

## Glossary

### A

**A-weighting:** A technique used to obtain a single number representing the sound pressure level of a noise containing a wide range of frequencies in a manner approximating the response of the ear: the human ear does not respond equally to sounds of all frequencies, and is less efficient at low and high frequencies than it is at medium or speech range frequencies. Thus, the low and high frequencies are de-emphasized with the A-weighting.

**Aberration:** Any variance from a perfect reproduction of an image.

**Aberrometer:** An instrument designed to measure optical aberrations. Ophthalmic aberrometers were developed in order to measure complex refractive errors that cannot be measured by autorefractors or more traditional clinical methods.

**Absolute threshold:** The smallest value of a stimulus that results in a sensory reaction.

**Acclimatization:** The physiological adjustment (adaptation) to new physical and/or environmental conditions.

**Accommodation:** The autofocus process of the eye that helps maintain a clear retinal image for different viewing distances.

**Achromats:** A combination of lenses (usually in contact) which reduce chromatic aberration.

**Acoustic:** Pertaining to sound or to the sense of hearing.

**Acoustic display:** A display presenting acoustic information.

**Acoustic field:** A description of the behavior of sound in a specific space; the distribution of acoustic pressure generated by one or more sound sources in the specific open, partially bound, or fully enclosed space. An area in space containing sound waves

**Acoustic impedance:** The ratio of effective acoustic pressure averaged over a given surface to effective volume velocity of acoustic energy flowing through this surface. The units for impedance are Pa-s/m<sup>3</sup> or dyne-s/cm<sup>5</sup>, which are called the acoustic ohm ( $\Omega$ ).

**Acoustic manikin:** A replica of the human head (or the human head and torso) with microphones placed in the ear canals, at the eardrum position, for making acoustic measurements and sound recordings.

**Acoustic nerve:** [See **Auditory nerve**]

**Acoustic pressure:** [See **Sound pressure**]

**Acoustic reflex:** An action of the middle ear muscles that reduces the sensitivity of the ear for high intensity stimuli.

**Acoustic signature:** Characteristic sound of a given sound source that permits sound source identification.

**Acoustic wave:** A mechanic disturbance propagating through an elastic medium.

**Acoustics:** The science of production, transmission and reception of sound.

**Active matrix electroluminescent (AMEL):** A type of electroluminescent display where individual pixels are controlled by a dedicated electronic switch, and which are organized in a matrix form (rows and columns).

**Active matrix liquid crystal display (AMLCD):** A type of liquid crystal display where each individual pixel is controlled by a dedicated electronic switch, which are organized in a matrix form (rows and columns).

**Active matrix OLED (AMOLED):** A type of organic light emitting displays where individual pixels are controlled by a dedicated electronic switch, and which are organized in a matrix form (rows and columns).

**Active noise reduction (ANR):** The process of reducing background noise by electronically inverting its phase by 180 degrees and adding this inverted signal to the original noise.

**Action space:** The area in which an individual moves and makes decisions (within a 2-meter radius).

**Actuator:** A devices used or intended to be used for moving or controlling something.

**Adaptation:** An automatic adjustment of the sensory system in response to a prolonged stimulation. [See **Visual adaptation** and **Auditory adaptation**]

**Adapter:** [See **Interface**]

**Adaptive automation:** This is a departure from traditional automation in which the operator is taken out of the loop and is simply an observer. In adaptive automation, operator status is constantly monitored and the system dynamically off-loads or loads tasks to prevent operator overload or underload, respectively.

**Addressability:** The number of discrete horizontal and vertical pixels or subpixels of a matrix display that may be distinctly driven.

**Advanced technology demonstration (ATD):** Technology demonstrations tightly focused on specific military concepts and that provide the incorporation of technology that is still at an informal stage into a warfighting system. ATDs are of militarily significant scope and of a size sufficient to establish utility.

**Aerial perspective:** A depth perception cue of closer objects appearing bright and sharp, while distant objects appear pastel and hazy.

**Afferent:** Leading inwards, toward the center.

**Air-bone gap:** A difference between the threshold hearing levels for air conduction and bone conduction.

**Air conduction:** The process by which sound is conducted to the internal ear through sound waves exciting the air in the ear canal.

**Aircraft retained unit (ARU):** The frontal portion of the Helmet Integrated Display Sight System (HIDSS), consisting of two image sources, and optical relays attached to a mounting bracket.

**Airspeed:** The magnitude of the speed at which the aircraft moves relative to the air.

**Ambient noise:** All-encompassing sound at a given location, usually a composite of sounds from many sources near and far.

**Ambient visual mode:** Generally located in the peripheral portion of our vision, it interacts with our vestibular system to provide orientation and movement cues and is thought to be pre-attentive, that is not requiring any cognitive resources to process the information.

**Amplitude modulation (AM):** A systematic variation of the magnitude of one signal (carrier) in proportion to the magnitude changes of another signal (modulating signal).

**Amplitude spectrum:** [See **Spectrum**]

**Angular resolution:** [See **Spatial resolution**]

**Anhedonia:** The inability to gain pleasure from enjoyable experiences.

**Anterior chamber:** The front chamber of the eye formed by the cornea, iris and front surface of the crystalline lens.

**Antihelix:** A cartilaginous ridge of the pinna that is medial to and parallel to the helix.

**Apex (of the cochlea):** The far away end of the spiral of the cochlea where scala tympani and scala vestibuli meet.

**Apparent motion:** The illusory sense that the objects have moved smoothly from one location to the other created by the rapid alternation of objects presented at different spatial locations.

**Apparent size:** The visual impression of size.

**Aqueous humor:** The fluid produced by the ciliary body which fills the anterior chamber of the eye.

**Articulation:** [See **Speech articulation**]

**Articulation index (AI):** An objective measure of speech intelligibility based on the average speech level and average noise level in 20 frequency bands over the frequency range from 250 Hertz (Hz) to 7000 Hz.

**Artificial ear:** [See **Ear simulator**]

**Artificial intelligence (AI):** The effort to computerize those skills that illustrate human intelligence e.g., understanding visual images, understanding speech and written text, problem solving.

**Artificial mouth:** [See **Mouth simulator**]

**Aspect ratio:** The ratio of horizontal dimension (width) to vertical dimension (height).

**Astigmatism:** One kind of refractive error in which optical power varies systematically over different radial meridians. It can be corrected with spectacles or contact lenses that have a corresponding distribution of refractive powers.

**Attention:** The application of cognitive or perceptual resources to a task; the concentration of mental effort on sensory or mental events. It is generally considered to be selective; only a subset of the stimuli received by our sensory organs is selected to enter the consciousness.

**Audibility threshold:** [See **Hearing threshold**]

**Audio:** Pertaining to an acoustic signal encoded in electrical form and to the means of its transmission.

**Audio bandwidth:** The range of audio frequencies that an electronic system is able to reproduce within predetermined tolerances.

**Audio display:** An acoustic display generated by audio signals.

**Audio frequency:** An acoustic frequency at which a sound is normally audible.

**Audio frequency range:** Frequency range that extends from the lowest to the highest acoustic frequencies perceived by humans, typically from 20 to 20,000 Hz.

**Audio signal:** An audible acoustic signal recorded or generated in an electrical form and reproduced by loudspeakers, earphones, or bone vibrators.

**Audiogram:** A graphic representation of the threshold of hearing of a person compared to the standardized threshold for normal hearing (in dB HL)

**Audiometric zero level:** A value of 0 dB arbitrarily assigned to the reference hearing threshold level permitting expression of hearing loss as a number of dB of hearing level (HL) above the audiometric zero. [See **Reference hearing threshold level**]

**Audition:** A conscious act of hearing a sound; the ability to hear.

**Auditory:** Pertaining to sense of hearing or act of audition.

**Auditory adaptation:** A decrease in auditory sensitivity as a result of prolonged auditory stimulation.

**Auditory cortex:** The part of the brain's cortex that is responsible for processing auditory signals.

**Auditory display:** A display presenting information capable of being heard.

**Auditory icon:** A natural, real world, non-speech sound used as a communication signal that has a meaning associated with the object it represents, e.g., throwing a document into the desktop trashcan can be accompanied by a crumpled-paper sound to symbolize deleting a file within the context of the desktop metaphor.

**Auditory image:** An overall auditory sensation created by a specific acoustic signal during specific listening conditions; an auditory representation of a specific auditory stimulus.

**Auditory nerve:** An auditory branch of vestibulocochlear nerve.

**Auditory pathways:** The paths traced by the nerves leading from the organ of Corti in the cochlea to the auditory cortex.

**Auditory perception:** A mental synthesis of auditory sensations based on prior experience and world knowledge to determine meaning of the stimulation. [See **Perception**]

**Auditory scene analysis:** The process by which the human auditory system organizes sound into perceptually meaningful elements.

**Auditory signal:** An acoustic, mechanic, or electric form of a message received or intended to be received by the auditory system.

**Auditory situation awareness:** The component of situation awareness that is derived from the auditory cues. Auditory cues include information about the presence and location of events within the environment, including azimuth, elevation, and distance. It encompasses information from noises in the ambient environment, weapon noise, vehicle sounds, as well as spoken information through speech communications.

**Auditory stimulus:** An acoustic, mechanic, or electric stimulus received or intended to be received by the auditory system.

**Auditory stream:** A sequence of events perceived as coming from the same sound source.

**Auditory tube:** [See **Eustachian tube**]

**Augmented cognition (AugCog):** Using psychophysiological operator state measures as inputs to an adaptively automated system.

**Augmented reality (AR):** A display where computer-generated imagery or symbology is superimposed on the real world.

**Aural harmonic:** A harmonic of a given stimulus generated in the ear of the listener.

**Auralization:** Creation of virtual acoustic environments by rendering specific sound events on the impulse response characterizing a real or non-existent space.

**Auricle:** [See **Pinna**]

**Autorefractor:** An instrument designed to measure the lower-order refractive errors of the eye including myopia, hyperopia and astigmatism.

**Aviator's night vision imaging system (ANVIS):** A passive, binocular, third generation I<sup>2</sup> system with improved sensitivity and resolution over the second generation I<sup>2</sup> tubes: ANVIS are used extensively in military aviation.

**Azimuth:** An angle at which the specific sound source is situated in the horizontal plane in reference to the median plane of the listener. Azimuth is measured in angle degrees.

## B

**Babble:** [See **Multitalker noise**]

**Backwards masking:** Auditory masking observed when a masking stimulus occurs after the test signal.

**Bandwidth:** The range of frequencies over which a device or system performs within specified limits.

**Bark:** A unit of the bark scale extending from 1 to 24 corresponding to a critical band.

**Bark scale:** A pitch scale created by adding side-by-side 24 non-overlapping critical bands and projecting them along the basilar membrane.

**Base (of the cochlea):** The first and widest coil of the spiral of the cochlea.

**Basilar membrane:** A membrane along the spiral of the cochlea that is the base of the organ of Corti.

**Battle fatigue:** A psychological disorder that develops in some individuals who have had major traumatic experiences (e.g., have been in a serious accident or through a war). The person is typically insensitive at first but later has symptoms including depression, excessive irritability, guilt (for having survived while others died), recurrent nightmares, flashbacks to the traumatic scene, and overreactions to sudden noises.

**Battlespace:** Refers both to the physical environment in which a confrontation (i.e., warfare) will take place and the forces that will participate in the confrontation. All elements that support the warfighting forces (e.g., logistics, intelligence) are included in this definition. This term is replacing the historical terms *battleground* and *battlefield*.

**Beam splitter:** An optical device that splits a beam of light in two beams.

**Beats:** Periodic variations in sound intensity resulting from the superposition of two sinusoidal quantities of different but close frequencies.

**Biaural:** A condition in which the same acoustic signal is presented to both ears of the listener. [See **Diotic**]

**Binaural:** Pertaining to, using, or involving the functions of two ears.

**Binaural advantage:** Improvement in the reception of an auditory signal resulting from the interaction of two ears.

**Binaural audio:** A method for recreating an original sound field by reproducing a binaural recording of the original sound field through earphones.

**Binaural dummy head:** A replica of the human head (or the human head and torso) with microphones placed in the ear canals, at the eardrum position, for making acoustic measurements and sound recordings.

**Binaural fusion:** Sensation of a single sound caused by two different sounds delivered to the left and right ears.

**Binaural listening:** Listening with two ears.

**Binaural masking level difference (BMLD):** The difference between the binaural masked thresholds of hearing when the binaural masker is in phase and out-of-phase for the two ears.

**Binaural mode:** A sound delivery mode in which auditory stimuli are delivered to both ears of the listener.

**Binaural summation:** An improvement in the threshold of hearing and increased sound loudness due to listening with two ears.

**Binaural recording:** A method of recording an acoustic field using a replica of the human head with two microphones in the place of the ears.

**Binaural signal:** A signal recorded with two microphones located at the ears of the listener or at the ears of a binaural dummy head.

**Biocular display:** A term pertaining to optical devices which provide two visual inputs from a single sensor.

**Biodynamic:** Referring to characteristics of a system that are related to forces that act on the human body.

**Binocular alignment:** The condition by which the optical axes of two independent oculars are parallel.

**Binocular display:** A term pertaining to optical devices which provide two visual inputs from two sensors which are displaced horizontally in space, making stereopsis possible.

**Binocular fusion:** The process by which two images, one seen by each one eye, are combined, or fused, into a single percept by the visual system.

**Binocular overlap:** That portion of an HMD's central display field that is observable by both eyes.

**Binocular rivalry:** The variation or suppression of a discerned image over time between images produced by two different eyes viewing different images.

**Biocular HMD:** The HMD configuration where both eyes see the same image source through the respective optic channels.

**Biofeedback:** A training technique that uses brain actuated control (BAC) based on the concept of recognizing alpha and gamma band EEG patterns that are to be used as a control signal.

**Bistable stimulation:** A form of multistable perception in which an ambiguous pattern of stimulation leads to two mutually exclusive perceptual interpretations. The observer or listener may alternate between, or be biased towards one of, the two interpretations. The Necker cube is a common example of visual bistable stimulation.

**Blackout:** A loss of consciousness.

**Blade slap:** The dominant noise produced by helicopters consists of a broadband spectrum generated by vortex formation and shedding in the flow past the helicopter blade. It is a distinctive, low frequency throbbing sound which increases during certain descent, maneuvering and high-speed cruise operations.

**Blink:** The rapid closing of the eyelids in response to a threat to the eye (reflex blink) or the slow closing of the eyelids to replenish and smooth the tear layer over the eye's surface (normal blink).

**Bloch's law:** Within a certain critical duration, all the light received by the retina is summed and processed as if it were a single light. Because of this, within the critical duration, a bright flash delivered within a short time has the same effect as a dimmer light delivered over a longer time, as long as the total quantity of light is the same. The critical duration can vary from 10 to 200 milliseconds depending on viewing conditions.

**Bone conduction:** The process by which sound is conducted through the cranial bones. This term applies to both the external sound and the talker's own speech transmitted through the bones to the internal ear or to the contact microphone located on the skull of the talker.

**Bony labyrinth:** A cavity within petrous portion of the temporal bone that houses the inner ear.

**Boresight:** An optical device with reticle used to align line of sight to the aircraft axis.

**Bowman's layer:** The second layer of the cornea, just below the epithelium. [See **Cornea**]

**Brain:** The command and control center of the central nervous system contained within the cranium.

**Brain scan:** A class of techniques in cognitive neuroscience that measure brain behavior and relate it to cognition.

**Brainstem:** The part of the central nervous system that connects spinal cord and majority of the cranial nerves to the forebrain and cerebrum; the lowest part of the brain.

**Brick-wall filter:** An informal term for an idealized electronic filter, which has 100% transmission in the pass band, 0% transmission in the stop band, and an abrupt transition(s) between the two bands.

**Brightness (Auditory):** A subjective percept that correlates with the amount of high frequency energy in the sound.

**Brightness (Visual):** A subjective percept that correlates with the luminance or intensity of a light. Along with hue and saturation, brightness is one of the attributes used to describe a particular color.

## C

**Catadioptric optical design:** An optical system which utilizes both reflection and refraction.

**Cataract:** Any opacity in the crystalline lens of the eye. Smaller opacities or cataracts can cause scatter of incoming light resulting in perceived halos or glare and reduced contrast sensitivity. Denser opacities or cataracts can cause more significant reduction in visual quality and decreases in visual acuity.

**Cathode-ray-tube (CRT):** A display device that produces images by modulating the intensity of a scanning electron beam striking a phosphor coated surface (the screen).

**Cent:** A unit of musical pitch equal 1/100 of a semitone. Cents are used to measure extremely small intervals or to compare the sizes of comparable intervals in different tuning systems.

**Center-of-mass (CM):** That point of a body or system of bodies which moves as though the system's total mass was located at that point.

**Central auditory nervous system (CANS):** A sound processing part of the central nervous system (CNS); a system of neural fibers and nuclei that connect the ear with the brain.

**Central masking:** Masking that occurs when a masking stimulus is present in one ear and its masking effect is observed in the other ear.

**Central nervous system (CNS):** The part of the nervous system consisting of the brain and the spinal cord.

**Change blindness:** An effect of perception and attention where a person fails to see significant changes between two scenes.

**Channel:** A route through which signal or data pass or progress.

**Channel capacity:** The maximum data rate that can be attained over a given channel.

**Characteristic impedance:** [See **Specific acoustic impedance**]

**Checkride:** A practical test to measure the skills developed throughout flight training. Pass/fail is based on performance against published test standards.

**Chromatic aberration:** An optical defect of a lens system that degrades image quality and may cause colored fringes around images. It occurs when more than one wavelength of light is used, as in white light, because the focal power of a lens differs for every wavelength. Although an image may be sharply focused for one wavelength, it will be out of focus for other wavelengths.

**Chromatic scale:** Ascending or descending sequence of 12 music tones separated by semitones; a music scale that consists of 12 equally spaced logarithmic steps (semitones) in an octave. Chromatic scale corresponds to playing all the white and black keys on a piano.

**Chromaticity:** A description of the color property of light based on hue and saturation.

**Cilia:** Plural of *cilium*. [See **Eyelashes** and **Hair cells**]

**Ciliary body:** The structure within the eye just posterior to the iris and anterior to the retina that contains the ciliary muscle, serves as the base for the iris, and produces aqueous humor.

**Ciliary muscle:** The muscle within the ciliary body which controls the accommodation of the crystalline lens. Contraction of the muscle releases tension on the zonules and allows the lens to bulge for near viewing; relaxation of the muscle increases tension on the zonules and pulls the lens flatter for distance viewing.

**Circumaural earphone:** An earphone that presses against the head with little or no contact with the surface of the pinna; the transducer is loosely coupled to the ear by the relatively large volume of air under the ear cup or earmuff.

**Clarity:** A sensation of the listener of being able to attend to the details of the auditory stimulus.

**Classification:** An arrangement according to some systematic division into groups of classes.

**Coarticulation:** An effect of the sequentially produced speech sounds upon each other.

**Cochlea:** The snail-shaped tube (in the inner ear coiled around the modiolus) where sound vibrations are converted into nerve impulses by the organ of Corti.

**Cochlear nucleus:** The most caudal auditory nucleus and termination point for all auditory nerve fibers.

**Cocktail party effect:** The ability to listen to different conversations within a crowded room simply attending to them. It is this ability that we take advantage of when presenting 3-D audio cues that improves speech intelligibility in the presence of noise and multiple talkers.

**Cognition:** The processes involved in human thought, perception, and action.

**Cognitive neuroscience:** The study of human cognition with emphasis on relating cognition to the brain.

**Cognitive science:** The study of cognition.

**Cognitive resources:** The capabilities and knowledge of information processing that are used to perform mental tasks. There are limited resources for different cognitive systems.

**Cognitive tunneling:** Difficulty dividing attention between two superimposed fields of information.

**Coincidence detectors:** Nerve cells that only respond to concurrent signals from more than one neuron.

**Colavita effect:** The phenomenon whereby participants presented with auditory, visual, or audiovisual stimuli in a speeded response task sometimes fail to respond to the auditory component of the bimodal targets.

**Cold stress:** Conditions where an individual is exposed for an extended period to temperatures significantly lower than normal body temperatures; can result in hypothermia, a condition marked by an abnormally low internal body temperature.

**Collimation:** The bringing of the optical components of a telescope into correct alignment. Collimated light is light whose rays are nearly parallel.

**Coma:** A higher-order optical aberration that causes an asymmetric image blur, such that a point of light is imaged somewhat like a comet. Within the Zernike system, for classifying ocular aberrations, the coma is divided into two sub aberrations labeled  $Z(3,-1)$  and  $Z(3,1)$ .

**Combiner:** A beamsplitter that reflects a portion of a beam of light and transmits a portion.

**Communicability:** [See **Speech communicability**]

**Communication:** The process of transmitting ideas, thoughts, feelings, and opinions by means of signs, symbols, and signals produced consciously or unconsciously.

**Complex tone:** A sound consisting of several, usually harmonically related, pure tones.

**Compression:** In the physics of sound, the segment of the longitudinal wave where pressure is increased, the other segment being rarefaction.

**Concha:** A bowl-shape depression in the pinna surrounding the entrance to the ear canal.

**Conductive hearing loss:** A hearing loss caused by the problems in transmitting sound from the outer ear to the inner ear. Conductive hearing loss has a mechanical origin.

**Cone of confusion:** An imaginary cone-shaped surface radiating outwards from each ear and connecting points from which, a sound source would produce identical interaural difference cues, making the use of such binaural cues useless for sound localization.

**Cones:** Photoreceptor cells located in the retina, responsible for high-acuity vision and color vision in moderate or bright light; their interaction forms the basis of color vision. Distribution of the cone photoreceptor cells varies across the retina. They are most highly concentrated in the fovea.

**Connotation:** The indirect, associated, or implied meaning of a word or an expression; a meaning suggested or coded by a word or an expression.

**Consonance:** A relation between two or more tones that form a chord or interval that sounds pleasant. Generally consonance results from intervals composed of tones with simple frequency ratios such as 1:2 or 2:3.

**Contralateral:** A term generally used to refer to anatomical structures that are “on the opposite side” of the body as another structure (e.g. the left eye is the contralateral eye with respect to the right eye since it is on the left side of the body/brain).

**Contrast:** A measure of the luminance difference between two areas. Contrast can be formulated in different ways, e.g., contrast ratio, modulation contrast, etc.

**Contrast ratio:** A mathematical expression of the luminance ratio for two adjacent areas. As used herein, contrast ratio is defined as higher luminance/lower luminance.

**Contrast sensitivity:** One measure of visual performance that describes how well an eye can see low contrast patterns. An eye with good vision can detect a low contrast pattern, while an eye with poor vision cannot detect a pattern unless it has high contrast.

**Convergence:** When the two eyes turn inward often used in order to place two images of an object on corresponding retinal locations.

**Core temperature:** The internal temperature of the body specifically in the deep structures of the body, in comparison to temperatures of peripheral tissues.

**Cornea:** The clear dome at the front of the eye. The cornea is the transparent collagen structure which serves as the primary focusing surface for the eye and provides about 65% of the eye’s total refractive power. The five layers of the cornea are the epithelium at the front surface, Bowman’s membrane, the stroma, Descemet’s layer and the endothelium at the back surface.

**Coronal plane:** [See **Frontal plane**]

**Cortex:** The outer layer of the brain.

**Countermeasure:** An action taken to offset another action.

**Critical band:** A frequency band (a) within which distribution of sound energy has no impact on loudness of sound and (b) an extension of the continuous masking noise outside of which has no impact on hearing threshold of a tone located in the center of the band.

**Critical distance:** The distance from the sound source at which the intensity of the direct and reflected sound fields are equal.

**Critical flicker frequency (CFF):** The frequency at which a flickering light appears to no longer flicker; that is, when the flicker “fuses” into an apparently continuous light. This is also sometimes referred to as the critical flicker fusion frequency or the critical flicker frequency.

**Critical ratio:** The level of pure tone at threshold (in dB) minus the spectrum level (dB per Hz) of the noise.

**Cross-talk:** A leakage of unwanted energy or message into a communication channel from another channel.

**Crystalline lens:** The transparent lens within the eye that provides additional focusing power to the eye and, in the young eye, through its ability to change shape provides accommodation to view near objects.

## D

**Dark adaptation:** The physiological process by which the retinal photoreceptors re-adjusts sensitivity to allow vision in darker conditions. That is, when the eyes “adjust to the dark.”

**Dark focus:** The point of accommodation of the eye in the absence of visual stimuli.

**Decay time:** The time taken by a quantity to decrease its level by a specified amount from its peak.

**Decibel (dB):** A logarithmic unit of the ratio of two powers (P) expressed as  $10 \log (P_1/P_2)$ .

**Declarative memory:** Memory experiences that can be explicitly recollected or declared.

**Dehydration:** Depletion of bodily fluids; the loss of too much body fluid through frequent urinating, sweating, diarrhea, or vomiting.

**Demographics:** The physical characteristics of a population such as age, sex, marital status, family size, education, geographic location, and occupation.

**Denotation:** An explicit or direct indication of the meaning of a word or expression.



**Depth perception:** The visual discrimination of absolute and relative distance using monocular and binocular cues.

**Descemet's membrane:** The fourth layer of the cornea, just anterior to the endothelium. [See **Cornea**]

**Design eye position:** The midpoint of the line segment of the open nosed vision line connecting two points which represents the predicted eye positions of the extremes of the aircrew population.

**Detection:** Determination of the presence of a sensory stimulus.

**Deutan:** A type of hereditary color vision anomaly in which the patient is missing or has defective M-cones. Since M-cones have peak sensitivity in the middle wavelengths range of the visible light spectrum, deutanans are sometimes called, "green weak, or green color blind."

**Diatonic scale:** An ascending or descending scale of 7 music tones separated by 5 tones and 2 semitones. Diatonic scale corresponds to playing only the white keys on a piano.

**Dichotic:** A condition in which the signal presented at the left sensor differs from the signal presented at the right sensor (ears or eyes).

**Dichotic display:** An earphone display presenting different acoustic signals to the left and right ear of the listener.

**Dichotic mode:** An information delivery mode in which different signals are delivered to the left and right sense organs (ears or eyes).

**Difference limen (DL):** A smallest perceived change in a physical variable.

**Differential threshold:** The smallest detectable difference in a specified modality of sensory input.

**Diffraction:** The spreading out of waves when they encounter a small obstacle or pass through a narrow opening

**Diffuse field:** An acoustic space where sound waves have an equal probability of coming from any direction at any given moment due to their reflection from multiple surfaces.

**Diffusion:** A scattering of sound waves from irregular objects and space boundaries.

**Digital micromirror device (DMD):** A matrix display where each pixel is a very small square mirror on the order of ten to twenty microns. Each mirror pixel is suspended above two electrodes driven by complementary drive signals.

**Diopter:** A unit expressing the refractive power of an optical system/component as the reciprocal of the focal length in meters.

**Diotic:** A condition in which the signal presented at each ear or eye is identical.

**Diotic display:** A display presenting the same signal to both the right and left sense organs (ears or eyes).

**Diotic mode:** A stimulus delivery mode in which the same signal is delivered to both the right and left sense organs (ears or eyes).

**Diplopia:** A condition in which a single object appears as two objects; double vision. Normally this occurs when the two eyes are pointed in different directions, such as with crossed eyes. This causes a single object to appear in a different location for each eye, so when input from the two eyes are combined, the object is seen in two different locations, that is, double. In some unusual conditions, it is possible to experience diplopia with one eye (monocular diplopia).

**Dipvergence:** The shifting of the eyes vertically, one up and one down.

**Directional device:** A device in which the received or radiated signal is dependent on the direction of observation.

**Discrimination:** Determination that two specific sensory stimuli are different.

**Disparity:** Difference or misalignment.

**Display:** A unique device or assemblage of devices used to systematically present specific information capable of being perceived by the human senses; a structured presentation of information to the senses.

**Display lag:** The time delay in a display measured from the time when the imaging data are received and the time they are presented.

**Dissonance:** A music interval or chord that sounds unpleasant or rough. The frequency components resulting in dissonant sound do not have simple frequency ratios.

**Distortion:** An unwanted variation in magnification or a prismatic deviation with angular distance from the center of an optical component or system; any undesired change in the frequency or amplitude of an acoustical signal.

**Divergence:** The shifting of the eyes outward.

**Divided attention:** An intentional effort to be aware of two or more things simultaneously.

**Duration:** The time during which something exists.

**Dynamic retention:** When pertaining to helmets, the condition of preventing the loss of a helmet during a crash sequence.

**Dynamic range:** In a system or a transducer, the difference, measured in decibels, between the overload level and the minimum acceptable level. The minimum level is commonly fixed by any or all of the following: noise level, low-level distortion, interference, or resolution level.

**Dysbarism:** A medical conditions resulting from exposure to decreased or changing barometric pressure.

## E

**Ear canal:** A part of the external ear that directs sound from the pinna to the tympanic membrane.

**Ear simulator:** A device simulating the acoustic characteristics of the human ear upon the sound radiated by an external sound source such as an earphone.

**Earbud:** A small earphone intended to be placed in the pinna at the entrance to the ear canal.

**Earcon:** An abstract, non-speech sound (e.g., synthetic sound, music sound) used as a communication signal.

**Earcup:** An enclosure surrounding the pinna.

**Eardrum:** [See **Tympanic membrane**]

**Earmuff:** [See **Earcup**]

**Earphone:** An electroacoustic transducer converting electric current into sound and directly coupled to the ear of the listener.

**Earphone display:** An audio display created by earphones.

**Earplug:** A device intended to be placed in the ear canal.

**Effector:** Any biological organ or system that becomes active in response to neural stimulation.

**Efferent:** Leading outwards, toward the periphery.

**Egocentric:** Using one's self as the reference frame.

**Egress:** The process of exiting an enclosed area (e.g., cockpit, tank interior).

**Electroacoustic transducer:** A transducer designed to receive an electrical signal and convert it into an acoustic signal or vice versa.

**Electroencephalography (EEG):** The measurement of brain wave rhythms of different frequencies. Brain waves are divided into: Delta (0.5 to 3 Hz), Theta (4 to 7 Hz), Alpha (8 to 12 Hz), Beta (13 to 30 Hz), and Gamma (>30 Hz).

**Electroluminescence (EL):** A flat panel display technology in which a layer of phosphor is sandwiched between two layers of a transparent dielectric (insulator) material which is activated by an electric field.

**Electromagnetic spectrum:** The entire range of radiation extending in frequency from approximately  $10^{23}$  Hz to 0 Hz or, in corresponding wavelengths, from  $10^{-13}$  cm to infinity and including, in order of decreasing frequency, cosmic-ray photons, gamma rays, x-rays, ultraviolet radiation, visible light, infrared radiation, microwaves, and radio waves.

**Electrophoresis (EP):** A nonemissive flat panel technology based on the movement of charged particles (of one color) in a colloidal suspension (of a second color) under the influence of an electric field. The application of the electric field changes the absorption or transmission of light through the solution.

**Electrostatic transducer:** A transducer consisting of a fixed electrode and a movable electrode, charged electrostatically in opposite polarity; the motion of the movable electrode changes the capacitance between the

electrodes and thereby makes the applied voltage change in proportion to the amplitude of the electrode's motion; also known as condenser transducer.

**Elevation angle:** An angle at which the specific sound source is situated in the vertical plane in respect to the horizontal reference plane of the listener. Elevation is measured in angle degrees.

**Emitter:** [See **Transmitter**]

**Emmert's law:** A law used in vision science that states that objects that generate retinal images of the same size will look different in physical size (linear size) if they appear to be located at different distances. Specifically, the *perceived linear size* of an object increases as its *perceived* distance from the observer increases.

**Emmetropia:** The condition of an eye with perfect optics, that is, no refractive error. When an emmetropic eye views a distant object, its image correctly focuses onto the retina.

**Endotracheal intubation:** The placement of a tube into the trachea (windpipe) in order to maintain an open airway in patients who are unconscious or unable to breathe on their own.

**Energy:** The ability or capacity of an object to do work.

**Energetic masking:** The type of masking that physically affects the audibility of the target sound through the presence of acoustic energy in the same spectral region as the target sound.

**Envelope:** An imaginary line connecting sequential peaks of a sound.

**Environment:** A set of circumstances and conditions that are extraneous to a given process but affect its nature or effectiveness.

**Equally masking noise:** Noise that equally masks tones of all frequencies.

**Equivalent rectangular bandwidth (ERB):** The bandwidth of a rectangular filter that has the same peak transmission as a given filter and that passes the same total power for a white noise input.

**Ergonomics:** [See **Human factors**]

**Eustachian tube:** The air channel that connects the middle ear cavity with nasopharyngeal cavity.

**Event related potentials (ERP):** Non-volitional EEG responses that generate a voltage – either negative (N) or positive (P) occurring within a specific timeframe – after an observed event. The P3 (also called the P300) is a positive voltage that occurs roughly 300 milliseconds after a sensory stimulus and the N1 is a negative voltage that occurs roughly 100 milliseconds after a stimulus.

**Executive control:** That part of our brain which allows us to direct attention or filter out unwanted stimuli.

**Exit pupil:** The region where the observer's eye(s) must be located in order to view the total field of view. In optics, it is the image of the aperture stop as formed from the image side of the optics.

**Exit pupil expander (EPE):** An optical device that increases the exit pupil.

**External auditory meatus:** [See **Ear canal**]

**Experimental psychology:** A field of study that investigates human behavior through scientific measurements.

**Externalization:** The sensation that a sound source is located away from the head.

**Extraocular:** Refers to structures outside of the eye generally associated with or connected to the eye (e.g., extraocular muscles).

**Eye clearance distance (ECD):** The minimum clearance from the closest display system component to the cornea of the eye. This parameter is important in determining system compatibility with add on devices, e.g. corrective lenses, protective masks, etc; also referred to as *physical eye relief*.

**Eye dominance:** The tendency of clusters of nerve cells in the visual system to respond primarily to one eye rather than to the other.

**Eye relief:** The distance between the last surface of the optical elements and the cornea of the eye.

**Eyelids:** The portion of moveable thin skin which serves to protect the front of the eye. The human eye is protected by an upper and lower eyelid; also referred to as "lids."

**Eyelashes:** Small hairs, also known as "cilia," which grow along the edge of each eyelid.

## F

**f number (f/#):** The expression denoting the ratio of the equivalent focal length of a lens to the diameter of its entrance pupil.

**Factor analysis:** A statistical method that reduces a larger set of variables to a smaller set of dominant factors based on correlations between those variables.

**Fatigue:** A condition of weariness, exhaustion, or decreased sensory sensitivity from labor, exertion, or prolonged stimulation.

**Fast Fourier transform (FFT):** An algorithm that allows quick, economical application of Fourier techniques to a wide variety of analyses.

**Fidelity:** Similarity of a given auditory image to the specific auditory standard or to another auditory image.

**Field emission display (FED):** An emissive flat panel display technology which consists of a matrix of miniature electron sources which emit the electrons through the process of field emission. Field emission is the emission of electrons from the surface of a metallic conductor into a vacuum under the influence of a strong electric field.

**Field-of-view (FOV):** The maximum image angle of view that can be seen through an optical device.

**Figure-of-merit (FOM):** A metric which quantifies some aspect of image quality.

**Filter:** A device or material that passes signals (waves) of certain frequencies while stopping others.

**Fiscal year (FY):** A 12-month period over which the military budget allocates funding. It runs from October 1 of the prior year through September 30 of the next year.

**Fixed-wing aircraft:** A powered aircraft that has wings attached to the fuselage so that they are either rigidly fixed in place or adjustable, as distinguished from rotary-wing aircraft, like a helicopter.

**Flashblindness:** A temporary loss of vision as a result of sudden high level of luminance, e.g., nuclear explosion.

**Flat panel display (FPD):** A wide-encompassing category of display technologies characterized by significantly lower depth compared to the height and width.

**Flicker:** A perceived rapid variation in brightness (intensity).

**Fluctuation strength:** Intensity of perceptual impression created by amplitude and frequency modulations of sound at low modulation rates, up to about 20 Hz.

**Focal visual mode:** Generally located in the central portion of our vision, it is that portion of our perception that provides us detailed information. It requires that we direct our attention and may narrow under cognitive load.

**Foot-Lambert (fL or ft-L):** A unit of luminance (photometric brightness), equal to  $1/\pi$  candela per square foot, or to the uniform luminance of a perfectly diffusing surface emitting or reflecting light at the rate of 1 lumen per square foot.

**Formant:** A significant peak in the complex sound spectrum of a given auditory stimulus.

**Forward masking:** Masking observed when a masking stimulus occurs before the test signal.

**Forward looking infrared (FLIR):** A thermal imaging sensor, where sensor output is based on infrared radiation (usually between 3 to 5 or 8 to 12 micron spectral range) generated by the external scene.

**Fourier analysis:** Data series analysis based on the concept that each shape of a waveform is a sum of several sinusoidal functions; a mathematical decomposition of a complex signal into elementary sine waves.

**Fovea:** A small microscopic depression at the center of the retina, which has the greatest density of cone photoreceptor cells, and therefore the best visual acuity. The center of an object being viewed is imaged onto the fovea, therefore this point corresponds to the straight-ahead visual direction; also referred to as the “foveola” or “fovea centralis.”

**Frame rate:** The frequency of frames produced per second (expressed in Hertz [Hz]).

**Frangibility:** The ability of a subsystem or component to separate from the major system. Some helmet and display system designs may employ helmet mounted displays, eye protection devices, etc., which actively or passively separate from the helmet under crash conditions.

**Frankfurt plane:** The eye-ear plane in which the human skull is placed in a position so that the lower margins of the eye socket and the upper margins of the auditory opening are on the same horizontal plane.

**Free field:** An acoustic reflection-free environment in which sound pressure level is inversely proportional to the distance from a sound source (a 6 dB decrease for each doubling of distance).

**Frequency:** Number of complete oscillation cycles per unit of time. The unit of frequency is the Hertz (Hz).

**Frequency modulation (FM):** A systematic variation of the frequency of one signal (carrier) in proportion to the magnitude changes of another signal (modulating signal).

**Frequency response:** The measure of any system's spectrum response at the output to a signal of varying frequency (but constant amplitude) at its input; in the audible range it is usually referred to in connection with electronic amplifiers, microphones and loudspeakers.

**Frequency resolution:** A precision with which a person or a system can differentiate between fundamental frequencies of two waveforms.

**Frontal plane:** An imaginary plane dividing human body in front (anterior) and back (posterior) parts.

**Fundamental frequency:** The lowest frequency in a harmonic series; the lowest common factor in a harmonic series.

## G

**G-loading:** An effect of the gravitational force at the earth's surface (force due to gravity); usually expressed as the numerical ratio.

**Gabor patch:** A luminance profile where the intensity at the center is the maximum grayscale value and the intensity at the edge of the diameter is one grayscale step above the background.

**Ganglion:** A group of cell bodies in the peripheral nervous system.

**Gestalt laws:** Gestalt is a German word meaning *form* or *pattern*. Gestalt laws refer to a set of principles used by the perceptual system to organize sensory information into patterns that are regular, orderly, symmetric, and simple. They include the *laws of proximity, similarity, good continuation, closure, simplicity* and *common fate*.

**Golay code:** A type of error-correcting code used in digital communications.

**Ghost image:** A spurious image produced as a result of an echo or reflection in the transmission of an image or signal.

**Glare:** A condition in which a bright light interferes with vision. One example is intraocular light scatter with cataracts that reduces contrast and degrades vision.

**Glaucoma:** A condition in which the intraocular pressure exceeds the eye's ability to maintain normal function. Glaucoma results in damage to the nerve cells within the eye which leads to loss of vision in the mid-peripheral visual field.

**Globe:** A protective structures of the eye consisting of the sclera and cornea which maintain the shape of the eye.

**Granit-Harper law:** A temporal vision phenomenon in which flicker is more easily seen if the light is larger.

**Grayout:** A transient loss of vision characterized by a perceived dimming of light accompanied and loss of peripheral vision.

## H

**Hair cells:** Sensory cells of the hearing and balance senses with tiny hair-like projections, called stereocilia or cilia, extending from the top of a cell and giving the cell its name.

**Halation:** A halo or glow surrounding a bright spot on a fluorescent screen or a photographic image.

**Hallucination:** A sensory perception (auditory, visual, etc) appearing without an actual physical stimulus. Unlike perceptual illusions, hallucinations are usually individual to the perceiver and may signal abnormal circumstances.

**Hand-arm vibration (HAV):** Vibration that is transmitted from vibrating surfaces of objects, such as hand tools, through the hands and arms.

**Haptic:** Refers to all the physical sensors that provide a sense of touch at the skin level and force feedback information from muscles and joints.

**Haptics:** The design of clothing or exoskeletons that not only sense motions of body parts (e.g., fingers) but also provide tactile and force feedback for haptic perception of a virtual world.

**Harmonic:** A pure tone component of a complex tone which frequency is an integral multiple of the fundamental frequency.

**Head-related transfer function (HRTF):** A frequency domain representation of the changes in magnitude and phase of the auditory signal at the entrance of the ear canal in relation to the signal at the source. The HRTF represents a linear transformation that occurs as a sound generated by a point source propagates to the left and right ears of a listener. The HRTF includes diffraction effects by the head and torso, as well as the directional spectral shaping effects of the outer ear or pinna. Unless otherwise specified, the HRTF is assumed to be the free-field HRTF.

**Head-supported weight (HSW):** the added weight required to be supported by the neck muscles as a result of the HMD system; used interchangeably with head-supported mass (HSM).

**Head-up display (HUD):** Any transparent display that presents data without obstructing the user's view.

**Headgear:** A system that covers the head or a part of it.

**Headphones:** Earphones applied outside the ear and supported by a headband.

**Health hazard assessment (HHA):** Assessment of risk to the health and effectiveness of personnel who test, use, and maintain the system. Hazards can arise from characteristics of the system itself or from the environment in which it operates.

**Hearing:** A sense by which biological systems are aware of the surrounding acoustic environment and perceive sound; an ability to perceive a sound.

**Hearing level (HL):** An amount by which a specific sound pressure level or force level exceeds a reference hearing threshold level.

**Hearing loss:** Any degree of impairment of the ability to hear sound.

**Hearing protection device (HPD):** A device designed or used to reduce the noise level reaching the auditory system.

**Hearing threshold:** A minimum (a) sound pressure level or (b) force level of a signal that is capable of evoking an auditory sensation in a specified fraction of the trials. The hearing threshold is defined for a given listener and a specified signal.

**Heat stress:** A group of conditions due to overexposure to or overexertion in excess environmental temperature. It includes heat cramps, heat exhaustion, which is more serious, and heatstroke.

**Helicotrema:** A narrow passage at the apex of the cochlea at which scala tympani and scala vestibuli are connected.

**Helix:** The cartilaginous fold of the pinna that curves around the outside edge of the pinna.

**Helmet:** Device covering the head and used for protecting the user from hazard to the head. A modern helmet serves as both the head protector and the supporting element for the communication system.

**Helmet Integrated Display Sight System (HIDSS):** A partially-overlapped biocular helmet-mounted display system under development for the RAH-66 Comanche helicopter consisting of two components: pilot retained unit (PRU) and an aircraft retained unit (ARU). The PRU is the basic helmet with visor assembly; the ARU is a front piece consisting of two image sources and optical relays attached to a mounting bracket.

**Helmet-mounted display (HMD):** A multimodal display systems used to enhance the user's situational awareness; a device, worn on the head or as part of a helmet, which has a small display optic in front of one (monocular HMD) or each eye (binocular HMD). HMDs can present both audio and visual information.

**Hemorrhage:** The act of bleeding or a collection of blood generally within a tissue (e.g., retinal hemorrhage).

**Homeostasis:** The ability or tendency of an organism or cell to maintain internal equilibrium by adjusting its physiological processes.

**Homeotherm:** An organism that is capable of keeping its core temperature within a relatively narrow range.

**Horizontal plane:** An imaginary plane dividing human body into zenith (superior) and nadir (inferior) parts.

**Horopter:** The region in space where the two images from an object falls on corresponding locations on the two retinas.

**Hot spot:** Pressure points that develop over time during the wearing of headgear.

**Human factors:** The science of human-machine relationships and interactions including all biomedical and psychological considerations; the science of designing the objects and environments according to human needs and capabilities.

**Human factors engineering assessment (HFEA):** Analysis of acceptable human engineering design criteria, principles and practices.

**Human-in-the-loop (HITL):** A model that requires active human interaction.

**Human-machine interface (HMI):** Any device that serves as a “bridge” connecting the (human) user and the machine. Common examples include keypad, mouse, touch screen, or keyboard.

**Hue:** The quality of color is most closely associated with a particular wavelength. Examples of hues include red, orange, yellow, green, blue and violet. To fully describe a color you must mention not only its hue, but its saturation and brightness as well.

**Hypnotics:** Drugs classified as central nervous system depressants used to induce sleep.

**Hyperacuity:** Usually refers to vernier acuity, or another visual task in which the threshold is significantly better than one arc minute, which is minimum angle of resolution expected for a standard Snellen visual acuity test.

**Hyperopia:** Farsightedness; a kind of refractive error in which an eye, viewing a distant object, focuses the image beyond the retina. With hyperopia, distant objects usually appear clearer than near objects, however some young patients can compensate for hyperopia without glasses by over accommodating.

**Hyperstereopsis:** A condition of exaggerated depth perception which occurs as a result of separation of the sensors greater than the eyes of the user.

**Hypoxia:** A condition resulting from a deficiency in the amount of oxygen reaching body tissues.

## I

**Identification:** An act of assigning a unique name to a given stimulus or object.

**Idiopathic disease:** A disease having no known cause.

**Illuminance:** A measure of visible energy falling on a surface.

**Illusion:** An erroneous mental representation.

**Infrasound:** An acoustic wave of a frequency lower than the lower limit of human hearing; usually considered to be a sound having frequency lower than 20 Hz.

**Image intensification ( $I^2$ ):** Sensor technology based on amplification of ambient light. Photons are imaged onto a photocathode which converts them into electrons. The number of electrons is multiplied and channeled onto a phosphor screen.

**Image overlap:** The portion (usually expressed as a percentage) of the total field of view of a biocular/binocular system that can be viewed simultaneously by both eyes.

**Image smear:** An image artifact resulting from relative motion between scene and sensor. This is caused by insufficient temporal characteristics within the imaging system, e.g., phosphor persistence, scan rate, etc.

**Immersion:** The feeling of being integrated in a computer-generated world.

**Impact attenuation:** The reduction of the mechanical force (and energy) through a protective material or device.

**Impedance:** The ratio of sound pressure to particle velocity of the sound wave; an opposition to the flow of energy through a system.

**Impulse noise:** A category of (acoustic) noise that is very intense and of short duration, usually less than a second, such as backfires from motor vehicles, sonic booms and weapons fire.

**In-the-head localization:** The sensation that all sound sources are located in the listener's head. Stereophonic sounds are typically considered lateralized in-the-head while spatial sounds are considered to be localized outside-the-head.

**Index of refraction:** The ratio of the speed of light in a vacuum to the speed of light in a substance; a relative measure of a lens material's ability to refract (bend) light.

**Inferior colliculus:** A part of the central auditory nervous system located in the dorsal part of the midbrain.

**Information:** A temporary change in a state of an object or matter. [See **Message**]

**Information superiority:** The capability to collect, process, and disseminate an uninterrupted flow of information while denying an adversary's ability to do the same.

**Informational masker:** A form of perceptual masking or interference that cannot be construed as energetic masking

**Infrared:** A portion of the electromagnetic spectrum; an invisible band of radiation with wavelengths from 750 nanometers to 1 millimeter, infrared starts at the end of the microwave portion of the spectrum and ends at the beginning of visible light portion.

**Inner ear:** A complex system of interconnecting cavities, consisting of cochlea (which contains the nerves for hearing), the vestibule (which contains receptors for balance), and the semicircular canals (which contain receptors for balance).

**Insert earphone:** An earphone that is inserted into the ear canal or is coupled to the ear canal by a tube, earmold, or other device.

**Intelligibility:** [See **Speech intelligibility**]

**Intensity resolution:** A precision with which a person or a system can differentiate between two levels of the same signal.

**Interaural cross correlation (ICC):** A measure of the difference in a signal received by the two ears. Its value varies from -1, meaning the signals are equal and out of phase, through 0, meaning the two signals have nothing in common, to +1, meaning the signals are equal and in phase.

**Interaural intensity difference (IID):** The difference between the intensity of the sound reaching the right ear and the left ear of a listener. IID depends on the location of the sound source and the frequency of the sound.

**Interaural level difference (LD):** [See **Interaural intensity difference (IID)**]

**Interaural phase difference (IPD):** A difference in the phase of the continuous periodic sound reaching the right ear and the left ear of a listener. IPD depends on the location of the sound source and the frequency of the sound.

**Interaural time difference (ITD):** The difference in the time of arrival of a sound reaching the right ear and the left ear of a listener. ITD is independent of the sound frequency but depends on sound source location.

**Interlace ratio:** The number of fields per frame pertaining to displays.

**Interface:** A boundary or connection between systems, equipment, concepts, or humans beings; a special device or system providing operative compatibility between two or more different devices or systems.

**Interference:** Any process in the same medium or channel other than the given process or signal itself.

**Internalization:** The sensation that a sound source is located inside the listener's head. Sounds presented through earphones without spatial processing appear as internalized.

**Interpupillary distance (IPD):** The distance between the centers of the pupils of the two eyes.

**Interval:** A distance between two notes corresponding to a ratio of two frequencies. Intervals can be measured by Hertz, cents, scale steps or semitones.

**Intraocular:** Refers to structures or conditions inside the eye (e.g., intraocular hemorrhage).

**Impact attenuation:** The reduction in mechanical force through the protective helmet.



**Ipsilateral:** A term generally used to refer to anatomical structures that are “on the same side” of the body as another structure (e.g., the ipsilateral optic nerve for the right eye would be the optic nerve on the right side of the body/brain).

**Iris:** The iris forms the aperture of the eye, the “pupil.” The iris consists of two opposing muscles which either constrict (sphincter muscle) or dilate (dilator muscle) the iris in response to light or neurological stimuli.

## J

**Jitter:** Small, rapid variations in a signal due to vibrations, voltage fluctuations, control system instability, and other causes.

**Just noticeable difference (jnd):** [See **Difference limen**]

## K

**Keratorefractive:** Describes any method that changes the eye’s focal power by changing the shape of the cornea. Kerato refers to the cornea and refractive refers to the focusing of light. The most common use of this word is with keratorefractive surgery, which alters the cornea’s focal power, usually with laser sculpting of the cornea.

**Key:** A first tone of a diatonic (major or minor) scale that a piece of Western music is based on. The key’s pitch is not absolute, but can be of any of several notes sharing the same pitch class e.g., the key of “C” refers to the note “C” in any octave

**Knot:** A unit of speed of one nautical mile (6,076.12 feet or 1,852 meters) per hour.

**Knot-hole effect:** The apparent limitation of the field-of-view due to the exit aperture.

## L

**Lambertian emitter:** An optical source with a luminous distribution that is uniform in all directions.

**Lamina cribrosa:** The mesh-like structure at the posterior portion of the globe of the eye through which the optic nerve passes.

**Language:** A system of symbols, signs, or signals used to convey information.

**Laser:** Any of several devices that emit highly amplified and coherent radiation of one or more discrete frequencies. The term “laser” is an acronym for “light amplification by stimulated emission of radiation.”

**Lasik:** An acronym for **laser-assisted in situ keratomileusis**, a type of laser eye surgery designed to change the shape of the cornea to eliminate or reduce the need for glasses and contact lenses in cases of severe myopia (nearsightedness).

**Latency:** The period between the initiation of something and the occurrence.

**Lateral geniculate nucleus (LGN):** A structure within the dorsal thalamus which regulates visual information received via the optic tracts from each eye.

**Lateralization:** The process by which a person determines location of a specific activity or mental event in one side of the body. The process of lateralization applies to the sound sources perceived as being located inside the listener’s head.

**Lead, lanthanum, zirconate, and titanate (PLZT):** A material that can be electronically switched rapidly in polarity such that when sandwiched with a near infrared blocking material and a fixed polarizing material, the visual transmittance can be varied from full open state (approximately 20%) to a full off (optical density (OD) is greater than 3.0) in approximately 150 microseconds.

**Lens:** An object made of transparent material, usually with two curved surfaces, that bends (refract) or focus light rays passing through it; the transparent structure inside the eye that focuses light rays onto the retina.

**Light emitting diode (LED) display:** Emissive display composed of multiple light emitting diodes arranged in various configurations which can range from a single status indicator lamp to large area x-y addressable arrays.

**Lightness:** The perceptual correlate of reflectance; perceived reflectance.

**Liquid crystal display (LCD):** A type of nonemissive flat panel display technology which produces images by modulating ambient light. The ambient light can be reflected or transmitted light from a secondary, external source (e.g., a backlight).

**Line of sight (LOS):** The line between the pupil of the eye to the object of interest.

**Line replaceable unit (LRU):** A maintenance term referring to a systems or module that can be replaced in the field; usually requires no special alignment.

**Listening:** An act of attentive audition.

**Lombard effect:** An involuntary tendency of the talker to increase voice intensity in noise.

**Localization:** The process by which a person determines the direction of an incoming stimulus or the direction to a specific object in space. The process of localization applies to the sound sources perceived as being located outside the listener's head.

**Long-term memory:** A hypothesized system of human memory that holds information for durations ranging from several seconds to years.

**Loss aversion:** A property of human decision-making. People are usually more sensitive to perceived losses than perceived gains.

**Loudness:** A perceptual attribute of sound in terms of which sounds may be ordered on a scale extending from soft to loud; a perceived impression of the intensity of sound. Loudness depends on the actual intensity of sound and its spectral content (frequency) and duration.

**Loudness adaptation:** [See **Auditory adaptation**]

**Loudness level:** A median sound pressure of a 1000 Hz tone that is judged equally loud as a given sound.

**Loudspeaker:** An electroacoustic transducer that converts electric current into sound radiating into open space.

**Loudspeaker display:** An audio display using loudspeakers.

**Law of the first wavefront:** (See **Precedence effect**)

**Luminance:** Luminous flux per unit of projected area per unit solid angle leaving a surface at a given point and in a given direction; measured in foot-Lamberts (fL).

**Luminance disparity:** In biocular/binocular helmet-mounted displays, the difference in the image luminance between the two channels.

**Luminance transmittance:** The fraction of luminance of the outside world seen through an optical component or system; usually expressed as a percentage.

**Luminous efficiency:** The ratio of the energy of the visible light output, such as the energy emitted by a phosphor, to the electron energy of the input signal.

**Luning:** The subjective darkening that can occur in the monocular side regions near the boundaries of the partially overlapped region in a binocular display.

## M

**Macula:** The central region at the posterior aspect of the retina which includes the fovea at its center. The macula has a denser distribution of cones than rods and is responsible for defined vision and color perception; also referred to as "macula lutea."

**Macular degeneration:** A common cause of vision loss in the elderly due to a degeneration of the central portion of the retina known as the macula. The degeneration is due to a build up of waste material in the macular region.

**Magnetic resonance imaging (MRI):** A method of scanning that produces detailed maps of the tissue relying on the difference in the magnetic resonance of certain atomic nuclei.

- Manpower and personnel integration (MANPRINT) program:** An Army system analysis which addresses manpower, training, personnel requirements; health and safety issues; and human factors issues.
- Masking:** A reduction of sensitivity to one stimulus resulting from the presence of another stimulus.
- Masking margin:** The additional amplification of the masker needed to completely mask the target sound.
- Mass moment of inertia (MOI):** The sum of the products formed by multiplying the mass of each component of a system by the square of its distance from a specified point.
- Mastoid (bone):** A hard, boney structure behind the ear in which the ear mechanism is housed.
- Maximum-length sequence (MLS):** A pseudorandom binary sequence that is used to measure impulse response of the transmission system.
- McGurk effect:** Auditory-visual illusion causing the misperception of a spoken phoneme. Occurs when the visual and auditory information disagree causing the speaker's mouth to appear to be uttering a different phoneme.
- Mean time between failure (MTBF):** For any device, a measure of the reliability of a component or system.
- Mechanical impedance:** The ratio of the effective pressure (force acting on a specific area of an acoustic medium or mechanical system) to the resulting effective velocity through or of this area. The units for mechanical impedance are Pa-s/m or dyne-sec/m, which are called the mechanical ohm ( $\Omega$ ).
- Medial geniculate nucleus:** A part of the thalamus that receives afferent auditory projections and from which they project to various parts of the cortex and cerebrum.
- Median plane:** The sagittal plane running through the midline and dividing human body into right and left parts.
- Mel:** A unit of pitch. A tone of frequency 1000 Hz and sound intensity of 40 dB (re 20  $\mu$ Pa) produces a pitch of 1000 mels. A tone of frequency 1000 Hz and sound intensity of 40 dB (re 20  $\mu$ Pa) has a pitch of 1000 mels.
- Melatonin:** A naturally occurring hormone found in most animals, including humans, which is important in the regulation of the circadian rhythms of several biological functions.
- Memory:** A hypothetical storage system. The ability or process of retaining and recalling what has been experienced and learned. Memory is frequently interpreted as an associative mechanism within the brain that relates present and past stimulations.
- Mesopic:** A state of visual adaptation which is between photopic (daylight) and scotopic (dark) conditions. Under mesopic conditions both the rod and cone photoreceptors are working.
- Message:** Meaningful information.
- Meta-knowledge:** Describe information that is one step removed from the actual knowledge itself, because it is derived primarily from sensors or displays. It is knowledge about knowledge and requires cognitive processing to convert it to useful knowledge.
- Metacontrast:** A type of backward masking in which the test stimulus and masking stimulus do not overlap spatially in the visual field.
- Michelson contrast:** One mathematical definition for contrast. It can have a maximum value of 1.0, which is the contrast of pure black stripes on a pure white background. It can have a minimum value of 0, which is the contrast of a neutral gray stripes on a neutral gray background; that is, a uniform gray field with no visible pattern.
- Microdisplay:** A small, usually 1-inch diagonal or less, electronic display device that can be suspended near the eye and viewed through magnifying optics or used with higher magnification optics to project an image.
- Microphone:** An electroacoustic transducer converting sound into electric current.
- Microsleep:** A brief, unintended episode of loss of attention associated with events such as blank stare, head snapping, and prolonged eye closure that may occur when a person is fatigued but trying to stay awake.
- Middle ear:** The main cavity of the ear; between the eardrum and the inner ear, containing the ossicles - three small bones that are connected and transmit the sound waves to the inner ear.
- Mid-sagittal plane:** [See **Median plane**]
- Military occupational specialty (MOS):** A job classification used by the U.S. Army and Marine Corps; the occupational specialty system uses a system of letters and numbers to identify general and specific jobs of

military personnel. The U.S. Air Force uses a system of Air Force Specialty Codes (AFSC). In the Navy, a system of naval ratings and designators is used along with Navy Enlisted Classification (NEC) system.

**Minimum angle of resolution (MAR):** A parameter used to describe visual acuity. It is the smallest angle between two objects for which they can be seen as two. For standard Snellen letters it refers to the width of one stroke of the letter.

**Minimum audible field:** Minimum audible sound pressure heard in a sound field.

**Minimum audible pressure:** Minimum audible sound pressure heard through the earphones.

**Mistakes:** A type of human error that involves incorrect intentions or plans.

**Modified rhyme test (MRT):** The accepted speech material used for determining speech intelligibility of a communication device.

**Modiolus:** The central bony pillar around which the spiral of cochlea winds.

**Modulation:** The systematic variation of one signal (carrier) caused by another lower frequency signal (modulating signal).

**Modulation rate:** A frequency of changes in a carrier caused by a modulating signal.

**Modulation transfer function (MTF):** The sine-wave spatial-frequency amplitude response used as a measure of the resolution and contrast transfer of an imaging system; a plot that describes the optical quality of an image-forming system, such as a camera or the human eye. This is not to be confused with the contrast sensitivity function (CSF), which describes visual performance, and includes neural image processing.

**Monaural:** Pertaining to, using, or involving the function of a single ear.

**Monaural listening:** Listening with a single ear.

**Monaural mode:** [See **Monotic mode**]

**Monaural signal:** An audio signal recorded with a single microphone located at a single ear of the listener or of the binaural dummy head.

**Monochromatic:** Description of a light that contains a single wavelength and therefore appears to have one particular colored hue. White light contains a mixture of many wavelengths (colors), therefore it is not monochromatic.

**Monophonic signal:** Audio signal that does not contain information about spatial distribution of sound sources.

**Monophonic system:** Means to record, transmit, or deliver a monophonic signal.

**Montonic:** Condition in which a sound stimulus is presented to only one ear.

**Monotic display:** An earphone display presenting acoustic signals to a single ear of the listener.

**Monotic mode:** A sound delivery mode in which auditory stimuli are delivered to a single ear of the listener.

**Monovision:** A vision correction method for people with presbyopia in which one eye is corrected for near vision and the other for far vision; the purposeful adjustment of one eye for near vision and the other eye for distance vision.

**Most comfortable loudness (MCL):** A loudness level of a specific auditory stimulus that is the most comfortable for the listener.

**Motion aftereffect:** The illusory impression, after prolonged viewing of movement in one direction, that a stationary object is moving in the opposite direction.

**Motion box:** The volume space in the cockpit within which the head-tracking sensors accurately can determine head position.

**Motion parallax:** A monocular depth perception cue based on the relative motion of object images that are at different distances from the observer.

**Mouth simulator:** A device simulating the acoustic characteristics of the head and mouth upon the radiated sound.

**Multidimensional scaling (MDS):** A statistical mapping technique in which the differences between N items are represented as points on n-dimensional map, where  $n \ll N$ . MDS technique is used to uncover dominant variables differentiating a given set of items.

**Multiple resources theory (MRT):** A theory which states that there are separate resources used for cognitive and perceptual activities based upon their different physical locations within the brain. These are: 1) Input perceptual or sensory modalities, 2) Central processing stages, 3) Response codes and 4) Channels of vision. Activities which share or overload these resources will cause greater interference and therefore poorer performance.

**Multisensory:** Refers to the use of more than one of the five human senses – vision, hearing, touch, smell, and taste.

**Multistable perception:** A perceptual phenomenon in which multiple perceptual interpretations are formed from a single sensory pattern. Multistable perception results from ambiguity in the sensory information that allows for more than one valid interpretation.

**Multitalker noise (MTN):** A noise made by multiple talkers speaking simultaneously.

**Myelin:** A fatty segmental covering on nerve fibers interrupted at the nodes of Ranvier. It accelerates the rate of propagation of the action potential along the nerve.

**Myopia:** Nearsightedness. A kind of refractive error in which an eye, viewing a distant object, focuses the image in front of the retina; near objects are seen more clearly than distant objects.

## N

**Nadir:** The direction pointing directly below a particular location.

**Naturalness:** A sensation of an agreement of a given auditory image with expectations of the listener.

**Nerve:** A collection of neurons that are bundled together forming a communication pathway.

**Network centric warfare:** A military doctrine or theory of war pioneered by the U.S. Department of Defense that seeks to translate an information advantage, enabled in part by information technology, into a competitive Warfighting advantage through the networking of well-informed geographically dispersed forces; also called network-centric operations (NCO).

**Neuron:** A cell that is capable of transmitting electrochemical information within the nervous system of the body.

**Neuroergonomics:** A relatively new field that integrates neuroscience and ergonomics with the goal of improving human performance through an understanding of how humans process visual, auditory and tactile information in the real world.

**Neutrality:** The characteristic of an optical medium which denotes reasonably flat transmittance over the visible spectrum (e.g. gray tint).

**Night myopia:** A condition that can occur in the dark, when an eye incorrectly focuses too close (over-accommodates). This causes blurred vision that is optically similar to myopia.

**Night vision goggle (NVG):** While strictly defined as second generation I<sup>2</sup> light amplification devices, the term often is used for all I<sup>2</sup> systems.

**Nit:** A metric unit for luminance, which is equal to 1 candela per meter squared.

**Noise:** Any unwanted, meaningless, or interfering information.

**Noise induced hearing loss:** A hearing loss that is caused either by a one-time or repeated exposure to very loud sounds.

**Nondeclarative memory:** Nonconscious memories that influence behavior but are not explicitly recalled.

**Nonsense syllable:** A pronounceable combination of phonemes that do not make a word used to test speech articulation.

**Note:** A tone having a specific pitch and duration of which musical pieces are composed.

**Numerical aperture (NA):** The sine of the vertex angle of the largest cone of meridional rays that can enter or leave an optical system or element, multiplied by the refractive index of the medium in which the vertex of the cone is located.

## O

- Obscurant:** Natural or made-made materials in the atmosphere that reduce or block visibility, e.g., smoke, fog, dust cloud, etc.
- Occlusion (vision):** A relative visual depth perception cue based on one or more objects blocking the view of one or more other objects.
- Occlusion effect (audition):** The perception of one's own voice as "hollow" or "booming" when the talker's ear canal is closed (covered). Occlusion effect is due to the amplification of bone conducted speech by the closed cavity of the outer ear.
- Octave:** A music interval produced by halving or doubling frequency.
- Octave band:** A band of frequencies where the highest frequency is the double of the lowest frequency.
- Oculomotor nerve:** The nerve that controls the movement of the muscles that move the eyeball.
- Omidirectional device:** A device in which the received or radiated signal is independent of the direction of observation.
- Operational memory:** [See **Working memory**]
- Ophthalmoscope:** A hand-held instrument used to inspect the internal parts of the eye.
- Optic chiasm:** The optic chiasm is where the optic nerves from the two eyes come together and retinal ganglion cell fibers from specific parts of the retina cross to the contralateral optic tract.
- Optic disc:** The portion of the optic nerve that is visible inside the eye; sometimes referred to as the "optic nerve head."
- Optic nerve:** The optic nerve is the third cranial nerve. It consists of a bundle of approximately 1 million retinal ganglion cell axons. The optic nerve exits the eye (or globe) posteriorly through the sclera at the lamina cribrosa.
- Optic relay:** A lens or lens system used to transfer a real image from one point within an optical system to another, with or without magnification.
- Optic tract:** The bundle of nerve fibers from the optic chiasm to the lateral geniculate nucleus.
- Optical axis:** The axis of symmetry of an optical system.
- Optical resolution:** The ability of an optical system to display all images as separate entities.
- Optimum sighting alignment point (OSAP):** Maximum eye clearance distance to obtain a full display field of view.
- Orbit:** The portion of the bony skull that surrounds and protects the eye and its supporting structures.
- Organ of Corti:** The sense organ of hearing located along the basilar membrane in the cochlea of the inner ear.
- Organic LED (OLED):** A thin film light-emitting technology that consists of a series of organic layers between two electrical contacts (electrodes) the acronym is derived from **Organic Light Emitting Device**, **Organic Light Emitting Diode**.
- Ossicles:** Three small bones in the middle ear that transmit vibrations from the tympanic membrane to the cochlea.
- Otitis media:** An infection of the middle ear.
- Otologically normal person:** A person without any sign of disease of the ear.
- Otosclerosis:** A condition in which bone grows around the oval window and stirrup, causing the stirrup to become immobile, and resulting in conductive hearing loss.
- Ototoxic substance:** A substances that have a toxic effect on the structures of the ear causing temporary or permanent damage to organs of hearing and balance.
- Outer ear:** The visible part of the ear, consisting of the pinna or auricle and is made of skin and cartilage.
- Over-the-counter (OTC):** Refers to be able to purchase without a prescription.
- Overlap:** The lateral angle subtended by the intersecting individual binocular fields-of-view.
- Overtone:** A component of sound with a frequency higher than the fundamental frequency. In a harmonic sound,  $N^{\text{th}}$  overtone is  $(N+1)$  harmonic.

**P**

**Panoramic NVG:** A night vision system that provides a horizontal field-of-view in excess of 100 degrees.

**Paracontrast:** A type of forward masking in which the test stimulus and masking stimulus do not overlap spatially.

**Parallax:** The apparent displacement or change of position of an object when viewed from different places, such as with the alternate use of the right and left eye.

**Partial:** A pure tone component of a complex tone.

**Pascal:** A unit of sound pressure equal to one Newton per square meter,

**Pentatonic scale:** A music scale using only five tones, usually the first, second, third, fifth, and sixth tones of a diatonic scale. Pentatonic scale corresponds to playing only the black keys on a piano.

**Perceived duration:** A perceptual assessment of the duration of the sensory stimulus.

**Perceived sound quality (PSQ):** A degree of the listener's satisfaction with perceived auditory image; an esthetic (beauty) or utilitarian (utility) value of an auditory stimulus.

**Perceptual conflict:** Situation that occurs when information from various sensory modalities or from within a modality is ambiguous. Some examples of perceptual conflict are when a visual object and a sound event are not co-located or when two sounds are arriving from different directions but seem to be produced by the same sound source. Depending on expectations and motivation, the brain can interpret conflicting stimulation in one or another way and the interpretation may change in time.

**Perceptual illusion:** A distorted perception of reality caused by misinterpretation of the stimulation pattern by the brain. Perceptual illusions are stable and generally shared by most people. An example of perceptual illusion is a pitch of sound that does not correspond to any frequency component of sound. Perceptual illusions reveal how the brain normally organizes and interprets sensory stimulation.

**Periodicity pitch:** Pitch determined on the basis of the period of the waveform of a stimulus.

**Periodicity theory of hearing:** A theory of hearing stating that differences in sound frequency are coded in time and resolved by the central nervous system.

**Peripheral masking:** Masking that occurs when a masking stimulus is present in one ear and its masking effect is observed in the same ear.

**Peripheral vision:** Vision near the edges of the visual field. That is vision in the side of the visual field, far from straight ahead.

**Percept:** Something what the perceiver sees or hears as a result of stimulation, as opposed to the physical reality of the stimulation; a perceptual image of the reality; the mental construct build up from sensory data by a biologic organism.

**Perception:** A mental analysis of sensations based on prior experience and world knowledge to form a mental representation of the surrounding environment; awareness of the surrounding environment through sensory stimulation; the conscious mental registration of a sensory stimulus.

**Permanent hearing loss:** [See **Permanent threshold shift**]

**Permanent threshold shift:** A non-reversible hearing loss due to chronic, sudden, or extended exposure to intense noise.

**Permanent memory:** [See **Long-term memory**]

**Personal space:** The area that a person reserves for themselves during business interaction with other people (within a 1-meter (3.28-foot) radius).

**Phase:** The fractional part of the wave period. Phase is frequently expressed as an angle that is an appropriate fraction of 360°.

**Phase difference:** The difference in phase angle between two waveforms.

**Phase locking:** The tendency for nerve firings to occur at a particular phase of the stimulating waveform on the basilar membrane.

**Phon:** Unit of loudness level. A tone of frequency 1000 Hz and sound intensity of 40 dB (re 20  $\mu$ Pa) presented frontally to the listener has loudness level of 40 phons.

**Phoneme:** The smallest unit of speech.

**Photopic:** Referring to the spectral sensitivity of the human eye due to the activity of the cones of the retina; exhibited under moderate to high light levels of illumination.

**Photoreceptor:** The specialized cells in the retina designed to capture photons of light. The two types of photoreceptors are rods, which are more sensitive to low luminance conditions and motion, and cones, which are more sensitive to high luminance conditions and color.

**Photorefractive keratectomy (PRK):** A kind of refractive surgery in which the superficial cell layer of the cornea is removed to expose the underlying stroma, which is then ablated with a laser to reshape the cornea and change its refractive power. The superficial cells grow back within a few days following the procedure. PRK has largely been supplanted by LASIK refractive surgery.

**Phototransduction:** A complex biochemical process that occurs within the photoreceptors (rods and cones). It begins with the adsorption of light and proceeds through a series of complex steps to produce an electrical signal that is relayed to the next neuron along the visual pathway.

**Physical-ear attenuation test (PEAT):** An acoustical test used to establish baseline sound attenuation data for evaluating the level of hearing protection provided by a system. An alternative test is the Microphone in Real Ear (MIRE).

**Piezoelectric transducer:** A device that uses the piezoelectric effect to measure pressure, acceleration, strain or force by converting them to an electrical signal.

**Pilot retained unit (PRU):** The helmet part of the RAH-66 Comanche Helmet Integrated Display and Sight System (HIDSS).

**Pilot's night vision system (PNVS):** A forward-looking infrared sensor mounted on the nose of the AH-64 Apache aircraft which serves as an imagery source for pilotage and/or targeting.

**Pincushion distortion:** A type of optical distortion that causes images to bow inwards on the horizontal and vertical planes; an image aberration that compresses the centre of the field.

**Pinna:** The external part of the human ear attached to the head around the opening of the external auditory meatus; the most visible part of the ear.

**Pitch:** A perceptual attribute of sound that is described by pitch height, pitch chroma, and pitch strength. Pitch depends primarily upon the fundamental frequency and spectral content of sound, but it also depends to some degree of sound intensity and duration of sound. Pitch is one of the three major auditory attributes of sounds along with loudness and timbre.

**Pitch class:** The set of all pitches that are a whole number of octaves apart. (e.g., the pitch class C consists of the Cs in all octaves).

**Pitch coding:** Term referring to the peripheral mechanisms used to represent frequency information in the auditory system.

**Pitch height:** A perceptual attribute of sound in terms of which sounds may be ordered on a scale extending from low to high; the perceived dominant frequency of a sound.

**Pitch strength:** A degree to which a sound has a definable pitch. Noise has low pitch strength. Pure tones, narrow bands, and complex tones with harmonic frequency components have stronger pitch strength.

**Pixel:** Short for "picture element;" represents the smallest individually addressable image element.

**Place theory of hearing:** A theory of hearing assuming that the basilar membrane is high resolution frequency analyzer. According to the place theory of hearing pitch is determined by sensing the place on the basilar membrane that has maximum excitation.

**Plasma display:** Emissive gas discharge flat panel display technology which produces light when an electric field is applied across an envelope containing a gas.

**Pleasantness:** A degree of the listener's satisfaction with the auditory image caused by a given auditory stimulus.



Antonym of pleasance is annoyance.

**Pointing accuracy:** A measure of the angular error between the pilot's line-of-sight (when aligned with the sighting reticle) and the sensor's and/or weapon system's line-of-sight.

**Polarity:** The condition of being positive or negative with respect to some reference point. For a sinusoid, reversing polarity essentially shifts the phase by 180 degrees.

**Posterior chamber:** The back chamber of the eye formed by the back surface of the crystalline lens, the ciliary body and the inside of the globe.

**Power spectrum:** The distribution of energy emitted by a source in a unit of time along the frequency scale.

**Precedence effect:** The ability of the auditory system to determine the actual position of the sound source without being confused by early sound reflections. When two identical sounds, originating from two locations arrive within 5 to 40 ms of each other, only the first sound is heard and the location information of the second sound is suppressed.

**Presbycusis/presbacusis:** A hearing loss associated with aging that develops when hair cells within the cochlea wear out, causing a loss of sensitivity to sound.

**Prominence ratio:** A ratio of the power in the critical band centered on the tone of interest to the mean power of the two adjacent critical bands (ANSI S1.13, 2005).

**Presbyopia:** The age-related condition in which the eye loses its ability to accommodate, that is, focus on near objects. Usually by about age 40, a patient with perfect distance vision begins to have difficulty focusing on fine print at a normal reading distance. Presbyopia can be compensated by reading glasses, bifocals or progressive lenses.

**Prismatic deviation:** A measure of the angular deviation in light rays that occurs when light rays pass through an optical medium, whose boundaries are nonparallel.

**Process:** A sequence of actions or events leading to a result.

**Proprioception:** The sense of body position

**Protan:** A type of hereditary color vision anomaly in which the patient is missing or has defective L-cones. Since L-cones have peak sensitivity in the long wavelengths range of the visible light spectrum, protans are sometimes called, "red weak, or red color blind."

**Prototype:** A standard representation of items in long term memory that correspond to a concept or category.

**Psychoacoustics:** A science of the relationships between auditory stimuli and auditory sensations.

**Psychomotor:** Relating to movement or muscular activity associated with mental processes.

**Psychophysics:** A science of the relations between external stimuli and sensory responses.

**Psychophysiological measures:** Real-time measurements of an individual that can give us an understanding of their physical and cognitive state. These include eye behavior (pupil diameter, blink and gaze), electroencephalography (EEG), heart rate, galvanic skin response (GSR), and functional near infrared imaging (fNIR).

**Pulfrich phenomenon:** A binocular visual effect in which a pendulum swinging in a plane parallel to the face appears to be swinging in an elliptical orbit. This occurs when a dark lens is placed over one eye while observing the pendulum. The brain receives a slightly delayed image from the covered eye, which causes the illusion of stereoscopic depth that varies with the pendulum's position.

**Pupil:** The hole or aperture in the center of the iris, which automatically adjust in size in response to light. The pupil plays an important role in the formation of the retinal image, directly controlling its illumination and quality of focus.

**Pupil forming optical design:** A system in which the eyepieces collimate virtual images that are formed using relay optics.

**Pure tone:** A sound consisting of only one sinusoidal component and no harmonics.

**Purkinje shift:** The shift in peak sensitivity from photopic to scotopic vision.

**R**

**Rarefaction:** In the physics of sound, the segment of the longitudinal wave where pressure is reduced, the other segment being compression.

**Real image:** An optical image formed when light rays converge such that the image can be projected onto a screen.

**Receiver:** Any device, system, or agent that responds to a specific signal.

**Receptor:** A specialized sensory cell that responds to a unique type of stimulus such as light, sound, or smell, and transmits this information to the central nervous system; a biological receiver.

**Recognition:** An act of assigning a stimulus or an object to a specific class or category.

**Recruitment:** An increase in loudness with increasing sound intensity at a rate greater than for normally hearing person.

**Redundant signal effect (RSE):** The speeding of reaction time (RT) with two rather than one stimulus.

**Reference hearing threshold level:** A mean standardized value of hearing threshold, expressed in dB (re 20  $\mu$ Pa), obtained under specific listening conditions for an adequately large number of ears of otologically normal listeners between the ages of 18 and 25 years.

**Reference equivalent threshold force level (RETFL):** A force level causing threshold sensation during bone conduction stimulation measured with the help of an acoustic couple or ear simulator.

**Reference equivalent threshold sound pressure level (RETSPL):** A sound pressure level causing threshold sensation during air conduction stimulation measured with the help of an acoustic couple or ear simulator.

**Reflection:** Return of radiation by a surface, without change in wavelength. The reflection may be specular, from a smooth surface; diffuse, from a rough surface or a combination of the two.

**Refraction:** The bending effect of incident rays as they pass from a medium having one refractive index into a medium with a different refractive index.

**Refractive error:** An optical aberration in which the eye has too much or too little focusing power. This causes blurred vision. The three most common and familiar refractive errors are myopia (nearsightedness), hyperopia (farsightedness) and astigmatism.

**Refractive index:** The ratio of the velocity of light in one medium to the velocity of light in the next medium.

**Refractive power:** The focusing effect of an optical component or system.

**Refresh rate:** The rate at which the picture on a display is redrawn.

**Relay optics:** An optical system which relays a real image from one plane within the system to another plane, usually for the purpose of magnification.

**Retention:** The act of keeping something in place (e.g., retaining a helmet on the head).

**Residual pitch:** [See **Periodicity pitch**]

**Resolution:** [See **Angular resolution**, **Frequency resolution**, **Intensity resolution**, **Optical resolution**, **Spatial resolution**, and **Spectral resolution**]

**Resonance:** A tendency of a mechanic or electric system to oscillate at a certain frequency characteristic for this system.

**Resonator:** A system that stores energy at a specific frequency that depends on the resonator properties.

**Response time experiment:** A method of experimental psychology that measures how long it takes a person to complete a task.

**Reticle:** A fine line pattern which is located in one of the focal planes of an optical device.

**Retina:** The thin neural layer at the back of the eye responsible for the initial capture and neural processing of light entering the eye. The retina consists of 10 layers, including the neural components of ganglion cells, bipolar cells, amacrine cells and photoreceptor cells, some dividing membranes, and the retinal pigment epithelium. In the very center of the retina at the posterior pole of the eye is a small area called the macula, which contains a pit or indentation called the fovea where the most defined vision occurs. [See **Fovea** and **Macula**]

**Retinal disparity:** Misalignment of the two retinal images.

**Retinal scanning display (RSD):** A system which employs the use of a laser which scans the image directly onto the retina of the user's eye.

**Reverberation:** Multiple reflections of sound off a hard surface.

**Rhyme test:** A speech intelligibility test where the listener must choose the answer from a multiple options, all differing only by a consonant, (i.e., items that rhyme).

**Risk-avoiding behavior:** In human decision making people tend to prefer certain choices when all choices have gains.

**Risk-seeking behavior:** In human decision making people tend to prefer uncertain choices when all choices have some loss.

**Rhodopsin:** The light-sensitive receptor protein in the retina. When rhodopsin absorbs a photon of light it releases energy, leading ultimately to an electrical signal.

**Rod:** One of the two principal light receptors of the retina; highly sensitive to low variations in illumination but relatively insensitive to color differences. [See **Photoreceptor**]

**Roll compensation:** In HMDs, the capability of keeping the imagery aligned about the roll axis.

**Roughness:** A sensation of the amount of harshness in sound. Perceptual impression created by amplitude and frequency modulations in sound at high modulation rates, above about 20 Hz.

## S

**Saccadic eye movement:** The sudden simultaneous movement of both eyes from one fixation point to another. The peak angular speed of the eye during a saccade reaches up to 1000 degrees per second. Saccades last from approximately 20 to 200 milliseconds.

**Saccule:** One of the two organs of balance (the other one is utricle) that responds to linear acceleration and head position relative to gravity.

**Safety of flight (SOF):** Refers to a process ensure that equipment is safe for air vehicle operation.

**Sagittal plane:** An imaginary plane passing through human body and dividing it into left and right parts.

**Saturation:** The purity or richness of a particular colored hue. For example, crimson is a highly saturated red hue, while pastel pink is a desaturated version of the same hue.

**Saccade:** A rapid shift in gaze that occurs when looking from one point to another.

**Scan line:** A single continuous narrow strip created by the scanning beam as it passes over the elements of a given area.

**Schema:** A cognitive structure that contains a mental model of how the world operates.

**Sclera:** The thick outer shell of the eye. The sclera is a thick collagen structure that protects the internal structures of the eye and serves an attachment point for the extraocular muscles of the eye. It covers 95% of the eye and connects to the cornea at the limbus at the front of the eye.

**Scotopic vision:** A state of visual adaptation under low illumination, such as during nighttime. Under scotopic conditions, light levels are below the working range for the cone, so only the rod photoreceptors are working.

**See-through display:** A display that presents imagery/symbology as a virtual image, allowing the viewer to look through the imagery (in varying degrees).

**Selective attention:** An act of purposely focusing conscious awareness onto a specific stimulus.

**Semicircular canals:** Three canals of the vestibular system that respond to angular acceleration of the body.

**Semitone:** A music interval equal 1/12 of an octave. On a piano a semitone is the interval between two adjacent keys.

**Sensation:** An awareness of external stimulation; an immediate reaction to external stimulation of a sense organ.

**Sensation level (SL):** An amount by which a specific sound pressure level or force level exceeds hearing threshold of a given listener for a specific sound.

**Sense:** A mechanism by which living organisms acquire information about the surrounding environment. The five human senses are vision, hearing, smell, touch, and taste.

**Sensitivity:** The capacity of a system or sensory organ to respond to stimulation; the smallest value of the stimulus that causes a specific reaction.

**Sensorineural hearing loss:** A hearing loss caused by damage to the sensory cells and/or nerve fibers of the inner ear.

**Serial position effect:** A memory-related term that refers to the tendency to recall information that is presented first and last (like in a list) better than information presented in the middle.

**Shades of gray (SOG):** Progressive steps in luminance where each step differs from continuous steps by a prescribed ratio, typically the square root of two.

**Shape constancy:** The recognition (visual perception) that the same object viewed at different distances, visual angles, and/or perspectives is the same objective shape.

**Sharpness:** An auditory sensation caused by acoustic energy concentrated in a narrow band around relatively high center frequency of sound.

**Shell tear resistance:** The property of the helmet shell to resist projectile damage.

**Shift lag:** A series of symptoms, to include excessive sleepiness, poor concentration, low productivity, and insomnia, associated with working and sleeping outside the normal circadian period for the activity. The clinical term is *shift-work sleep disorder*.

**Shop replaceable unit (SRU):** A maintenance term referring to a systems or module that cannot be replaced in the field; usually requires special tooling or fixturing for installation and alignment.

**Short-term memory:** A hypothesized system of human memory that holds information for durations ranging from one to thirty seconds.

**Sight:** [See **Vision**]

**Signal:** A change in the form or amount of energy intended to transmit information and by which information is transmitted.

**Signal-to-noise ratio (SNR):** The ratio of some measured aspect of a signal to a similar measure of concurrent noise expressed usually in a logarithmic form. The measured aspect, frequency range, and statistical properties of the signal and the noise should be stated explicitly.

**Simulator sickness:** Also referred to as cybersickness, a series of conditions which may include nausea, dizziness, and overall disorientation experienced during or after simulator training.

**Simultaneous masking:** Masking observed when a masking stimulus and a test signal occur at the same time.

**Situation awareness (SA):** A dynamic understanding of the individual (and vehicle or aircraft), environment, and status surrounding the individual. It is commonly divided into three levels: 1) the perception of the elements in the environment within a volume of time and space, 2) the comprehension of their meaning, and 3) the projection of their status in the near future. Lacking SA or having inadequate SA has been identified as one of the primary factors in accidents attributed to human error

**Size constancy:** The recognition (visual perception) that the same object viewed at different distances, visual angles, and/or perspectives is the same size.

**Slaving lag:** The latency of the sensor/weapon line-of-sight relative to the helmet line-of-sight. This includes the tracker computational time, data bus rate, and physical slaving time of the sensor/weapon.

**Sleep deprivation:** Refreshing sleep quality or quantity insufficient to support optimal daily functions; a wake-state-associated physiologic and/or psychological condition characterized by persistent sleepiness and/or impaired cognitive functioning.

**Slips:** Human errors in execution and/or storage of an action sequence.

**Snellen visual acuity:** A test of visual acuity commonly used and expressed as a comparison of the distance at which a given set of letters are read correctly to the distance at which the letters would be read by someone with

clinically normal vision. Normal visual acuity is 20/20, which is equivalent to 0.29 milliradians (1 arcminute) of resolution.

**Sone:** Unit of loudness. One sone is the loudness of a pure tone of frequency 1000 Hz and a sound pressure level of 40 dB (re 20  $\mu$ Pa) presented frontally to the listener. The loudness of sound that is judged by the listener to be N times that of 1 sone is N sones.

**Sonification:** A mapping of numerically represented relations in a non-acoustic domain to relations in an acoustic domain to facilitate interpretation of the relations in the non-acoustic domain; an interpretation of data sets by representing the data with sound; data-controlled sound generation.

**Sound:** The presence of a sound wave; an auditory sensation caused by a sound wave.

**Sound field:** [See **Acoustic field**]

**Sound intensity:** The amount of sound power that travels through a certain area ( $W/m^2$ ).

**Sound intensity level (SIL):** Ten times the logarithm to the base ten of the ratio of the time-mean sound intensity in a stated frequency band to the reference sound intensity of  $10^{-12} W/m^2$ .

**Sound pressure:** The magnitude of change in the local pressure caused by the propagating sound wave.

**Sound pressure level (SPL):** Ten times the logarithm to the base ten of the ratio of the time-mean-square pressure of sound in a stated frequency band to the square of the reference pressure of 20 micropascals ( $\mu$ Pa).

**Sound quality:** An objective or perceptual assessment of value of the auditory stimulus according to specific criteria. [See **Perceived sound quality**]

**Sound wave:** An acoustic wave at a frequency that is capable of being heard by a human listener. The nominal frequency range of acoustic waves that can be heard extends from 20 Hz to 20,000 Hz.

**Soundscape:** An acoustic environment. An environment created with sound.

**Spaciousness:** An auditory overall impression made by the surrounding acoustic space.

**Spatial disorientation (SD):** When the aviator experiences loss of situational awareness with regard to the position and motion of his aircraft or himself.

**Spatial frequency:** A parameter that corresponds with the size of black/white stripes in a pattern used to test vision. It is expressed as the number of cycles (black/white pairs) contained in one degree of visual angle. A high spatial frequency pattern contains many narrow bars while a low spatial frequency pattern contains a few broad bars.

**Spatial resolution:** A precision with which a person or a system can differentiate between two signals or objects presented from two different locations in space.

**Spatial signal:** [See **Stereophonic signal**]

**Spatial vision:** The aspect of vision concerned with how well we see images, without regard to color, motion, time, etc. The study of spatial vision considers how images are formed by the eye's optical system, and include subtopics such as visual acuity and contrast sensitivity.

**Specific acoustic impedance:** The ratio of the effective sound pressure to the effective particle velocity at a point of an acoustic medium or mechanical system. The units for specific acoustic impedance are Pa-s/m or dyne-s/cm<sup>3</sup>; which are called the *rayl* in honor of Lord Rayleigh. If specific acoustic impedance is measured at a given point in a free progressive sound wave (free field) it is called the *characteristic impedance* and is equal to the product of the density of the medium and the speed of sound in this medium ( $\rho_0 c$ ).

**Spectral density:** [See **Spectral power density**].

**Spectral envelope:** The imaginary line connecting the maxima of the sound spectrum.

**Spectral resolution:** A precision with which a person or a system can differentiate between frequencies of two simultaneously presented sine waves.

**Spectral transmittance:** That amount of radiant energy passing through an optical component or system as a function of wavelength.

**Spectral power density:** The amount of the total power available in the specific bandwidth divided by the width of the bandwidth ( $W/Hz$ ). The reference bandwidth is 1 Hz.

**Spectrum:** The distribution of amplitudes of the sinusoidal components of the complex waveform along the frequency scale. The spectrum can be instantaneous or averaged over time.

**Spherical aberration:** The failure of an optical component or system to focus all monochromatic paraxial and peripheral light rays at a single point; a rotationally symmetric higher-order optical aberration that causes a point of light to be imaged as a blurred circle. Within the Zernike system for classifying ocular aberrations, spherical aberration is labeled  $Z(4,0)$ .

**Speech:** An expression of thoughts in spoken words.

**Speech articulation:** The act or process of producing speech.

**Speech articulation (metric):** A percentage of spoken phonemes or meaningless syllables correctly received by the ideal listener. A metric typically used to assess speech production by talkers or speech synthesizers.

**Speech audibility (metric):** A percentage of words or other meaningful units of the ideal speech transmitted through a given transmission system and correctly received by a listener.

**Speech awareness threshold:** The lowest level at which one detects speech fifty percent of the time.

**Speech communicability (metric):** A percentage of words or other meaningful units of a speech signal correctly received by a listener under a given set of conditions.

**Speech detection threshold:** [See **Speech awareness threshold**]

**Speech intelligibility:** Property of speech leading to its recognition.

**Speech intelligibility (metric):** A percentage of words or other meaningful units of speech correctly received by the ideal listener.

**Speech intelligibility index (SII):** A general term for objective measures of speech intelligibility used in ANSI S3.5-1997 (R2007).

**Speech reception threshold:** The lowest level at which one correctly identifies 50% of the words from a list of words (usually spondees).

**Speech recognition:** Ability of the listener to understand speech.

**Speech recognition metric:** A percentage of words or other meaningful units of the ideal speech transmitted over the ideal transmission system and correctly received by a listener.

**Speech recognition threshold:** [See **Speech reception threshold**]

**Speech transmission index (STI):** A measure of speech intelligibility (one of two described by ANSI S3.5-1997(R2007)) where speech is modeled by a special test waveform that is modulated by low-frequency signals. The depth of modulation of the received signal is compared with that of the test signal in each of a number of frequency bands and reductions in the modulation depth are associated with loss of intelligibility.

**Speech transmissibility metric:** A percentage of words or other meaningful units of the ideal speech transmitted through a given transmission system and correctly received by the ideal listener.

**Spondee:** A two-syllable word with equal emphasis on each syllable (e.g., ice cream, northwest, and airplane) used in determination of a speech reception threshold.

**Spot size:** The diameter in millimeters of a spot typically at 50 percent of its normal intensity level.

**Steady-state sound:** Sound with negligible fluctuations of level within the period of observation.

**Stereocilia:** Hair-like projections extending from the top of a hair cell.

**Stereophonic signal:** An audio signal that contains information about the spatial distribution of sound sources.

**Stereophonic system:** Means to record, transmit, or deliver a stereophonic signal.

**Stereopsis:** A very high-quality sense of depth perception that is unique to binocular vision. Stereopsis is stimulated when the brain detects slight differences (disparity) in the positions of objects seen by the two eyes. The image that the brain receives from each eye is slightly different because each eye views objects from a slightly different position.

**Stiles-Crawford effect:** The phenomenon by which light seems brighter if it enters the eye through the center of the pupil rather than the peripheral pupil.

**Stimulus:** An agent, action, or environmental change that causes or is intended to cause a reaction. A stimulus is a physical realization of a signal. [See **Signal**]

**Streaming:** The task of analyzing complex sounds and partitioning them into auditory streams; the process of separating sound elements into different auditory objects is called *auditory stream segregation*. Conversely, the process of assigning different sound elements to a single object is known as *auditory stream integration*.

**Stress:** A nonspecific response of the body to a demand, which can be physical, environmental, psychological, etc.

**Stressor:** Any agent that causes stress to an organism; any stimulus or condition that causes physiological arousal beyond what is necessary to accomplish an action.

**Stroma:** The thick central layer of the cornea consisting of lamellar sheets of collagen. The arrangement of the collagen lamellae provides strength as well as transparency to the cornea.

**Superior olivary complex:** A group of nuclei of the central auditory nervous system located in the pons and playing a major role in coding sound localization information.

**Suppression:** The unconscious inhibition of an eye's retinal image. The condition in which sensations from one or both eyes is voluntarily or involuntarily ignored.

**Supra-aural earphone:** Earphone that rests on the external ear against the pinna.

**Symbol:** An individual representation of information.

**Symbology:** A set of symbols.

**Synchrony:** The state of two or more events occurring at the same time.

**Synthetic vision:** A system that uses various sensors to augment the viewer's view of the outside world.

**System:** A structure of elements operating together to accomplish a predescribed end result.

**Systems safety assessment (SSA):** A system analysis which addresses safety and health issues.

## T

**Tarsal plate:** The cartilage-like plate within the upper and lower eyelids that provide rigidity and shape to each eyelid.

**Technology readiness level (TRL):** A measure used by some U.S. government agencies and many major world's companies (and agencies) to assess the maturity of evolving technologies (materials, components, devices, etc.) prior to incorporating that technology into a system or subsystem.

**Tectorial membrane:** The gelatinous membrane that lies over the hair cells of the organ of Corti.

**Telepresence:** Enables the operator to participate in activities at remote locations.

**Temporal envelope:** The imaginary line connecting the maxima of the sound waveform.

**Temporal integration:** [See **Temporal summation**]

**Temporal masking:** A masking effect that occurs when the masker reduces sensitivity to the sounds that is presented immediately preceding or following the masker.

**Temporal resolution:** The precision of sensation with respect to time; the ability to detect rapid changes in auditory or visual information.

**Temporal summation:** Sensory addition of the effects of a single stimulus or several stimuli over a short period of time.

**Temporal vision:** The time-related or time-dependent aspects of vision; it is closely related to motion perception.

**Temporary hearing loss:** [See **Temporary threshold shift**]

**Temporary threshold shift:** A temporary reduction in hearing sensitivity due to exposure to intense levels of noise.

**Terminal threshold:** A sensory threshold above which specific sensation does not exist or changes its character.

**Thermoneutral zone (TNZ):** The temperature range when metabolic heat production does not need to be increased to maintain thermostability.

**Thermoplastic liners (TPL™):** A liner developed by Gentex Corporation, Carbondale, PA, consisting of two to five plies of thermoplastic sheets covered with a cloth cover, designed to improve comfort and to alleviate helmet fitting problems.

**Thermoregulation:** The regulation of body temperature; the ability of an organism to keep its body temperature within certain boundaries.

**Three-dimensional (3-D) audio:** Variety of signal processing techniques that simulate sounds coming from all directions using a single pair of audio transducers.

**Threshold of pain:** A sound pressure level beyond which sound causes pain.

**Timbre:** A perceptual attribute of sound in terms of which a listener can judge that two sound that are similarly presented and have the same loudness, pitch, and subjective duration are dissimilar. Timbre is the main perceptual property of sound that guides in sound source recognition.

**Time error:** An error in a sensory judgment resulting from sequential presentation of stimuli.

**Tonality:** In music, tonality refers to the tonic, or the key in which a piece was written. In psychoacoustics, tonality refers to the degree to which a sound has a particular pitch.

**Tone:** An audible sound of specific pitch and periodic waveform; an interval of two semitones.

**Tone chroma:** [See **Pitch class**]

**Tone-to-noise ratio:** A ratio of the power of a specific pure tone to the power of the critical band centered on that tone. A method of specifying the audibility of a specific tonal component embedded in noisy background.

**Tonic:** [See **Key**]

**Tonotopic:** The one-to-one correspondence between specific sound frequency and its representation along the basilar membrane of within a specific neural structure of the auditory system.

**Tracking:** A helmet mounted display enhancement in which the line-of-sight-direction of the aviator is continuously monitored, and any change is replicated in the line-of-sight-direction of the aircraft-mounted sensor.

**Tragion:** An anthropometric point situated in the notch just above the tragus of the ear.

**Tragus:** A small cartilaginous part of pinna that is immediately anterior to the opening of the ear canal.

**Transducer:** A device for converting one form of energy into another (e.g., acoustic energy into electric energy).

**Transfer function:** The output versus input response characteristics of a device expressed either mathematically or graphically.

**Transient sound:** A state of motion that lasts only a very short time.

**Transmeridian:** Refers to crossing a number of time zones.

**Transmission (T):** An act or process of moving a certain quantity through a medium or a communication channel.

**Transmissibility:** The ratio of the magnitude of a certain transmitted quantity received after transmission to the magnitude that was sent. In optics, a ratio of the amount of the radiant flux received after propagating through a medium or a body to the amount that was sent; usually expressed as a percent.

**Transmission coefficient:** [See **Transmissibility**]

**Transmission loss (TL):** [See **Transmissibility**]

**Transmitter:** Any device, system, or agent that sends a signal out.

**Transverse plane:** [See **Horizontal plane**]

**Tritan:** A rare color vision anomaly in which the patient has abnormal sensitivity for short wavelengths. These patients are sometimes referred to as having a blue-yellow color vision defect.

**Troland:** A metric unit for retinal illumination. It describes the amount of light falling on the retina.

**Tympanic membrane:** A membrane separating the outer ear from the middle ear converting acoustic waves of the outer ear into mechanical vibration of the middle ear.



## U

**Ultrasound:** An acoustic wave of a frequency higher than the upper limit of human hearing; usually considered to be a sound having frequency higher than 20 kHz.

**Underload syndrome:** A lack of stimulation (such as a boring job) can result in depression and health problems, e.g., headache, fatigue and recurrent infection.

**Unmanned aerial vehicle (UAV):** Remotely controlled or autonomous aircraft used for surveillance and strike missions.

**Update rate:** The rate at which the position of the helmet/head display or signal is sampled and used to provide drive inputs to the head-slaved sensor or display, usually expressed as a frequency (in Hz).

**Utricle:** One of the two organs of balance (the other one is saccule) that responds to linear acceleration and head position relative to gravity.

## V

**Vacuum fluorescent display (VFD):** A flat vacuum tube emissive display device that uses a filament wire, control grid structure, and phosphor-coated anode.

**Ventriloquism effect (VE):** The result of the domination of visual localization over auditory location.

**Vernier acuity:** A type of visual acuity task in which the patient tries to detect a small offset of one line relative to another.

**Vergence:** The symmetric movement of the eyes toward or away from each other.

**Vestibule:** The part of the bony labyrinth that contains two organs of balance. The utricle and saccule are located within the vestibule and the semicircular canals begin and end at the vestibule.

**Vestibulocochlear nerve:** A nerve connecting inner ear with the brainstem.

**Vestibulo-ocular reflex (VOR):** A reflex that causes the eyes to rotate in the opposite direction as a head tilt. This helps to stabilize vision.

**Vibration:** An oscillation where the quantity is a parameter that defines the motion of a mechanical system.

**Video:** Pertaining to a visual signal encoded in electrical form and to the means of its transmission.

**Virtual image:** An optical image formed when light rays do not actually converge and cannot be projected upon a screen.

**Virtual pitch:** [See **Periodicity pitch**]

**Virtual reality (VR):** A synthetic (computer-generated) environment.

**Vision:** The act or power of sensing with the eyes.

**Vista space:** The viewable space around a person that is approximately 30 meters out and beyond.

**Visual acuity:** A measure of the ability of the eye to resolve spatial detail; a description of the sharpness or quality of spatial vision. [See **Snellen acuity**]

**Visual angle:** The angle subtended by an object at the eye or retina.

**Visual capture:** The phenomenon in which visual perception dominates when visual cues and other sensory cues – auditory, proprioceptive, haptic, etc. – are in direct conflict.

**Visual cortex:** Located at the posterior portion of the brain, this is the part of the brain where vision occurs; also referred to as the “occipital cortex.”

**Visual field:** The extent of space that is visible to an eye while it is looking at one particular point; a plot of the remaining unaided field of vision available when wearing a helmet, helmet-mounted display, etc.

**Visually coupled system (VCS):** A system in which the line-of-sight of the user’s eyes (or head) is continuously monitored, and any change is replicated in the line-of-sight-direction of the sensor.

**Visual adaptation:** The automatic adjustment of the pupil in response to different levels of ambient illumination.

**Visual search:** An experimental method for measuring human behavior. The task is for an observer to find a designated target among a field with other information.

**Vitreous humor:** The fluid or gel body that fills the posterior chamber of the eye.

**Vocal folds:** A stretchable pair of bands of mucous membrane that project into larynx. When air passes up from the lungs though stretched vocal folds it produces acoustic event that is the basis for all vocal (voiced) sounds of speech.

**Vocal tract:** The airway (tube) used in speech production. It consists of the upper part of the respiratory tube from larynx up including pharyngeal, mouth, and nasal cavities.

## W

**Warfighter:** All military personnel trained to engage in combat operations.

**Wave:** A disturbance that travels through a medium by virtue of the elastic properties of that medium.

**Weber fraction:** A relation between the intensity of a standard stimulus and the intensity of a stimulus required to produce a just noticeable difference in perception.

**Weber's law:** A rule stating that a just-noticeable difference in a stimulus is proportional to the magnitude of the original stimulus.

**Weber-Fechner law:** Equal stimulus ratios correspond to equal sensation differences. An empirical law stating that sensation changes in equal arithmetic increments in response to geometric changes of the stimulus.

**Whole-body vibration (WBV):** Vibration that is transmitted to a workers body from vibrating surfaces on which a worker stands or sits.

**Working memory:** A term used for short-term memory that underscores its use as a working buffer for incoming information as well as information retrieved from long-term memory. [See **Short-term memory**]

**Workload:** The hypothetical relationship between a group or individual human operator and task demands.

## Y

**Yerkes-Dodson law:** An empirical relationship between arousal and performance, stating that performance increases with physiological or mental arousal, but only up to a point, beyond which performance decreases.

## Z

**Zenith:** The direction pointing directly above a particular location.

**Zonule:** The thin fiber-like structures that suspend the crystalline lens within the eye. These fibers are connected to the ciliary muscle, which controls tension on the fibers to allow for accommodation of the crystalline lens.