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| Title | **Definitions, acronyms, and abbreviations** |
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| Source(s) | **Jeong, Sangkwon Peter** ceo@joyfun.kr **(JoyFun Inc.)** |
| Re: |  |
| Abstract | Definitions, acronyms, and abbreviations |
| Purpose | Review and comments |
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1. **Definitions, acronyms, and abbreviations**
	1. **Definitions**

For the purposes of this document, the following terms and definitions apply. The IEEE Standards Dictionary Online should be consulted for terms not defined in this clause. [[1]](#footnote-1)

360 degree camera: A camera designed to capture 360 degree spherical surfaces.

4K ultra high definition (4K UHD): A term referring to high-definition resolution with a horizontal resolution in the order of 4,000 pixels.

accelerometer: A sensor for measuring linear acceleration or angular acceleration by measuring inertia-induced reaction.

angular resolution: A value of representing an interval between pixels of an image displayed by a HMD on the basis of an angle. The unit of measurement is PPD (Pixel Per Degree).

background complexity: The number of figures, colors, and sizes of objects, and the level of optical flow in background scene. The background complexity may have an effect on Cybersickness.

binocular disparity: Difference in image location of an object seen by left and right eye images.

biomarker: A biomarker, or biological marker, generally refers to a measurable indicator of some biological state or condition.

body: A body frame that forms the overall shape of the HMD.

constant bit rate encoding (CBR encoding): An encoding method that the rate at which a codec's output data is consumed constantly with respect to time.

controllability: The level of control over VR content, which can be either an active control experience or passive exposure to VR content. The more passive the VR experience is, the less controllability the user has.

depth of field: The effective focus range or distance between the nearest and farthest objects in a moving scene used to ensure sharp images. Inadequate depth of field in rendered VR stereoscopic scene can cause the symptoms of VR sickness.

display: An electronic visual display, informally a screen, is a display device for presentation of images, text, or video transmitted electronically, without producing a permanent record.

eye dominance: The preference of processing visual input by the left or right eye.

eye relief: The distance between the eyepiece and the user’s eyes.

eye tracking: A technique to track the position of the eye by sensing the movement of the pupil.

fast motion sickness scale (FMS): The FMS represents only the lowest (0) and the highest (20) scores. Motion sickness symptoms are reported verbally every minute, including general discomfort, and stomach awareness.

field of view (FOV): The angular width of a screen that fills the user’s visual field. Angles indicate the range of horizontal, vertical, or diagonal directions over which the camera can hold an image through the lens.

fisheye lens: An ultra-wide angle lens with viewing angle over 100 degrees.

foveated rendering: An upcoming graphics rendering technique which uses an eye tracker integrated with a virtual reality headset to reduce the rendering workload by greatly reducing the image quality in the peripheral vision (outside of the zone gazed by the fovea).

frame of reference: Referential objects (e.g., trees, clouds, and frames) that are stationary in a moving scene. Other similar definitions include Visual Guide and Point of Reference.

frame per second (FPS): The number of images that can be processed per second.

frame rate: The amount of frames through a certain device or a transmission link per a fixed duration. The measurement unit is FPS.

full high definition (FHD): A term created for a marketing purpose and has 1920x1080 resolution.

gyroscope: A sensor for measuring orientation and angular velocity. It is also the term collectively refers to a device for measuring gravity using elastic deformation by gravity. In HMD, it refers to a gravity meter that works perpendicular to the center of the earth.

haptic interface: An interface that recreates the sense of touch and sense of movement by applying forces, vibrations, or motions to the user.

head mounted display (HMD): A generic term for display devices that are attached to the head.

head tracking: A technique in which tracks the rotational and translational movement of the HMD.

Inter-ocular distance (IOD): The distance between the ocular lens of HMD optical systems and eyes.

Interpupillary distance (IPD): The distance between the centers of the pupils of the left and the right eyes.

line-of-sight propagation (LOS propagation): A propagating way of electromagnetic waves that travel in a straight line.

magnetometer: A sensor for measuring magnetism – the direction, strength and relative change of a magnetic field at a particular location.

motion blur: It is the apparent streaking of rapidly moving objects in a still image or a sequence of images such as a movie or animation.

motion feedback frequency: The frequency that an HMD sends collected data, mainly motion, to a VR server.

motion-to-audio latency: Time delay from the HMD user’s movement and the change of sound in HMD caused by the movement.

motion-to-photon latency: Time delay from the HMD user’s movement and the change of view in HMD caused by the movement.

non-line of sight propagation (NLOS propagation): Radio transmissions across a path that is partially obstructed, usually by a physical object in the innermost.

number of motion axes: The number of directional and rotational factors of optical flow. This number influences the magnitude of cybersickness and motion sickness.

objective measurement: Quantification of the user’s behavioral and physiological changes. In the study of cybersickness, objective measures include the user’s magnitude of postural sway and physiological signals, such as measured by an electroencephalogram (EEG), electrogastrogram (EGG), or electrocardiogram (ECG) etc.

ocularity (monocular, binocular, biocular): Type of optical systems used in the HMD determined by the number of video signals.When the video signal is delivered to one eye, it is called monocular. When two different video signals are delivered to both eyes, it is called binocular. When a single video signal is delivered to both eyes, it is called biocular.

optical distortion: Distortion occurred by the optical system – often the distorted image is in a barrel or pincushion shape depending on the system.

optical flow: Apparent visual motions of objects, surfaces, and edges which are relative visual movements between the observer and a scene.

photoplethysmography (PPG): An optical measurement technique that can be used to detect blood volume changes in the microvascular bed of tissue.

pixel per inch (PPI): A measurement of the pixel density of an electronic image device such as a computer monitor or television display.

polygon per second (PPS): The number of polygons that can be processed per second.

positional tracking: A technique in which tracks the rotational and translational movement of all objects including head mounted display (HMD), controllers and peripheral devices.

postural stability: The ability to maintain balance using the muscles in your ankles, knees, and hips in response to movement. Postural stability decreases with fatigue, particularly in the knees and hips.

postural sway: The sense of the positions and movements of a person’s own limbs and trunk, plus the strength employed in such movements.

reality-virtual continuum: The level of mixture of real and virtual objects presented in display devices. Real environments are situated at one end of the continuum, and virtual environments are at the other end of the continuum.

reference object: A visual scene or component that provides stationary location or orientation cue, and which matches the vestibular signal.

refresh rate: The number of pictures that can be processed by the imaging device at one time. The measurement unit is Hz (Hertz).

response time: It is the amount of time a pixel in a display takes to change (It is measured in milliseconds (ms)).

sensory conflict theory: A working hypothesis to explain the physiological mechanism of motion sickness and cybersickness. Sensory disparity between the visual and the vestibular systems can induce symptoms of motion sickness and cybersickness.

sensory mismatch: The discrepancy between different sensations related to orientation and movement, especially from the visual and the vestibular organs, which causes motion sickness and cybersickness (VIMS, simulator sickness etc.).

simulator sickness: Psychological and physiological symptoms similar to those of motion sickness, typically experienced by pilots and drivers who receive simulator training.

six degrees of freedom: Six operating elements of a moving object in three dimensional space. 6DOF can be used to describe rotational movements (roll, pitch, yaw) and translational movements (forward/back, left/right, up/down).

spatial 3D sound: A technology that allows the user to identify the location of a sound source where sound is generated. In conjunction with head tracking of HMD, the sound is generated relative to the head direction.

spatial velocity: The velocity of virtual scene movement which represents the speed of the scene movement.

speed of VR content: One of the factors of optical flow. The faster the speed of an object, the larger the measurement of the optical flow.

stereoscopy: Three-dimensional vision with the illusion of depth from two-dimensional images using the visual difference of both eyes.

stitch: Technique to combine two or more videos to create 360 degree video and minimize the image distortion.

subjective measurement: Quantification of the user’s subjective experiences. In the study of cybersickness, subjective measures include scores on the Simulator Sickness Questionnaire (SSQ), Nausea scale, Fast motion sickness scale (FMS), and Misery scale (MISC) etc.

three degrees of freedom (3DOF): Three rotational elements of moving objects in three dimensional space. The three degrees refer to the roll (x axis), pitch (y axis), and yaw (z axis) rotation operations on X, Y and Z axes.

time warping rendering: A technique in VR that warps the rendered image before sending it to the display to correct for the head movement occurred after the rendering. It is either used to reduce the latency or maintain the desired frame rate.

tracking sensor: A device for tracking the movement of the user to synchronize with the content.

ultra high definition (UHD): A term created for a marketing purpose and has at least 3840x2160 resolution.

variable bit rate encoding (VBR encoding): An encoding method—as opposed to constant bit rate (CBR) encoding—where a codec’s output data rate is consumed inconsistently with respect to time.

vection: Visually induced illusions of self-motion experienced by physically stationary observers in real environment or in virtual environment.

vestibular system: The sensory system that provides a sense of bodily movement and balance. It also provides the spatial orientation for the purpose of coordinating movement.

vestibulo-ocular reflex (VOR): A reflex, where activation of the vestibular system causes eye movement.

video tracking: It is a computer vision technology for finding the position change of a specific object such as a person, an animal, or a car in a video shot by a camera.

viewing angle: The maximum side angle at which a normal screen can be seen on the display device.

virtual reality (VR): It refers to any specific environment, situation or technology itself that either simulates the actual reality or creates the virtual spaces and objects according to the imagination of human beings by using computer graphics or videos.

VR fidelity: The level of similarity in sensation and perception between real and virtual environments.

* 1. **Acronyms and abbreviations**

3GPP Third Generation Project Partnership

4K UHD 4K Ultra High Definition

8K UHD 8K Ultra High Definition

CBR constant bit rate

CR contrast ratio

FOV field of view

FPS first person shooter [game]

fps frame per second

FHD full high definition

GPU graphics processing unit

GSR galvanic skin response

HDMI high definition multimedia interface

HMD head-mounted display

IMU inertial measurement unit

IOD interocular distance

IPD interpupillary distance

IRB institutional review board

MIMO multiple input and multiple output

PPG photoplethysmography

PPI pixel per inch

PPS polygon per second

QHD quad high definition

QoE quality of experience

QoS quality of service

3DOF three degrees of freedom

UHD ultra-high definition

USB universal serial bus

VBR variable bit rate

VIMS visually induced motion sickness

VR virtual reality

VRS virtual reality sickness

VRSL virtual reality sickness level

1. IEEE Standards Dictionary Online is available at: <http://dictionary.ieee.org>

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