A Power Assistance System for Steering Characteristics Classified by Deep Neural Network

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***Abstract*—This paper presents the power steering assistant system for drivers' handling characteristics classified by deep neural network. The purpose of identifying car handling characteristics is to help the weak by compensating for the lack of power in steering a vehicle. Classification of driver's handling force has been performed and the class has been used to support the driver to steer the testbed system. The success rate of matching patterns was about 81.2% by deep neural network.**

***Index Terms*—Handling characteristics, vehicle steering, steering compensation, deep neural network**

I. Introduction

STEERING a car is a regular task for people to commute work place and home every day. Motor driven power steering(MDPS) systems help drivers to manipulate car handle with ease. The amplifying gains of power steering system of commercial vehicles are set equal for all the drivers.

Recently, some sports cars provide a choice of power steering gains to select rigid handling or flexible handling for his/her driving amusement. Most of cars provide a constant gain for power steering device regardless of the age and the gender of drivers. This may cause driving pain, specially handling pain to those who have less handling power. The old and the weak can suffer from Carpal tunnel syndrome or wrist/arm pain when they drive their cars.

Different power gains of steering wheels for different drivers will alleviate the driving problem [1]. Therefore, compensation for the vehicle steering tasks of the old will help them greatly for the safety of driving a vehicle.

In this paper, handling patterns of drivers are classified into three groups depending upon their handling power, weak(W), medium(M) and strong(S). Deep neural network is used to learn drivers' handling characteristics and classify them so that the power steering system provides assistive power according to the handling power shortage.

Experimental studies of the proposed power assistive system for different drivers are conducted. Driving patterns of drivers are trained with neural network and their patterns are tested in the MDPS testbed system.

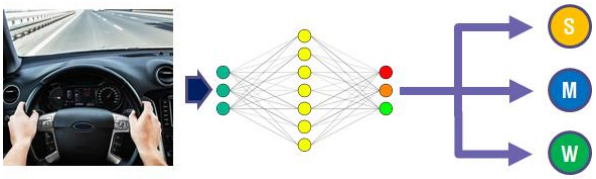


Fig.1 Concept of handling classification

II. Classification of Handling Characteristics

Several groups of drivers are tested for their power strength to generate exemplars and testing patterns into three classes. Three data sets such as angle, angular velocity, and torque of a driver are collected for the same driving pattern in a given time. Normalized input data for the 4 convolution neural network (CNN) layers and CNN outputs are fed into the max pooling layer to reduce the feature size. Then multi-layered perceptron network is used for classifying into three groups. Softmax layer for the output is used. The size of data is 27 and the number of data samples used for training is 1168. More than one hour training time was taken for 6000 epochs.

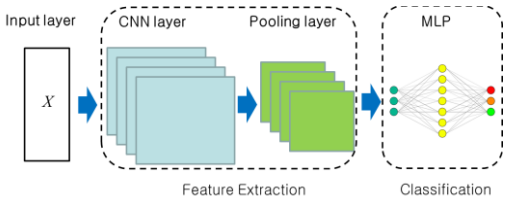
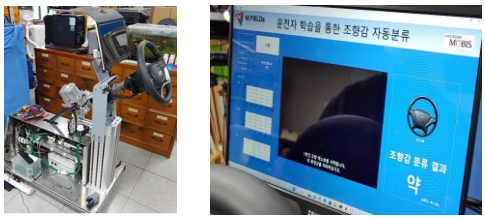


Fig. 2 Deep neural network structure.

III. Experiment

Fig. 3 (a) shows the steering testbed system. A driver follows the instruction of turning a handle for a minute. Then the pretrained neural network classifies his/her driving pattern and MDPS provides assistive force to the driver so that the driver feels the force. Fig. 3 (b) shows the GUI panel that shows the the driver's class, which is weak presently.



(a) Testbed (b) Display

Fig. 3 Handling test system

IV. Conclusion

In this paper, motor driven steering system was developed to support drivers according to their power strength classified by deep neural network. The success rate of matching patterns was about 81%.

References

[1] Y. S. Shin, H. J. Song, J. Y. Park, J. W. Choi, "Deep Learning Based Real-Time Driver Style Classification Using Vehicle CAN Data ", *KSAE*, pp. 594-598, 2020.