ICIEA 2022

16 - 19 Dec 22

Chengdu, China

ICIEA22-000332
Curve Trajectory Prediction Based on Vehicle Infrastructure Cooperative Systems

Li Zhaoyang, Liang Tianhao, Ren Qiyuan

Zhejiang University

In this work, the concept of vehicle infrastructure cooperative systems is used to predict the vehicle trajectory of curves. By integrating the multi-sensor data of the on-vehicle and on-road sensors, the perception dimension is broadened. This work utilizes the Bidirectional Long-Short Term Memory to enhance the ability to process historical vehicle status information, while combining the Encoder-Decoder with the attention mechanism. The Mixture Density network is also adopted to obtain the probability distribution of predicted trajectory points. The experimental results show that compared with the traditional model-based prediction method, the prediction trajectory obtained by the prediction algorithm using the deep neural network is more accurate.

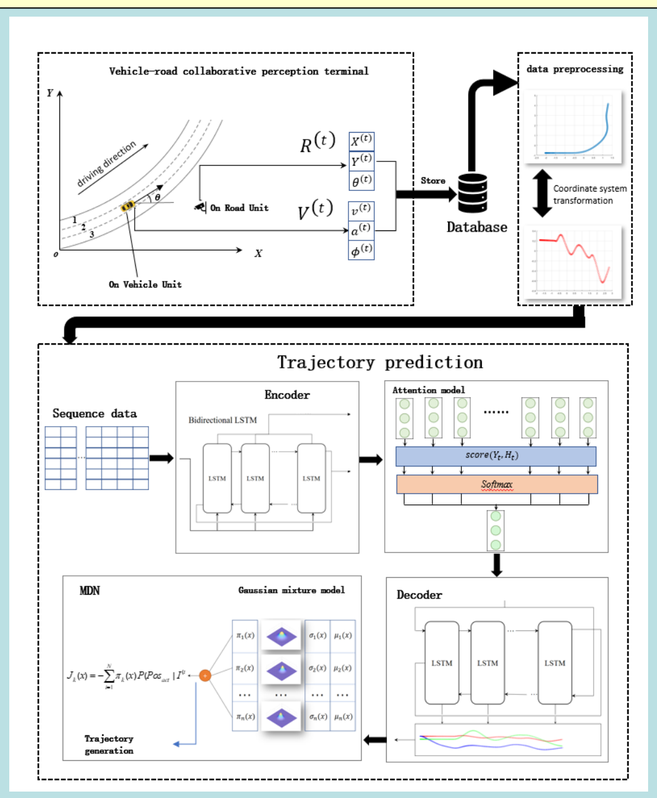

Fig.1 Overall Architecture of the System

Architecture

The roadside equipments are composed of cameras, lidars, millimeter-wave radars, and industrial computers. The vehicle information is collected through the CAN bus. (X, Y) corresponding to the relative position of the vehicle in the target detection area, θ corresponding to the yaw angle of the vehicle. The above three quantities are used as the main parameters of trajectory estimation provided by the roadside end. The onboard sensors mainly collect vehicle speed, acceleration, and front wheel angle information. This work converts the Cartesian coordinate to the Frenet coordinate. By using the data collected from the experiment, the Encoder-Decoder-based model can be trained, which can generate the trajectory for the next few seconds.

Experiments

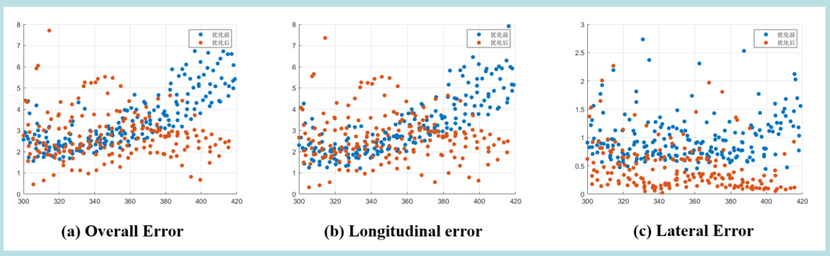

Fig.2 Comparison of Error at Different Positions

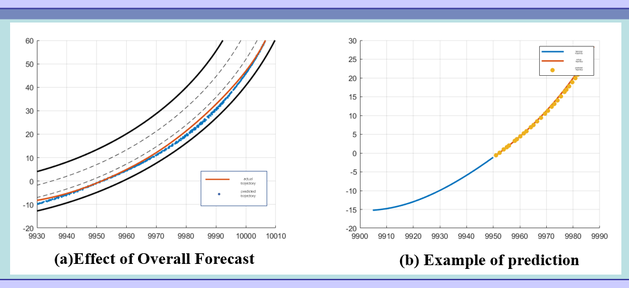

Fig.3 Prediction Effect Diagram

The training results are verified on the test sets, and the following prediction effect diagram is finally obtained by choosing historical time as 3 seconds and prediction time as 6 seconds.
This algorithm is optimized for the curve scene, and the original Cartesian coordinate system is transformed into the Frenet coordinate system. The overall error of the optimized algorithm is smaller, and the overall error distribution is more even.

Summary

1)This work designs a trajectory prediction system for high-risk scene curves. Through vehicle-road collaboration technology, the multi-sensor information of the devices on the vehicle and roadside is obtained. Using deep learning technology, the sensors are effectively fused, and the prediction framework is optimized using structures such as long and short-term memory, encoder-decoder and attention mechanism, which improve the accuracy of long-term prediction.
2)This work optimizes the special scene of the curve through the method of coordinate system transformation, which can be extended to other risky scenarios. The work also collects real-time data in the corresponding scene, builds a database, and forms an efficient and specific target risk prediction system.