International Workshop Agreement

IWA 3

Image safety — Reducing the incidence of undesirable biomedical effects caused by visual image sequences

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Sécurité de l'image — Réduction de l'incidence des effets biomédicaux indésirables causés par des séquences d'images visuelles

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Foreword

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In order to respond to urgent market requirements, ISO has also introduced the possibility of preparing documents through a workshop mechanism, external to its normal committee processes. These documents are published by ISO as International Workshop Agreements. Proposals to hold such workshops may come from any source and are subject to approval by the ISO Technical Management Board which also designates an ISO member body to assist the proposer in the organization of the workshop. International Workshop Agreements are approved by consensus amongst the individual participants in such workshops. Although it is permissible that competing International Workshop Agreements exist on the same subject, an International Workshop Agreement shall not conflict with an existing ISO or IEC standard.

An International Workshop Agreement is reviewed after three years, under the responsibility of the member body designated by the Technical Management Board, in order to decide whether it will be confirmed for a further three years, transferred to an ISO technical body for revision, or withdrawn. If the International Workshop Agreement is confirmed, it is reviewed again after a further three years, at which time it must be either revised by the relevant ISO technical body or withdrawn.

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

International Workshop Agreement IWA 3 was approved following consultations with and comments by interested parties on a draft framed based on discussions at a workshop organized jointly by the Japanese Industrial Standards Committee (JISC) and the National Institute of Advanced Industrial Science and Technology (AIST), and held in Tokyo, Japan, in December 2004. Appreciation is extended to the Japanese Industrial Standards Committee (JISC) and the National Institute of Advanced Industrial Science and Technology (AIST) for both organizing the workshop and preparing for this International Workshop Agreement.

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Supplement

This proposal was prepared in Japan during the workshop held in Tokyo on image safety and was created under the leadership of the National Institute of Advanced Industrial Science and Technology (AIST) and the Japanese Industrial Standard Committee (JISC) with the participation of the following members:

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Workshop resolutions

This International Workshop on Image Safety adopted the following resolutions on which the International Workshop Agreement is based.

a) This International Workshop on Image Safety (hereafter International Workshop 3) considers this International Workshop Agreement to be the first step in a process that may eventually lead to the development of ISO International Standards on image safety, which will supply guidelines intended to reduce the incidence of undesirable biomedical effects caused by visual image sequences. The process will continue to be open to the participation of all interested parties, according to the ISO procedures.

b) This International Workshop 3 defines concerns of stationary and moving images that are communicated through various media. It may therefore apply to several different types of image providers including internet providers, web page producers, graphic artists, video and motion picture production companies, computer/video game software developers and publishers, imaging device manufacturers, media companies and distributors.

c) This International Workshop 3 recognizes that there are certain undesirable biomedical effects associated with visual images. Although incidences of the effects may be low, the effects may be considerable. Therefore, accurate knowledge of the biomedical effects is important for all categories of image providers as well as those who view images.

d) This International Workshop 3 recommends that the issue be handled with an appropriate balance between the varying interests of viewers, and the interests involved in the provision of images including not only image providers' interests but also society's interest in promoting freedom of expression and artistic creativity, the balance being settled on the basis of scientific knowledge.

e) This International Workshop 3 recognizes that viewers and image providers may benefit from information about image safety, both generally and as concerns individual products. Such information is likely to be of most use before viewers are exposed to visual images. It is recognized that any proposed guidelines should be comprehensive and easily interpreted so that they can be applied without difficulty.

f) This International Workshop 3 considers the scope of this agreement to cover all aspects of image safety while recognizing that the International Telecommunications Union (ITU-R, SG6) has considered the image safety issues in relation to TV broadcasting.

g) This International Workshop 3 collected scientific information from experts with respect to three undesirable biomedical effects:

   — photosensitive seizures,

   — visually-induced motion sickness, and

   — visual fatigue.

   Scientific knowledge will be critical in the development of any guidelines in the ISO International Standards on image safety, particularly any involving numerical guidelines. Such guidelines will require research that is designed to consider the effects of various image properties in the various visual media.

h) This International Workshop 3 recognized that the workshop participants could not fully represent the various interests involved and expressed the desire for greater participation of stakeholders in the process outlined in a) above.

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Introduction

0.1 General

Computerized systems that create and edit moving images enable us to enjoy attractive and stimulating screen images, such as movies, videogames and video pictures on Internet communications. This innovative technology, bringing in a new era of digital visual amusements and arts, creates novel effects of lights and sounds, and also immersiveness through stereoscopic images and dynamic movements of viewpoint. Moving image technology not only provides amusement, but expands the possibility of educational and business communication. Recent developments of many new kinds of image-recording media and of new types of display devices and systems allow people to enjoy dynamic images on demand and on an individual basis.

Along with the broad diffusion of the innovative image technology, the incidence of undesirable biomedical effects on human health may increase. Those effects include photosensitive seizures, visually-induced motion sickness and visual fatigue. These biomedical effects depend on individual susceptibility and general health. In 1997, an incident occurred with a TV animation program in Japan. Approximately 685 medical episodes occurred, and more than 150 children required at least transient hospitalization [1]. Some of these episodes may have been migraines or other forms of disequilibrium [2], but most of them were seizures. Approximately three-quarters of the children had no prior history of epilepsy [3]. The main cause of this incident was reported to be alternate flashing of red and blue lights dominating most of the screen area, which was a component of the animation. Apart from this dramatic incident, it is also known that certain individuals suffer from visually-induced motion sickness occasionally when playing videogames that include frequent changes of viewpoint, or when watching movies that include footage shot by a hand-held camera shaken unpleasantly in order to indicate tension. Moreover, people can sometimes suffer from visual fatigue, or eyestrain, with symptoms of headache and nausea when they watch certain images, particularly those containing geometric patterns and those of stereoscopic images.

The opportunity of watching a variety of moving images can enrich our lives, and the creation of images is a necessary aspect of cultural activities, especially for education, business and the leisure industry. Moreover, freedom of expression and artistic creativity should be respected as far as is consistent with human health. We should avoid the undesirable biomedical effects not by prohibiting developments of the technologies but by providing the necessary information both for the people who make images and those who view them, particularly those who are vulnerable.

The primary purpose of this International Workshop Agreement is

— to raise awareness of the risks of the undesirable biomedical effects caused by moving images, effects such as photosensitive seizures, visually-induced motion sickness and visual fatigue,

— to encourage studies on technical issues for the development of International Standards on this issue, and

— to be the first step in a process that will eventually lead to the development of International Standards on this issue, which will supply guidelines intended to reduce the incidence of the biomedical effects.

0.2 Image safety

The introduction of the notion of “image safety” is important in raising awareness of the risks of the undesirable biomedical effects caused by moving images. “Image safety” is a concept that has as its purpose the protection of vulnerable persons from the undesirable biomedical effects on human health, particularly those caused by moving images presented on electronic displays.

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0.3 Background to image safety issues

Our everyday life already benefits from a wide variety of electronic images and the use of such images is likely to increase. During the growth of the electronic images, there have been several news reports of undesirable events traceable to visual images.

In 1993, in the United Kingdom, three persons watching a TV commercial suffered from photosensitive seizures. In 1997, in Japan, approximately 685 people, who were watching a TV animation program, were treated in hospitals because of uncomfortable symptoms and photosensitive seizures. In July 2003, again in Japan, a total of 36 out of approximately 300 junior high-school students experienced motion sickness while watching a homemade movie in a class, and were sent to a hospital.

A large variety of visual image products, such as videos and videogames, are being sold in a global market as popular consumer goods. The consumers enjoy watching a variety of screen images, often without sufficient information about the contents of the products or the risks of their biomedical effects. Therefore, a safety standard on image products is needed in the global market, to establish appropriate methods of avoiding or reducing the incidence of the biomedical effects.

0.4 Special considerations for vulnerable persons

It is recognized that there are large individual differences in the susceptibility to the undesirable biomedical effects. For example, the incidence of the photosensitive seizures is known to be approximately one per 100 000 per annum [4]. Susceptibility to visually-induced motion sickness is higher in females [5][6][7]. Therefore, there needs to be special consideration for vulnerable persons, the minority who are susceptible to the biomedical effects.

0.5 Previous recommendations relevant to image safety

Recommendations for image providers to reduce incidence of precipitating photosensitive seizures are already published in broadcasting industries both internationally and domestically in some countries; some of those recommendations are listed below.

a) International Telecommunication Union: Recommendation ITU-R BT. 1702 *Guidance for the reduction of photosensitive epileptic seizures caused by television* [8]

b) Independent Television Commission in United Kingdom (ITC). *Guidance note for licensees on flashing images and regular patterns in television* [9]

c) Japan Broadcasting Corporation (NHK) and National Association of Commercial Broadcasters in Japan (NAB). *Guidelines for picture techniques involved with animation programs, etcetera*. [10]

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Image safety — Reducing the incidence of undesirable biomedical effects caused by visual image sequences

1 Scope

This International Workshop Agreement establishes the concept of image safety for all categories of image providers as well as for those who view moving images, such as computer/video games, movies, videos and video pictures on websites. It also defines the following undesirable biomedical effects caused by moving images:

— photosensitive seizures;

— visually-induced motion sickness;

— visual fatigue.

This International Workshop Agreement supplies viewers as well as image providers with recommendations as to how to reduce the biomedical risks to which they may be susceptible.

This International Workshop Agreement does not have any contents intended for regulatory use.

NOTE ITU-R SG6 considers the image safety issues in relation to TV broadcasting. Some of these are described in ITU-R Recommendations.

2 Terms and definitions

2.1
moving image
The visual images that are presented by a sequence of images on visual display devices, which usually but not invariably produce temporal change of the visual image. A moving image not only gives the appearance of motion but also includes flashing and flickering visual images and sometimes images that appear to be still.

2.2
image providers
Persons or parties who are involved in providing moving images, including internet providers, webpage producers, graphic artists, video and motion picture production companies, computer/video game software developers and publishers, imaging device manufacturers, media companies and distributors.

2.3
viewers
Persons who watch moving images distributed by image providers.

2.4
undesirable biomedical effects
This IWA 3 is concerned with photosensitive seizures, visually-induced motion sickness, and visual fatigue, all of which are undesirable.

2.5
biomedical risks
The risk relates both to the likelihood of the occurrence of a biological effect, and its severity.

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2.6
photosensitivity
Photosensitivity, in this IWA 3, refers to human individual sensitivity to flickering or intermittent light stimulation and/or visual patterns, evidenced by the occurrence of a photoparoxysmal response (PPR). The PPR is a spike-wave discharge at around 3 Hz detected bilaterally and simultaneously in all areas of the scalp. The PPR is diagnosed by electroencephalogram (EEG).

2.7
electroencephalogram
EEG
Electrical activity measurement of the brain recorded by attaching electrodes to the scalp.

2.8
photosensitive seizures
Seizures triggered as a result of photosensitivity, while photosensitivity does not always trigger seizures.

2.9
photosensitive epilepsy
A chronic neurological condition characterized by photosensitive seizures, or convulsions precipitated by visual stimuli; nonconvulsive seizures such as absence seizures (absence of mind) occasionally occur along with them.

2.10
visually-induced motion sickness
Visually-induced motion sickness concerns motion sickness-like symptoms induced by motion within the visual environment, such as when watching movies and screen images of videogames. These symptoms may include dizziness, vertigo, sweating, odd feelings in the stomach, and nausea which may progress to vomiting.

2.11
dizziness and vertigo
Dizziness refers to physical unsteadiness, lack of balance or light-headedness, while vertigo refers to an abnormal sensation of rotation while being at rest.

2.12
ataxia
Loss of balance caused by inability to coordinate muscle activity, particularly while walking and reading.

2.13
visual fatigue
Eyestrain or asthenopia, caused by both two-dimensional and stereoscopic moving images. Visual fatigue has a wide range of visual symptoms, including tiredness, headaches, and soreness of the eyes.

2.14
visual display terminal
VDT
A display device that presents text and/or graphics particularly for communicating with a computer.

2.15
binocular parallax
The apparent difference in the position of an object as seen separately by one eye and by the other, while the head remains in a fixed position. Binocular parallax is equivalent to the optic angle between the optic axes of the both eyes, when directed to a single point.

2.16
stereoscopic images
Two pictures taken from different position with binocular parallax particularly for providing depth perception among the pictures.

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2.17
strabismus
Defect of eye movement control which prevents the eyes from being directed simultaneously toward an object of interest.

2.18
accommodation
Adjustment of human lens to focus on objects at different distances.

2.19
vergence
Binocular eye movement in which the eyes rotate toward or away from each other particularly for maintaining retinal image of an object at fovea, an area of the retina where resolution is the greatest.

3 Undesirable biomedical effects caused by moving images on viewers

3.1 Photosensitive epileptic seizures

Photosensitive epilepsy is a chronic neurological condition characterized by repeated seizures that are triggered by visual stimuli, such as certain types of flashing or flickering lights or patterns. For flashing lights, flash rates of 15 Hz to 25 Hz are the most provocative but individuals may be sensitive to single flashes or to flash rates as high as 65 Hz [11]. For patterns, light/dark stripes are the most provocative particularly at spatial frequencies of about 3 cycles per degree [12]. Red-blue flicker is known to be particularly provocative [13], and the use of this type of visual stimulus on television may have been responsible for the incident in Japan in 1997. Both natural and artificial light sources can evoke seizures, but the most common causes are images on video screens.

Prevalence of photosensitive epilepsy is approximately 0,025 % of the population aged 20 years or under [4]. There is, however, an unknown number of photosensitive persons who have not yet experienced a seizure but are at risk of doing so if sufficiently provoked. Most patients have their first seizure between the ages of 9 and 15 years [4]. After the early 20's a first seizure due to photosensitivity is rare [4]. Seventy five percent of people with this condition remain photosensitive for life [4]. In young people the incidence of photosensitive seizures is 5,7 per 100 000 of the population per annum [4]. In females photosensitivity is approximately twice as common as in males. However, amongst video game players, for example, seizures appear to be more common in males in terms of absolute numbers, since more males than females play video games [4].

Photosensitivity is diagnosed by electroencephalographic (EEG) recordings. The electrical activity of the brain is recorded by attaching electrodes to the scalp while the subject is exposed to intermittent photic stimulation (IPS). If the subject is photosensitive, the EEG recording shows a photoparoxysmal response (PPR) which is a bilateral spike-wave discharge with a slow-wave component at 2,5 Hz to 3,5 Hz or a polyspike-wave discharge [4] [14]. The abnormal EEG responses to IPS can be classified on the basis of their shape and scalp distribution, the most severe response being seen in all areas [4] [11].

Photosensitivity is probably a genetically determined predisposition; its inheritance, however, is complex. The literature reported that approximately 40 % of siblings of patients with photosensitive epilepsy showed a PPR on IPS, and approximately 16 % of parents also showed a PPR [15]. The literature also reported that 25 % of children of photosensitive mothers show photosensitivity and 50 % of those go on to develop photosensitive seizures precipitated by flickering light or patterns in the everyday environment [4].

3.2 Visually-induced motion sickness

Motion sickness describes a syndrome provoked by physical or visually-perceived motion of the body or its surroundings, particularly under conditions in which the visually-perceived motion does not correspond to physical self-motion (e.g. in a ship or airplane). Symptoms of motion sickness generally include dizziness, vertigo, malaise, pallor, cold sweats, salivation, drowsiness, stomach awareness, and nausea which may progress to vomiting [16] [17] [18] [19].

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Visually-induced motion sickness can occur from watching movies, playing computer games (sometimes referred to as cybersickness [20]), or training in flight or driving simulators (also referred to as simulator sickness). Sickness severity not only depends on the motion characteristics, but also on an individual's susceptibility, which is dependent on age, gender, state of habituation, fatigue, digestion, psychological conditioning, and more [21] [22] [7]. Visually-induced motion sickness is generally worse with larger image size (particularly visual screen angle). It is also reported to be significantly affected by navigation (or global image) velocity [23] [6]; spatial complexity of the images [24]; and methods of navigation control [25]. Roll causes most sickness, followed by pitch, followed by yaw [26] [27]. The risk also depends on exposure time, and the time delay between self-motion and the matching image motion, where this occurs as, for example, in the case of a moving base or head-mounted display (HMD). The amount of veridical earth fixed texture is also critical and this in turn can depend on the ambient light level. Countermeasures to reduce visually-induced motion sickness may reduce sensation of apparent self-motion, known as vection. For some viewers, this may reduce the "thrill" experience.

Visually-induced motion sickness, like motion sickness, is usually recognized as just a minor annoyance and not signifying any serious medical illness. Some people are, however, incapacitated by it (e.g. by vomiting or ataxia), and a few even suffer from symptoms for a full day after the onset of the sickness. These after-effects may cause a risk in certain tasks, like flying, for which reason pilots are forbidden to fly a real airplane within a certain period after a simulator sortie [28].

Motion sickness, including that which is visually induced, is often explained by the widely accepted hypothesis of sensory conflict or neural mismatch [17] [29] [30] [31], which has been developed from the 1970's on. This hypothesis suggests that sickness occurs when the pattern of input signals, both those from different senses and those within a single sense, do not correspond to the patterns of such inputs that are stored in the brain on the basis of past experience. It has been hypothesized that people obtain information on body motion by means of different resources such as the eyes, the vestibular apparatus, and the proprioceptive system. According to the neural mismatch hypothesis, people constantly compare visual, vestibular and proprioceptive cues with their internal expectations. As a consequence, motion sickness can occur when there is a discrepancy between the external signals obtained by the various senses and the internal expectations based on the perception of body movement at the time.

3.3 Visual fatigue

Visual fatigue can be caused by stress on early visual functions such as focusing and converging the eyes on a near object but may also involve central cortical structures, for example when looking at a large high-contrast geometric pattern. Individuals with migraine are particularly susceptible to visual stress of the latter central kind [32]. Visual fatigue can also arise when people are watching stereoscopic images. Symptoms of visual fatigue generally include malaise, headaches, drowsiness, reduced visual acuity possibly caused by reduced powers of lens accommodation, double vision, painful irritation with lachrymation and reddening of the eye [33].

Most of the visual tasks in everyday life can contribute in some way to visual fatigue; people suffer from visual fatigue especially when the eyes are used for long periods, for fine work, reading poorly printed texts or low-quality computer images, inadequate or intense lighting, and when the individual is exposed to flickering light or geometric patterns, or has uncorrected optical aberrations of the eye. Stereoscopic images have particular technical demands that need to be met in order to avoid visual fatigue.

Visual fatigue became a focus in the 1970's onwards with the introduction of visual display terminals, (VDT), in the office environment. To reduce the symptoms, many kinds of recommendations [34] on working environment for using VDT have been drawn up. Although it has been reported that the number of people suffering from visual fatigue in the office environment has decreased since the recommendations were introduced, there remain many people who still suffer from visual fatigue. Moreover, since the development and diffusion of stereoscopic image display devices and systems have advanced especially in the leisure industry, visual fatigue caused by stereo image has been well recognized.

Some of the factors that contribute to fatigue from stereo images may concern the characteristics of the display devices, such as lower refresh rates for a stereo field pair, discrepancies of size, luminance and colour between two screen images, and also crosstalk between the images to each eye. Other factors may involve optical arrangements not only as concern the basic mechanical structure, such as parallelism of the optical

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axes of two eyes, but also the inconsistencies inherent in the stereo display, such as the discrepancy between the optical distance of a point on a stereoscopic image and the distance determined by binocular parallax of the point on the image, which can lead to an conflict between lens accommodation and convergence [35].

Some ophthalmologists remain concerned that viewing mis-aligned stereoscopic images may cause strabismus in young children. Strabismus is an abnormality in binocular alignment, usually congenital. It affects accommodation, vergence and binocular vision. There is no evidence for or against this hypothesis although the theoretical possibility of development of strabismus cannot be ignored. It has been reported that the development of binocular vision continues up to 3 years, 5 years or 10 years-old according to the visual skill under assessment [36].

4 Recommendations

Image providers as well as viewers are recommended to make themselves aware of the known biomedical risks caused by images. Image providers are further recommended to pay attention to their products in terms of the risks they may pose to susceptible individuals.

The image safety issue should be handled with an appropriate balance between the varying interests of viewers, and the interests involved in the provision of images including not only image providers' interests but also society's interest in promoting freedom of expression and artistic creativity, the balance being settled on the basis of scientific knowledge.

Although there is a wealth of scientific and technical knowledge on image safety, especially in relation to reducing the incidence of photosensitive seizures [37], further research is necessary before definitive guidelines can be offered.

To reduce the risk of visual fatigue especially in using VDT in the working environment, refer to ISO 9241 [34].

Viewers and image providers may benefit from information about image safety, both generally and as concerns individual products. Such information is likely to be of most use before viewers are exposed to visual images.

Viewers need to refer to the recommendations described below.

a) Stop watching moving images, if you have any symptoms of headache, dizziness, nausea, malaise and any uncomfortable feelings that might be caused by the images. It is advisable to take a break for 5 min to 15 min every hour, even if the symptoms are not experienced.

b) Make the viewing conditions comfortable by:

— adjusting the illumination, sound and air conditioning in the room;

— adjusting the height of the chair and desk to suit your physique;

— adjusting the brightness, focus or any other parameters of your display terminal or operating devices.

c) Guardians are encouraged to protect their children's health by controlling viewing conditions.

d) Avoid unnecessary fatigue caused by overwork or lack of sleep, before watching visual products.

e) When watching stereoscopic images, do not incline your head relative to the horizontal direction of the images.

f) Stop watching stereoscopic images if you notice double images. It is important that display devices be adjusted appropriately.

g) The recommendations described in this list may apply to some visual products more than others.

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5 Future work

In order to reduce the biomedical risks, it will be desirable to develop methods for evaluating the risks in detail, and so provide information about image safety, both generally and as concerns individual products. For this purpose, further scientific studies as well as further discussions among consumers, image providers and scientific experts are required.

To continue efforts to develop an International Standard on image safety with more precise guidelines than was possible at present, it is crucial to establish a new Technical Committee or Working Group in ISO, to which the stakeholders can make full representations, and to submit a New Work Item Proposal based on this IWA 3.

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Bibliography

[1] ISHIDA S, YAMASHITA Y, MATSUISHI T, OHSHIMA M, OHSHIMA H, KATO H, MAEDA H. Photosensitive seizures provoked while viewing "pocket monsters," a made-for-television animation program in Japan. *Epilepsia*, **39**, 1998, pp.1340-1344

[2] FURUSHO J, YAMAGUCHI K, IKURA Y, KOGURE T, SUZUKI M, KONISHI S, SIMIZU G, NAKAYAMA Y, ITOH K, SAKAMOTO Y, ISHIKAWA A, EZAKI S, NAWATA J, KUMAGAI K. Patient background of the Pokemon phenomenon: questionnaire studies in multiple pediatric clinics. *Acta Paediatr. Jpn*., **40**, 1998, pp.550-554

[3] TAKADA H, ASO K, WATANABE K, OKUMURA A, NEGORO T, ISHIKAWA T. Epileptic seizures induced by animated cartoon, "Pocket Monster". *Epilepsia*, **40**, 1999, pp.997-1002

[4] HARDING GFA, JEAVONS PM. *Photosensitive epilepsy*. London, Mac Keith Press, 1994

[5] JOKERST MD, GATTO M, FAZIO R, GIANAROS PJ, STERN RM, KOCH KL. Effects of gender of subjects and experimenter on susceptibility to motion sickness. *Aviat. Space Environ. Med.,* **70**, 1999, pp.962-965

[6] MOURANT RR, THATTACHENY TR. Simulator sickness in a virtual environments driving simulator. *Proc. IEA2000/HFES2000 Congress*, 2000, pp.I-534-537

[7] STANNEY KM, HALE KS, NAHMENS I, KENNEDY RS. What to Expect from Immersive Virtual Environment Exposure: Influences of Gender, Body Mass Index, and Past Experience. *Human Factors*, **45**, 2003, pp.504-520

[8] International Telecommunication Union. Recommendation ITU-R BT. 1702. *Guidance for the reduction of photosensitive epileptic seizures caused by television*

[9] Independent Television Commission in United Kingdom. *Guidance note for licensees on flashing images and regular patterns in television*

[10] Japan Broadcasting Corporation and National Association of Commercial Broadcasters in Japan. *Guidelines for picture techniques involved with animation programs, etcetera*

[11] JEAVONS PM, HARDING GF. *Photosensitive Epilepsy: A review of the literature and a study of 460 patients*. Clinics in Developmental Medicine, No. 56. London, William Heineman Medical Books Ltd., 1975

[12] WILKINS, AJ, DARBY, CE and BINNIE, CD. Neurophysiological aspects of pattern-sensitive epilepsy. *Brain*, **102**, 1979, pp.1-25

[13] TAKAHASHI Y, FUJIWARA T, YAGI K, SEINO M. Wavelength dependence of photoparoxysmal responses in photosensitive patients with epilepsy. *Epilepsia,* **40** (Suppl 4), 1999a, pp.23-27

[14] TAKAHASHI T. *Photosensitive Epilepsy: EEG Diagnosis by Low-luminance Visual Stimuli and Preventive Measures*. Tokyo, Igaku-Shoin Ltd., 2002

[15] WALTZ S, CHRISTEN H-J, DOOSE H. The different patterns of the photoparoxysmal response: a genetic study. *Electroencephalography and Clin. Neurophysiol*., **83**, 1992, pp.138-145

[16] MONEY KE. Motion sickness. *Physiol. Rev*., **50**, 1970, pp.1-39

[17] REASON JT, BRAND JJ. *Motion sickness*. London, Academic Press, 1975, pp.39-54

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[18] BRANDT T. VERTIGO: *Its multisensory syndromes*. London, Springer-Verlag., 1999, p.471

[19] KENNEDY RS, LANE NE, BERBAUM KS, LILIENTHAL MG. Simulator Sickness Questionnaire: An enhanced method for quantifying simulator sickness. *Int. J. Aviat. Psych.,* **3**, 1993, pp.203-220

[20] MCCAULEY ME, SHARKEY TJ. Cybersickness: perception of self-motion in virtual environments. *Presence,* **1**, 1992, pp.311-318

[21] COBB SVG, NICHOLS S, RAMSEY A, WILSON JR. *Virtual Reality-Induced Symptoms and Effects (VRISE)*.

[22] HILL KJ, HOWARTH PA. Habituation to the Side Effects of Immersion in a Virtual Environment. *Displays,* **21**, 2000, pp.25-30

[23] SO RHY, LO WT, HO ATK. Effects of navigation speed on the level of cybersickness caused by an immersive virtual environment. *Human Factors*, **43**, 2002, pp.452-461

[24] SO RHY, LO WT. A metric to quantify virtual scene movement for the study of cybersickness: definition, implementation, and verification. *Presence*, **10**, 2000, pp.193-215

[25] STANNEY KM, HASH P. Locus of User-Initiated Control in Virtual Environments: Influences on Cybersickness. *Presence*. **7**, 1998, pp.447-459

[26] UJIKE H, YOKOI T, SAIDA S. Effects of Virtual Body Motion on Visually-Induced Motion Sickness. *Proc. 26th Annual Int. Conf. IEEE EMBS*, 2004, pp. 2399-2402

[27] LO WT, SO RHY. Cybersickness in the presence of scene rotational movements along different axes. *Applied Ergonomics*, **32**, 2001, pp.1-14

[28] U.S. Navy. OPNAVINST 3710.7T. 2004.

[29] OMAN CM. A heuristic mathematical model for the dynamics of sensory conflict and motion sickness. *Acta Otolaryngol. Suppl.*, **392**, 1982, pp.1-44

[30] BLES W, BOS JE, DE GRAAF B, GROEN E, WERTHEIM AH. Motion sickness: only one provocative conflict? *Brain Res. Bull.*, **47**, 1998, pp.481-487

[31] BOS JE, BLES W. Motion sickness induced by optokinetic drums. *Aviat. Space. Environ. Med.,* **75**, 2004, pp.172-174

[32] HUANG J, COOPER TG, SATANA B, KAUFMAN DI, CAO Y. Visual distortion provoked by a stimulus in migraine associated with hyperneuronal activity. *Headache,* **43**, 2003, pp.664-671

[33] WILKINS AJ. *Visual Stress*. Oxford: Oxford University Press, 1995, p.194

[34] ISO 9241 (all parts), *Ergonomic requirements for office work with visual display terminals (VDTs)*

[35] OKADA Y, UKAI K, WOLFFSOHN JS, GILMARTIN B, IIJIMA A, BANDO T. Target spatial frequency determines the response to conflicting defocus- and convergence-driven accommodative stimuli. *Vision Res.*, in press

[36] HUGHES LE, WILKINS AJ. Typography in children's reading schemes may be suboptimal: evidence from measures of reading rate. *J. Res. Reading*, **233**, 2000, pp.314-324

[37] HARDING GFA, WILKINS AJ, ERBA G, BARKLEY G, FISHER RS. Photic- and pattern-induced seizures: expert consensus of the Epilepsy Foundation of America Working Group. *Epilepsia*, **46**, 2005, pp.1426-1441

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