

Characteristics of visual responses viewing at VDTs

T. Takeda, Y. Fukui and T. Iida
Industrial Products Research Institute of MITI, JAPAN

INTRODUCTION:

The authors have developed three-dimensional Optometer (TDO) which can measure major three basic ocular functions - eye movement, accommodation and iris area - while watching real visual targets. The TDO was applied to measure visual responses of three young subjects working at VDTs.

METHOD

Equipment: The TDO system is shown in Fig. 1. The second box from the left depicts a modified auto refractometer (NIDEK, AR3-SV4) to measure accommodation. The left box contains a light relay system which directs infrared light emitted from the AR3-SV4 into the pupil perpendicularly, irrespective of the angular eye position. The feature is obtained by moving two galvano-mirrors in the box according to eye movements. On the right side, there is an eye monitor, a controller of the galvano-mirrors, a calculator to determine the area of the iris and a microcomputer to control the timing of measurement.

Precision and cutoff frequency in measuring accommodation and iris response are the same as for commercially sold devices ($\pm 0.25D$, 1.2% ; 4.7Hz, 8.4Hz, respectively), and those of eye movement are $\pm 0.5^\circ$ and 4.7Hz, respectively. Visual angles allowed are 40° horizontally and 30° vertically (-25° - $+5^\circ$).

Subjects: Three emmetropic youth (2 females O.R. age 23, B.S. age 21 and a male K.H. age 19) were used as subjects. They demonstrated visual acuity of 1.0 or more without correction and accommodative power of 7.7, 4.6 and 7.2 diopters, respectively. The dominant eye, which was the right eye for all the subjects, was measured.

Task: The subjects were required to search specified 2 digits numbers out of 19×14 displayed random numbers on a CRT as shown in Fig. 2. The search time was consecutive 60 minutes without a break. Accommodation, eye direction and iris area were measured every 10 minutes while the subjects were continuing the task.

Results:

Fig. 3-4 show the visual responses (left) before the VDT work and (right) after 1 hour work of subjects OR and BS. Lines (A) are accommodation responses, lines (X) are horizontal eye movement (left eye position is shown in upper side deviation in the figures), lines (Y) are vertical eye movement and lines (I) are pupil diameter. Vertical division means 1 diopter change of accommodation, 5 degrees of eye movement and 1 mm pupil diameter change.

The most remarkable and prominent feature of the visual responses as shown for examples in the Fig. 3-4 is that the amount of fluctuation in the accommodative responses tend to increase by the prolonged usage of VDTs.

REFERENCES:

1. Takeda, T., Fukui, Y. and Iida, T., Three-dimensional optometer, Applied Optics, 27, 12, 1988.
2. Takeda, T., Iida, T. and Fukui, Y., Dynamic eye accommodation evoked by apparent distances, Optometry and Vision Science, 1990.

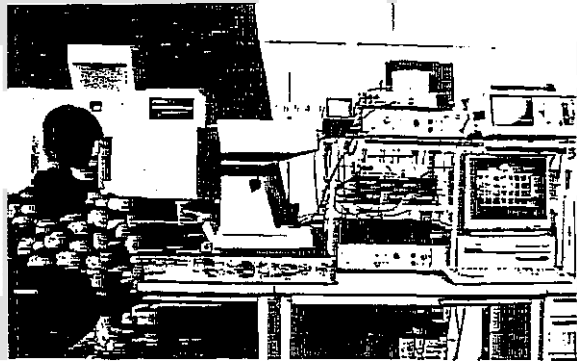


Fig.1 The TDO system which can measure accommodation, eye movement and iris diameter simultaneously while Subjects are shifting eye position freely

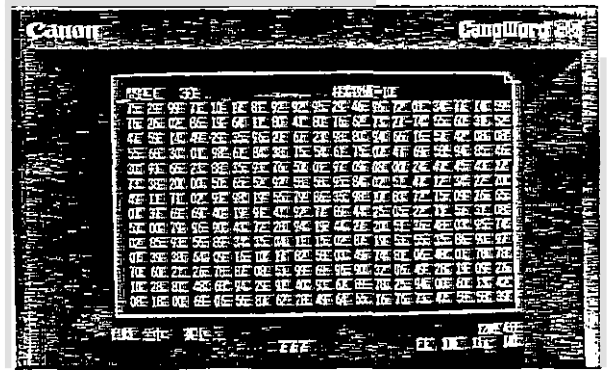


Fig.2 The display used. It shows 2 digits random numbers (19*14). Subjects are required to search a specified number.

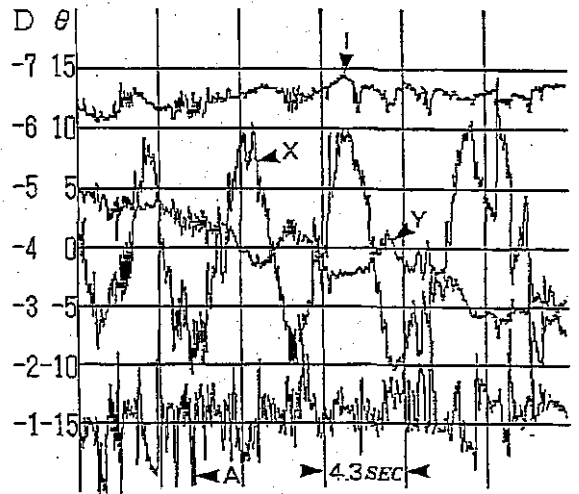
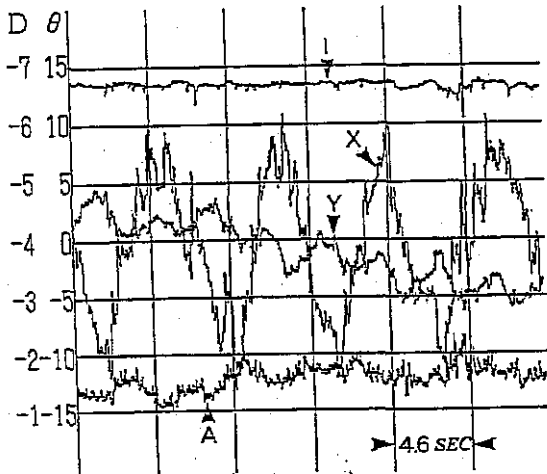


Fig.3 Response of subject OR. Left is a response before the VDT work and the right is a response after an hour of the W T work. The response curves are accommodation (A), horizontal eye position (X), vertical eye position (Y) and pupil diameter (I), respectively. Horizontal divisions are 1 diopter of change in accommodation, 5 degrees of eye position and 1 mm change of iris diameter, respectively.

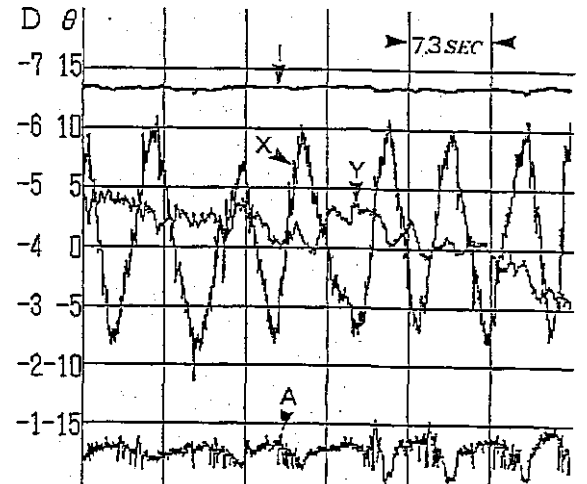
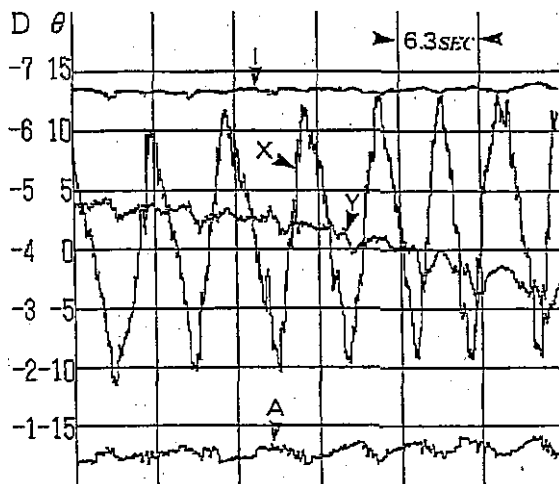


Fig.4 Response of subject BS. Left is an response before the W T work and the right is the response after an hour of the W T work. The mean of symbols and vertical division are the same as in Fig.3.