DETECTION OF ABNORMAL DRIVING APPLYING RECURRENCE PLOTS

Yuta ARAKAWA[1], Kazuyuki TAKADA[1], Kota MIYAUCHI[1]

[1] Tokyo Denki University, Japan

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1. INTRODUCTIONS

In Japan, the number of traffic accidents caused by elderly drivers is increasing. The National Police Agency of Japan requires elderly drivers over the age of 75 to have a cognitive impairment test to check their ability of driving aptitude. However, it is difficult to prevent the occurrence of traffic accidents among the elderly by these measures alone. It is necessary for each elderly driver to understand his or her own driving skills and to take appropriate measures.

In this study, a recurrence plot was created from driving behavior data, and a deep learning image recognition technique was applied to detect abnormal driving.

2. DATA

A summary of the observation survey is shown in Table 1. The subjects were 17 persons aged 65 or older living in Higashimatsuyama City, Saitama Prefecture. The subjects' driving behavior data were observed using a developed, easy-to-use driving behavior observation application, including latitude and longitude and acceleration of the 3-axis components.

Table 1. Outline of observation survey

Target person in survey	Those who live in Higashimatsuyama City, Saitama Prefecture and are 65 years old
Number of people	17 people
Observation equipment	iPhone
Observation items	・Observation date and time※1 ・Acceleration of 3-axis components(G) ※1 ・Azimuth（deg）※1 ・Vehicle speed(km/h) ※2 ・location information（deg）※2
Observation interval	※1：10Hz (Measured at 0.1 second intervals) ※2：1Hz (Measured at 1 second intervals)
Recording Method	The data is saved in csv format in the cloud in real time.

3. PRODUCTION OF ANALYSIS DATA

Figure 1 shows an example of intersection operation data and recurrence plot. The recurrence plot was created by arranging the left/right acceleration in the first half and the front/rear acceleration in the second half from the extracted operation data.

Figure 2 shows a comparison of the data for different days. The colors are coordinated by showing larger or smaller values of acceleration, respectively. It is also possible to make an overall comparison by showing the entire time series and multiple accelerations as images.

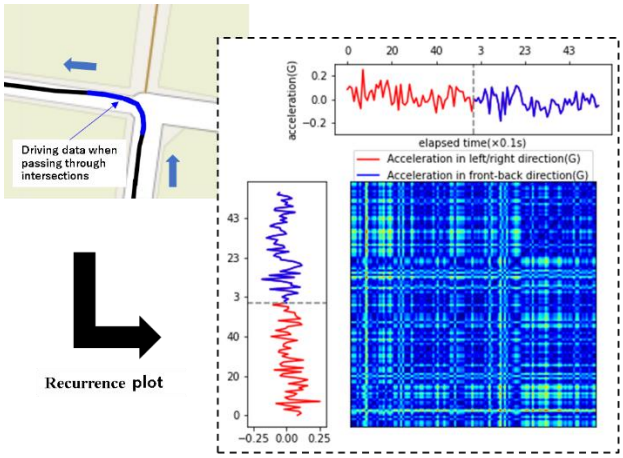

Figure 1. An example of intersection operation data and recurrence plot

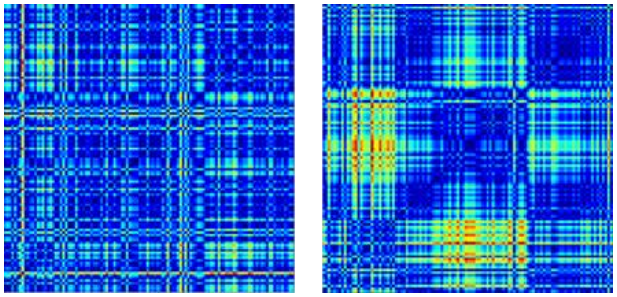

Figure 2. Comparison of Recurrence Plots

4. CONCLUSIONS

In this study, intersection areas were extracted from the observed driving behavior data and recurrence plots were created. Abnormal driving was detected by applying deep learning image recognition techniques to the recurrence plots created.

In the future, we will use the developed abnormal driving detection method to make elderly drivers aware of their own driving. As a result, we will verify whether or not we have led to safer driving.

REFERENCES

[1] Zhiguang Wang, T. Oates: Encoding Time Series as Images for Visual Inspection and Classification Using Tiled Convolutional Neural Networks, Workshops at the Twenty-Ninth AAAI Conference on Artificial Intelligence, 2015.

[2] Kota MIYAUCHI, Kazuyuki TAKADA: Development of Driver Identification Method using Driving Behavior at Intersections, Journal of the Eastern Asia Society for Transportation Studies, Vol.14, pp. 2277-2293, 2022.