

Study on the Characteristic of Eye During Traffic Operation

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Abstract. To design vehicle auxiliary equipment, it need master the characteristic of eyes. The paper adopted iView X HED as equipment to get the characteristic of eye during traffic operation, results could be treat as experiment research. The paper collected text data of eye, and adopted location, during, blink time, blink frequency, and transient of eye focus as parameters to study the characteristic of eye, and given a measurable value to them. It was a foundation to further research of driver's characteristic. The result showed that: the location mainly focus in ahead, the average value of time and blink was 0.3098s and 0.231s. Frequency of blink was respond to traffic condition, the mainly direction of transient was left and right.

Introduction

Traffic flow could produce traffic conflict. Mainly reason was the drivers got inadequate information about traffic environment. ITS proposed a concept of assistance system to driver, but need to know the characteristic of drivers, especially to the characteristic of driver's eye^[1,2]. Then, it could design an equipment of information collection and dangers warning^[3,4]. Such, the paper design a test to study the characteristic of eye, via by collected data of location, during, blink time, blink frequency, transient of eye focus, to quantitative study to characteristic of eye in traffic^[5,6].



Fig1. Investigate scenes1



Fig2. Investigate scenes2

The equipment of information collection was iiView X HED. Principle of work was got the eye's image by infrared camera, and to track the trajectory of eye's focus. Real-time computing the time, distance and speed of eye in Horizontal and vertical direction, and computing the location and diameter of pupils. Sampling rate was 50/60Hz, Tracking resolution was 0.1° , Monitor accuracy of recording was $0.5 \sim 1^\circ$, and the weight of helmet was 450g. The connection had two method: Wired and wireless (wireless connection was Bluetooth, the max control distance was 300m). Fig1 and fig2 was the special scene in traffic survey. Cross was the calibrated point and the circle was the location of driver's view-point in traffic survey scene^[7,8].

Location and During of View-point

During the driving, drivers transit their view-point corresponding to the change of traffic environment. In the proceeding, the view-point would remain in a stable point, and collected the information of traffic environment and to make a judgment, then, to decide the operating characteristic in next step. It could get from the traffic survey; the parameter of view-point during reflected the capacity of driver to concept and deal information. The average during of view-point was 700.4s. The mount of simple was 1233.

Location of View-point. Distribute of view-point location were shown in fig3 when driving in city road. So, it could get the conclusion: the distributed of view-point was mainly in the center of the field view-area.

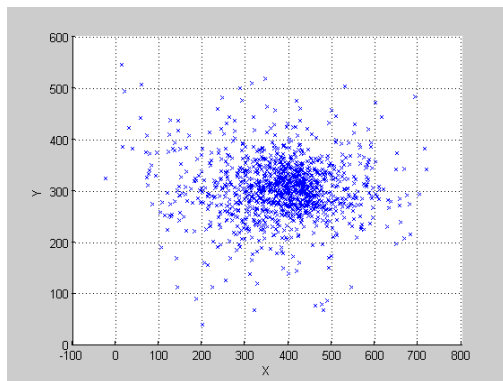


Fig3. Distribution of the view-focus location

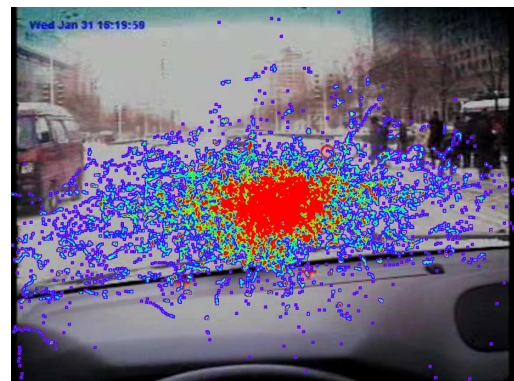


Fig4. Heat of the view-focus location

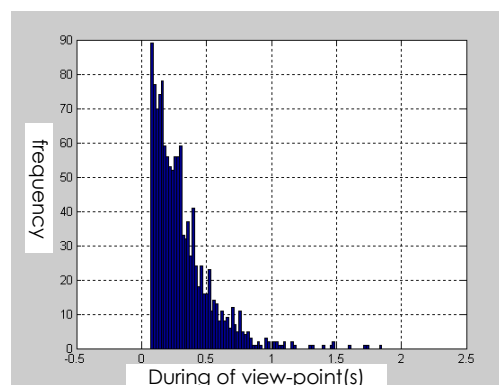


Fig5. Frequency of the viewpoint residence time

During of View-point. It divides the collection data of view-point during into 0.02s groups, then to draw the frequency chat shown in fig5. The max value was 1.840s, the min value was 0.078s, and the average value was 0.3098s. The frequency was 89 in the interval (0.07s, 0.09 s], 77 in the interval (0.09s, 0.11s], and 70 in the interval (0.11s, 0.13s]. Overall, the frequency of view-point during reduced corresponds to the increased of operation time.

Blink time and Blink Frequency

Blink time and blink frequency were indicators which reflect the physiological characteristic of drivers. It could get the capacity of drivers to receiving and processing information. The length of survey dada was 700.4s, and got 1413 simples of blink.

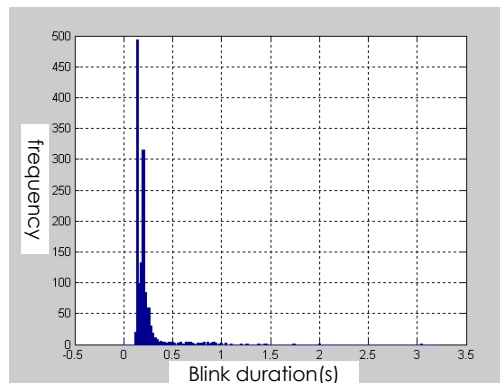


Fig6. Distribution frequency of blink duration

Blink Time. Blink time of drivers distribute in the interval [0.02s, 3.04s], the average value was 0.231s. It divide the blink time in several groups, the interval was 0.02s, draw the frequency chat shown as fig5.

The frequency was 493 in the interval (0.13s, 0.15s], it was the first peak about the blink. The frequency was 315 in the interval (0.19s, 0.21s], it was the second peak about the blink.

It could get the result that the frequency nearly equivalent in the interval [0.35s, 1.05s], the frequency value in the interval [1, 4], the value was 0 or 1 in the interval (1.05s, ∞). Blink time mainly concentrated in the interval [0.11s, 0.33s].

Blink Frequency. The blink frequency was real time change during operation. Operation time and environment were main reason to change the blink frequency. Thus, it could get the fatigue characteristic of drivers though the parameter of blink frequency.

It got the statistics table via by survey data, as shown in fig 1, and take parameters such as average value, max value, min value, Mean square error. Average value reflected the number of blink, max value reflected the strength of blink, and Mean square error reflected the dispersion of blink. Min blink frequency was 0 times/10s, average was 2.213 times/10s.

Tab.1 Descriptive statistical indicators of blink data (10s)

index	value
average value	2.165
max value	11.000
min value	0.000
Mean square error	2.213

It could get the result though analysis the statistical data: the driver need often blink to ease the fatigue witch cause by continued driving. On the other side, it also proves the correct that adopted blink frequency as the evaluated parameter to visual adaptability.

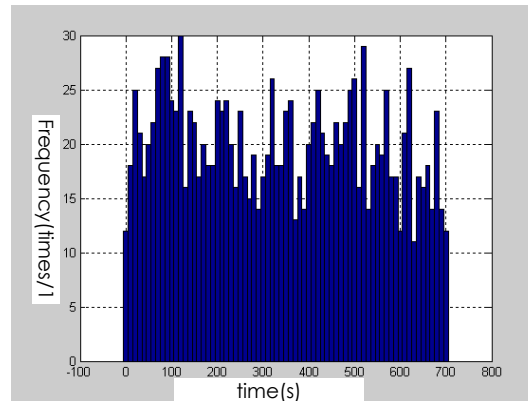


Fig7. Blink frequency

Transient of Eye Focus

The survey got 374 group data about transient of eye focus. It could draw a transient chat by the survey data in view field, as shown in fig9. Arrow direction reflected the direction of transient, Arrow size reflected the speed of transient. The transient of eye focus mainly occur in the center of view, but the transient speed was slowly relative to around field. The traffic environment and object continued change during driving, the drivers need to change location of view-point to collection the information. So, to study the regular pattern of eye focus transient could reflect the characteristic of driver correspond to the traffic change and urgent condition. In order to analysis the transient of eye focus, Enlarge the fig 9, and shown in fig10, fig11, fig12, fig13, fig14.



Fig8. Viewpoint stay and transfer

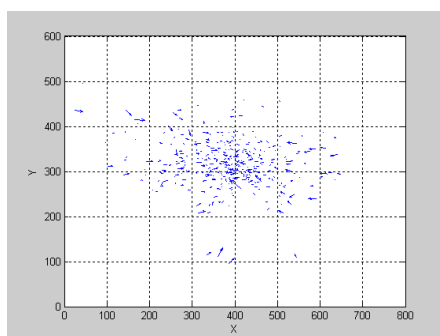


Fig9. Viewpoint quickly transfers

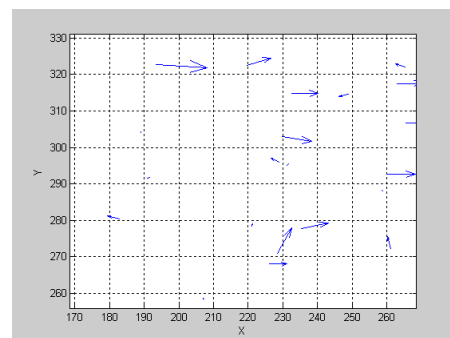


Fig10. Partial view of the left

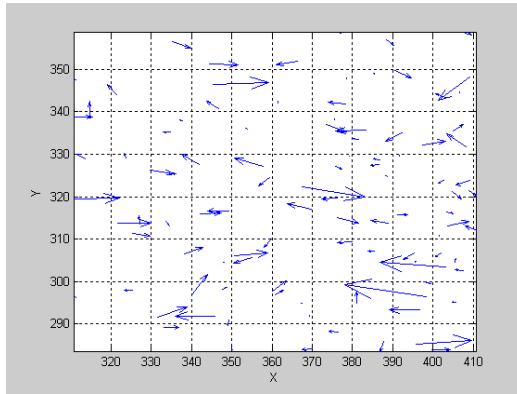


Fig11. Partial view of the center

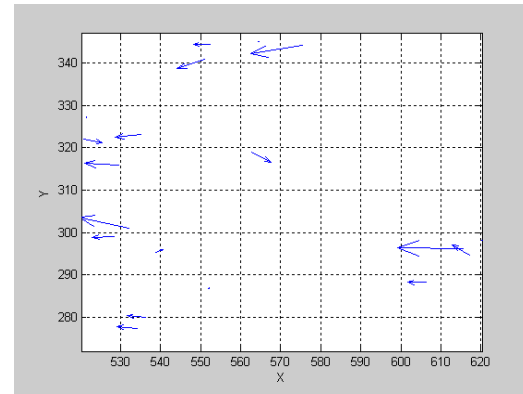


Fig12. Partial view of the right

It could know from fig10, the main direction of eye focus transient was right in left view field. In order to get the information in center and right area when eye focus in left, the speed of transient became fast, and more left, more fast.

It could know from fig11, the main direction of eye focus transient was left and right in center view field. Direction of up and down seldom appears. It transit became more frequency in the center view field.

It could know from fig12, the main direction of eye focus transient was left in right view field. The characteristic of eye focus transient was opposite to the left view field.

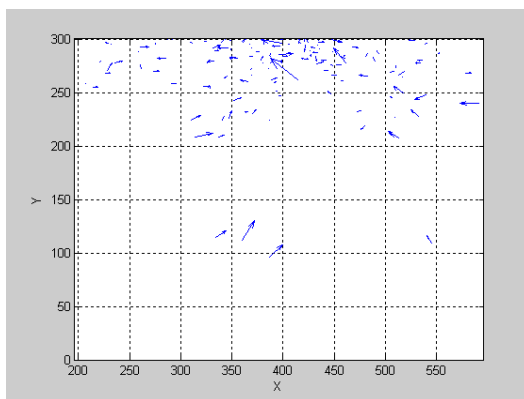


Fig13. Partial view of the lower

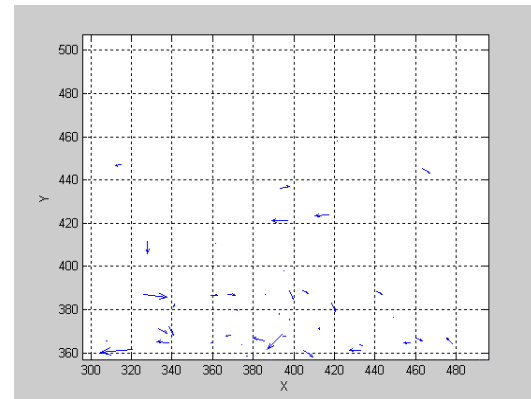


Fig14. Partial view on the side

It could know from fig13, the main direction of eye focus transient was down, left, right in up view field. The drivers though up view field to get the information in distant, the survey was city road, the average velocity was 20km/h, the eye focus of driver was in 30~40m ahead. The change in distant could not cause the rapid reflect, so, the characteristic of eye focus transient was less. In order to get the information in center and right area when eye focus in left, the speed of transient became fast, and more left, more fast.

It could know from fig14, the main direction of eye focus transient was up, left, right in down view field. The drivers though up view field to get the information in nearby, the driver was less attention to the information. The main direction was up, it reflect the characteristic that the driver transient his eye focus into center field when got the traffic information.

So, it could get the conclusions: the direction of eye focus transient was left and right. The more away to center field, the transient became more fast.

Conclusion

It adopted the characteristic of eyes as study object, Quantitative analysis the parameters of location, during, blink time, blink frequency, transient of eye focus. The result shown that: the location of eye focus mainly in ahead, the average value of time and blink was 0.3098s and 0.231s, frequency of blink was respond to traffic condition, the mainly direction of transient was left and right.

Acknowledgements

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