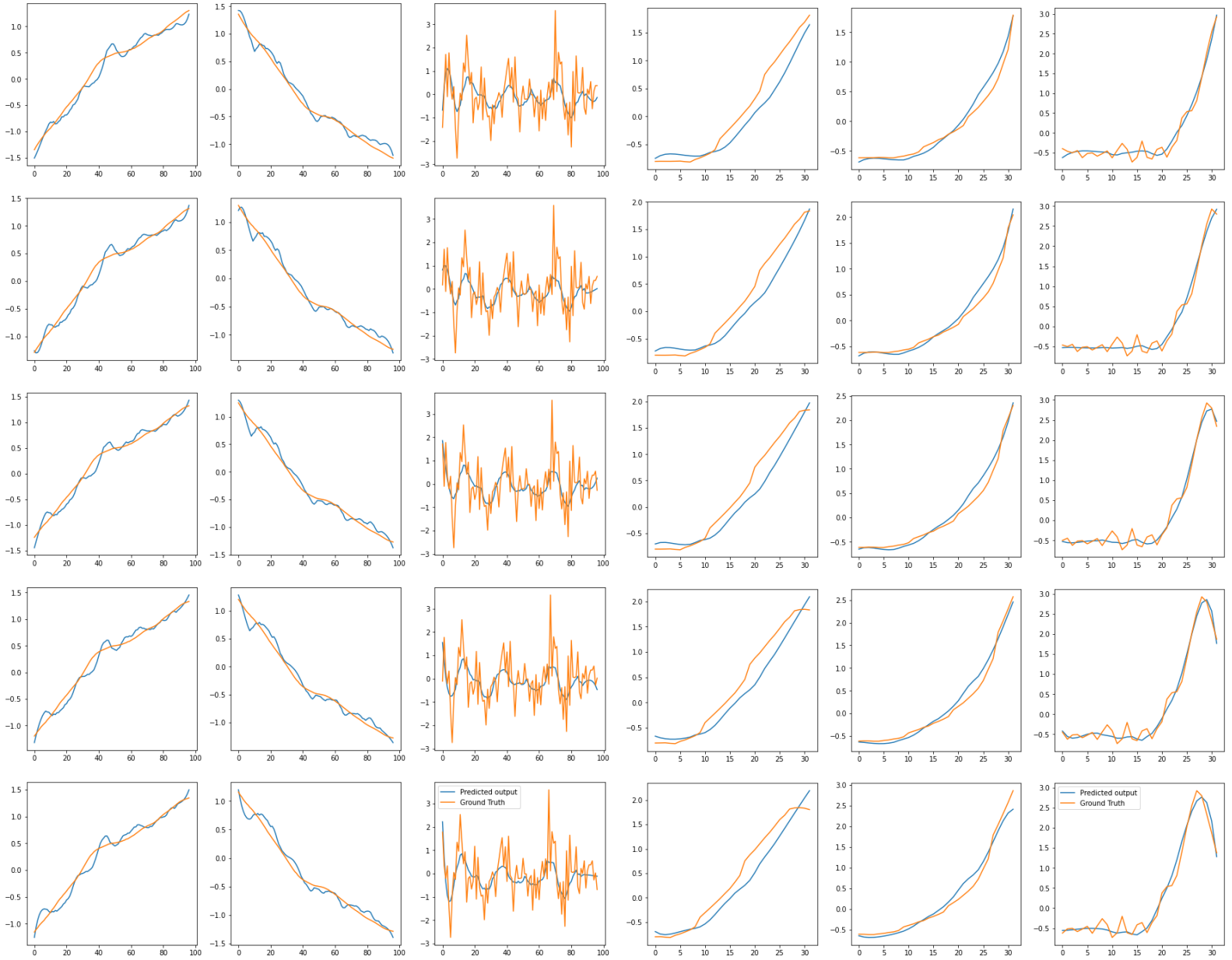
Future Work:

Dataset creation:

Currently we are training model using Apollo dataset which is not enough for training. So we need to collect our own dataset especially with multiple dynamic traffic agents. Based on new dataset we need to train model again with some changes in architecture of model.

MPC control design:

Also, once model is ready we need to design new MPC for P1 which can take advantage of predicted future states.



Test 1 - Posx, Posy, Heading (Future 5 Pos)

Test 2 - Posx, Posy, Heading (Future 5 Pos)

Reference:

Jeong, Y., Kim, S. and Yi, K., 2020. Surround vehicle motion prediction using LSTM-RNN for motion planning of autonomous vehicles at multi-lane turn intersections. IEEE Open Journal of Intelligent Transportation Systems, 1, pp.2-14.