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Road vehicles — Measurement of driver visual behaviour with respect to transport information and control systems —

Part 1: Definitions and parameters

Véhicules routiers — Mesurage du comportement visuel du conducteur en relation avec les systèmes de commande et d'information du transport —

Partie 1: Définitions et paramètres

[Revision of first edition (ISO 15007-1:2002)]

ICS 13.180; 43.040.15

ISO/CEN PARALLEL PROCESSING

This draft has been developed within the International Organization for Standardization (ISO), and processed under the **ISO-lead** mode of collaboration as defined in the Vienna Agreement.

This draft is hereby submitted to the ISO member bodies and to the CEN member bodies for a parallel five-month enquiry.

Should this draft be accepted, a final draft, established on the basis of comments received, will be submitted to a parallel two-month approval vote in ISO and formal vote in CEN.

To expedite distribution, this document is circulated as received from the committee secretariat. ISO Central Secretariat work of editing and text composition will be undertaken at publication stage.

Pour accélérer la distribution, le présent document est distribué tel qu'il est parvenu du secrétariat du comité. Le travail de rédaction et de composition de texte sera effectué au Secrétariat central de l'ISO au stade de publication.

Contents

Foreword

ISO (the International Organization for Standardization) is a worldwide federation of national standards bodies (ISO member bodies). The work of preparing International Standards is normally carried out through ISO technical committees. Each member body interested in a subject for which a technical committee has been established has the right to be represented on that committee. International organizations, governmental and non-governmental, in liaison with ISO, also take part in the work. ISO collaborates closely with the International Electrotechnical Commission (IEC) on all matters of electrotechnical standardization.

International Standards are drafted in accordance with the rules given in the ISO/IEC Directives, Part 2.

The main task of technical committees is to prepare International Standards. Draft International Standards adopted by the technical committees are circulated to the member bodies for voting. Publication as an International Standard requires approval by at least 75 % of the member bodies casting a vote.

Attention is drawn to the possibility that some of the elements of this document may be the subject of patent rights. ISO shall not be held responsible for identifying any or all such patent rights.

ISO 15007-1 was prepared by Technical Committee ISO/TC 22, *Road vehicles*, Subcommittee SC 13, *Ergonomics applicable to road vehicles*.

This second/third/... edition cancels and replaces the first/second/... edition (), [clause(s) / subclause(s) / table(s) / figure(s) / annex(es)] of which [has / have] been technically revised.

ISO 15007 consists of the following parts, under the general title *Road vehicles — Measurement of driver visual behaviour with respect to transport information and control systems*:

- *Part 1: Definitions and parameters*
- *Part 2: Equipment and procedure*

Annex A of this part of ISO 15007 is for information only.

Introduction

Vision provides the primary source of information available to a driver. Information is gathered by looking at objects and events and this in turn affords control and navigation of the vehicle in the road traffic environment. Assessment of a driver's visual behaviour provides a method of quantifying the driver's visual allocation to the roadway or in-vehicle information sources (see e.g. Allen et al., Green P., 2011, Sivak, M., 1996).

Transport Information and Control Systems (TICS) applications for vehicles may have visual displays that can present a range of driver-selected information. If these visual displays have associated controls (e.g. to select a zoom level or menu option) then these associated hand-control activities may also be visually guided and become part of the visual behaviour associated with a display/TICS application. For this reason it may be important to consider not only the visual behaviour in relation to information display, but also the duration and frequency of glances following driver controlled actions.

Comparisons between specific vehicle systems have been made more difficult because the studies were conducted in different environments using different experimental techniques, different measurement definitions, and different analysis methods.

ISO 15007 has been developed to give guidance on the terms and measurements relating to the collection and analysis of driver visual behaviour data. This approach aims to assess how drivers respond to vehicle design, the road environment, or other driver-related tasks in both real and simulated road conditions. More specifically, the approach of this standard is based on the assumption that efficient processing of visual information is essential to the performance of the driving task.

Part 1 of ISO 15007 defines key terms and parameters applied in the analysis of driver visual behaviour focused on glance and glance related measurements. Part 2 of ISO 15007 gives guidelines on equipment and procedures for analysis of driver visual behaviour.

Practical assessments of drivers in real or simulated environments are conducted to quantify the allocation of visual behaviour to specified areas of interest. Visual behaviour may be quantified by the location, duration and frequency of glances to a specified area of interest in the visual scene (and, over time, between areas of interest). This approach often uses commonly available eye tracking and/or video-recording equipment. However, it does not preclude the use of more sophisticated technologies which may elicit additional driver visual behaviour information.

Results from such assessments should enable comparison of the relative influence of the TICS use with reference conditions.

Road vehicles — Measurement of driver visual behaviour with respect to transport information and control systems — Part 1: Definitions and parameters

1 Scope

Part 1 of ISO 15007 defines key terms and parameters applied in the analysis of driver visual behaviour focused on glance and glance-related measures. These terms and parameters can be applied in environments from real-world driving experiments to laboratory-based driving simulator studies.

The procedures described in this part of ISO 15007 could also apply to more general assessments of driver visual behaviour without the introduction of TICS-specific systems. The parameters and definitions described below are intended to assist development of a common source of reference for driver visual behaviour data.

Minimum requirements for reporting the results of Transport Information and Control Systems (TICS) evaluations are provided.

Further guidance including the specification of how to analyse and present the results of studies of visual behaviour is available in other ISO publications (see, for example, ISO ISO 2854 and ISO/TR 13425:2006). However, data collected and analysed according to this standard will allow comparisons to be performed across different TICS applications and experimental scenarios.

2 Normative references

The following referenced documents are indispensable for the application of this document. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

ISO 2854, *Statistical interpretation of data — Techniques of estimation and tests relating to means and variances*

ISO/TR 13425:2006, *Guide for the selection of statistical methods in standardization and specification*

ISO 15007-2, *Road vehicles — Measurement of driver visual behaviour with respect to transport information and control systems — Part 2: Equipment and procedures*

3 Terms and definitions

The following terms and definitions apply, as well as the measures defined below in Clause 4.

3.1
accommodation
adjustment of the lens of the eye to bring about focusing of an image of an object upon the retina

NOTE The time for the eye to accommodate from one object to another depends on the distance between the objects.

3.2
adaptation
ability of the eye to adjust to changing light conditions

NOTE Adaptation times to transition from dark to light and light to dark are different.

3.3
direction of gaze
area of interest to which the eyes are directed

3.4
fixation
alignment of the eyes so that the image of the fixated area of interest falls on the fovea (the middle of the retina responsible for our central, sharpest vision) for a given time period

NOTE Typically, individual fixations last from 100 to 2 000 ms (Karsh, R., & Breitenbach, F.W, 1983). Fixations are the briefest of pauses during which visual information extraction is done by the eyes-and-brain from spatial areas that fall on the fovea of the eye (and hence are quite small). During fixation, there are believed to be at least three processes taking place (Viviani, 1990): (1) analysis of the image falling on the fovea, (2) selection of a new saccade target, and (3) programming of the saccade to-be-made-next. It is not yet known how these processes are synchronized by the brain, nor how precisely they are synchronized – since fixation durations are not always long enough to comprehend completion of all the processes. (Sometimes the eyes move before information extraction from the site of fixation has been completed, as evidenced by frequent corrective return fixations to a site under some conditions that was fixated too briefly). There is evidence that the brain both pre-programs fixation duration, and also does “process-monitoring” during a fixation to determine if analysis of the foveal image is complete within the fixation’s duration.before moving on. Thus, fixation time is dependent on both the immediate stimulus and the history of prior fixations. The contribution of both components suggests that fixation time may depend on the task and the amount of useful information in the fixated display (or viewed information) (Over, EA., et al., 2007).

See Annex A.1. to A.4

3.5
glance
maintaining of visual gaze within an area of interest, bounded by the perimeter of the area of interest; may be comprised of more than one fixation and saccades to and from it. Its duration is measured as “glance duration”

NOTE A glance is a scientific **construct** that sums over one or more fixations that are made contiguously within a given area of interest (but one that is larger than the area corresponding to the eye’s foveal region – an area that usually requires more than one fixation to view). The construct of a glance, therefore, typically comprehends more than a single fixation and is a coarser unit of analysis than a single fixation (since it is summing over fixations that are contiguous in time and spatially proximal within an area of interest). (“Area of interest” is formally defined below in 4.2.5). The construct of a “glance” is needed because often the salient questions in a study relate to the amount of contiguous time spent gazing at a particular area of interest (before the eyes move away from it). (Of course, in some instances, the “glance” construct is also necessary because some measurement approaches are not capable of the fine discriminations needed to identify <u>individual</u> fixations (spatially and temporally) -- and can only discriminate at the spatial/temporal granularity of glances. Thus, “glances” are a coarser measure of visual information extraction by the eyes/brain from a continuously viewed but somewhat larger spatial region. Typical glance lengths vary by stimulus and task, but might (for example) range from 500 ms to 3 sec for a task like “tuning the radio” (Rockwell, 1988).

See Annex A.1. to A.4

3.6
saccade
brief, fast movement of the eyes that changes the point of fixation.

NOTE Saccades reach velocities as high as 500°per second (Rayner K., 1998), whereby the mean saccade ranges between 1 (text reading) to 5 deg (scene perception) (Velichkovsky, B. et al., 2000)

See Annex A.1. to A.4

3.7
smooth pursuit movement
smooth, continuous movement of the eyes made to closely follow/pursue a moving object or signal;

NOTE Humans generally perform smooth pursuit movements better in the horizontal than vertical dimension, and better in the downward than upward direction. Smooth pursuit movements can have a velocity as high as 90 °/s (*Meyer, et al.,1985)*

3.8
Blink
short moment in which the eye is closed by the eyelid. The blink starts when the eyelid starts moving downwards and ends when the eye is fully opened again

According to the duration for which the eye is closed the following classification applies (Stern, J. A., Skelly, J.J. 1984):

Normal blinks: ≤ 300 ms (mean duration 257 ms; standard deviation 11 ms)

Long closed durations: 300 ms – 500 ms

Eye-lid closures: ≥ 500 ms (indicating microsleeps)

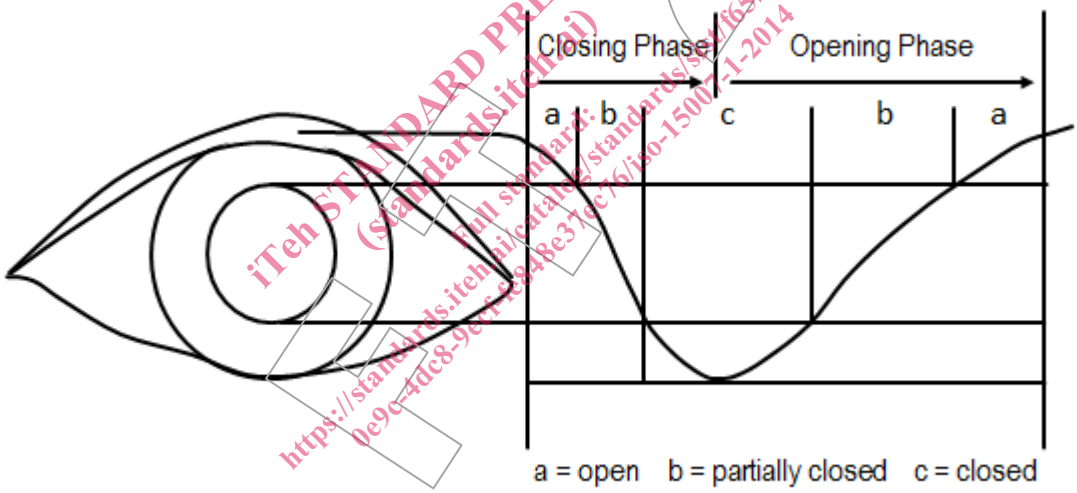

Figure 1 — Phases of a blink (according to Wild, H. 1983)

3.9
fly through (artfactual fixation)
small ‘snapshot’ of a saccade (< 120 ms) that may be an artefact captured when the eye is moving from one Area of Interest to another Area of Interest, and passing through one or more intermediate Areas of Interest in between (e.g. the eye moves from the road scene ahead to the instrument cluster and passes the head-up display)

NOTE 1 - Sometimes a small ‘snapshot’ of such a saccade may appear to be a short fixation, when it is really still part of the saccade. Such fly troughs (< 120 ms) are not treated as fixations. Fly troughs may be grouped with the saccade they are part of, if saccades are being measured.

NOTE 2 -Research shows (*Rayner K., 1998)* that fixations can´t be shorter than 100 ms)