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Meaning of perceive in tamil

Word: self perception - The english word have 15 alphabets and vowels.. tanvetanai (□□□□□□□□)□□□□□□□□□□ Related English Marathi Meaningconso nance or connexion in a stanzaconso nantconsociateconsolationconsoleconsoledconsolerconsolidate mercuryconsolidated drugsconsolidated mer curyconsolidated orpimentconsolidated sal ammoniacconsolidated vermilionconsolidatedconsolidatingconsolidationconsolingconsonance of an inferior order including every kind except the two given aboveconsonance of the second and third letters in each line of a stanzaconsonance of the second letters in the first foot of each line in a stanza Perceive : □□□□□□To obtain knowledge of through the senses; to receive impressions from by means of the bodily organs; to take cognizance of the existence, character, or identity of, by means of the senses; to see, hear, or feel; as, to perceive a distant ship; to perceive a discord.To take intellectual cognizance of; to apprehend by the mind; to be convinced of by direct intuition; to note; to remark; to discern; to see; to understand.To be affected of influented by. Bill perceived a tiny figure in the distance. I perceived a note of unhappiness in her voice. Perceiving that he wasn't happy with the arrangements, I tried to book a different hotel. Thesaurus: synonyms, antonyms, and examples For other uses, see Perception (disambiguation). "Percept" redirects here. For other uses, see Percept (disambiguation). Organization, identification, and interpretation of sensory information in order to represent and understand the environment The Necker cube and Rubin vase can be perceived in more than one way. Humans are able to have a very good guess on the underlying 3D shape category/identity/geometry given a silhouette of that shape. Computer vision researchers have been able to build computational models for perception that exhibit a similar behavior and are capable of generating and reconstructing 3D shapes from single or multi-view depth maps or silhouettes[1] Part of a series onPsychology Outline History Subfields Basic types Abnormal Behavioral genetics Biological Cognitive/Cognitivism Comparative Cross-cultural Cultural Differential Developmental Evolutionary Experimental Mathematical Neuropsychology Personality Positive Quantitative Social Applied psychology Applied behavior analysis Clinical Community Consumer Counseling Critical Educational Environmental Ergonomics Forensic Health Humanistic Industrial and organizational Legal Medical Military Music Occupational health Political Religion School Sport Traffic Lists Disciplines Organizations Psychologists Psychotherapies Publications Research methods Theories Timeline Topics Psychology portalv t e Part of a series onPhilosophyPlatoKantNietzscheBuddhaConfuciusAverroes Branches Aesthetics Axiology Cosmology Epistemology Ethics Law Logic Metaphilosophy Metaphysics Linguistic of Mind of Science Political of Religion Social Periods Ancient Medieval Modern Contemporary Traditions Analytic Neopositivism Ordinary language Aristotelian Buddhist Abhidharma Madhyamaka Pramāṇavāda Yogacara Cārvāka Christian Augustinian Humanist Scotist Thomist Occamist Confucian Neo-Confucianism New Confucianism Continental Existentialism Phenomenology Hegelian Hindu Mīmāṃsā Nyāya-Vaiśeṣika Sāṃkhya Vedanta Islamic Ash'arism Early Islamic Averroist Avicennist Illuminationist Ismāʿīlism Sufi Jain Jewish Judeo-Islamic Kantian Legalism Platonist Neoplatonist Pragmatism Skepticism Taoist philosophy Traditions by region African Eastern Chinese Indian Middle-Eastern Egyptian Iranian Western Literature Aesthetics Epistemology Ethics Logic Metaphysics Political philosophy Philosophers Aestheticians Epistemologists Ethicists Logicians Metaphysicians Social and political philosophers Women in philosophy Lists Index Outline Years Problems Publications Theories Glossary Philosophers Philosophy portalv t e Neuropsychology Topics Brain regions Clinical neuropsychology Cognitive neuropsychology Cognitive neuroscience Dementia Human brain Neuroanatomy Neurophysiology Neuropsychological assessment Neuropsychological rehabilitation Traumatic brain injury Brain functions Arousal Attention Consciousness Decision making Executive functions Natural language Learning Memory Motor coordination Perception Planning Problem solving Thought People Alan Baddeley Arthur L. Benton David Bohm Antonio Damasio Phineas Gage Norman Geschwind Elkhonon Goldberg Patricia Goldman-Rakic Donald O. Hebb Kenneth Heilman Eric Kandel Edith Kaplan Muriel Lezak Benjamin Libet Rodolfo Llinás Alexander Luria Brenda Milner Karl H. Pribram Oliver Sacks Mark Rosenzweig Roger W. Sperry Hans-Lukas Teuber Henry Molaison ("H.M.", patient) K.C. (patient) Tests Benton Visual Retention Test Continuous Performance Task Halstead-Reitan Neuropsychological Battery Hayling and Brixton tests Lexical Decision Task Luria-Nebraska neuropsychological battery Mini–Mental State Examination Rey–Osterrieth complex figure Stroop Test Wechsler Adult Intelligence Scale Wechsler Memory Scale Wisconsin Card Sorting Task Psychology portal Philosophy portal Medicine portal v t e Perception (from the Latin perceptio, meaning gathering or receiving) is the organization, identification, and interpretation of sensory information in order to represent and understand the presented information or environment.[2] All perception involves signals that go through the nervous system, which in turn result from physical or chemical stimulation of the sensory system.[3] For example, vision involves light striking the retina of the eye; smell is mediated by odor molecules; and hearing involves pressure waves. Perception is not only the passive receipt of these signals, but it's also shaped by the recipient's learning, memory, expectation, and attention.[4][5] Sensory input is a process that transforms this low-level information to higher-level information (e.g., extracts shapes for object recognition).[5] The process that follows connects a person's concepts and expectations (or knowledge), restorative and selective mechanisms (such as attention) that influence perception. Perception depends on complex functions of the nervous system, but subjectively seems mostly effortless because this processing happens outside conscious awareness.[3] Since the rise of experimental psychology in the 19th century, psychology's understanding of perception has progressed by combining a variety of techniques.[4] Psychophysics quantitatively describes the relationships between the physical qualities of the sensory input and perception.[6] Sensory neuroscience studies the neural mechanisms underlying perception. Perceptual systems can also be studied computationally, in terms of the information they process. Perceptual issues in philosophy include the extent to which sensory qualities such as sound, smell or color exist in objective reality rather than in the mind of the perceiver.[4] Although the senses were traditionally viewed as passive receptors, the study of illusions and ambiguous images has demonstrated that the brain's perceptual systems actively and pre-consciously attempt to make sense of their input.[4] There is still active debate about the extent to which perception is an active process of hypothesis testing, analogous to science, or whether realistic sensory information is rich enough to make this process unnecessary.[4] The perceptual systems of the brain enable individuals to see the world around them as stable, even though the sensory information is typically incomplete and rapidly varying. Human and animal brains are structured in a modular way, with different areas processing different kinds of sensory information. Some of these modules take the form of sensory maps, mapping some aspect of the world across part of the brain's surface. These different modules are interconnected and influence each other. For instance, taste is strongly influenced by smell.[7] "Percept" is also a term used by Deleuze and Guattari[8] to define perception independent from perceivers. Process and terminology The process of perception begins with an object in the real world, known as the distal stimulus or distal object.[3] By means of light, sound, or another physical process, the object stimulates the body's sensory organs. These sensory organs transform the input energy into neural activity—a process called transduction.[3][9] This raw pattern of neural activity is called the proximal stimulus.[3] These neural signals are then transmitted to the brain and processed.[3] The resulting mental re-creation of the distal stimulus is the percept. To explain the process of perception, an example could be an ordinary shoe. The shoe itself is the distal stimulus. When light from the shoe enters a person's eye and stimulates the retina, that stimulation is the proximal stimulus.[10] The image of the shoe reconstructed by the brain of the person is the percept. Another example could be a ringing telephone. The ringing of the phone is the distal stimulus. The sound stimulating a person's auditory receptors is the proximal stimulus. The brain's interpretation of this as the "ringing of a telephone" is the percept. The different kinds of sensation (such as warmth, sound, and taste) are called sensory modalities or stimulus modalities.[9][11] Bruner's model of the perceptual process Psychologist Jerome Bruner developed a model of perception, in which people put "together the information contained in" a target and a situation to form "perceptions of ourselves and others based on social categories."[12][13] This model is composed of three states: When we encounter an unfamiliar target, we are very open to the informational cues contained in the target and the situation surrounding it. The first stage doesn't give us enough information on which to base perceptions of the target, so we will actively seek out cues to resolve this ambiguity. Gradually, we collect some familiar cues that enable us to make a rough categorization of the target. (see also Social Identity Theory) The cues become less open and selective. We try to search for more cues that confirm the categorization of the target. We also actively ignore and even distort cues that violate our initial perceptions. Our perception becomes more selective and we finally paint a consistent picture of the target. Saks and John's three components to perception According to Alan Saks and Gary Johns, there are three components to perception:[14] The Perceiver: a person whose awareness is focused on the stimulus, and thus begins to perceive it. There are many factors that may influence the perceptions of the perceiver, while the three major ones include (1) motivational state, (2) emotional state, and (3) experience. All of these factors, especially the first two, greatly contribute to how the person perceives a situation. Oftentimes, the perceiver may employ what is called a "perceptual defense," where the person will only "see what they want to see"—i.e., they will only perceive what they want to perceive even though the stimulus acts on his or her senses. The Target: the object of perception; something or someone who is being perceived. The amount of information gathered by the sensory organs of the perceiver affects the interpretation and understanding about the target. The Situation: the environmental factors, timing, and degree of stimulation that affect the process of perception. These factors may render a single stimulus to be left as merely a stimulus, not a percept that is subject for brain interpretation. Multistable perception Stimuli are not necessarily translated into a percept and rarely does a single stimulus translate into a percept. An ambiguous stimulus may sometimes be transduced into one or more percepts, experienced randomly, one at a time, in a process termed "multistable perception." The same stimuli, or absence of them, may result in different percepts depending on subject's culture and previous experiences. Ambiguous figures demonstrate that a single stimulus can result in more than one percept. For example, the Rubin vase can be interpreted either as a vase or as two faces. The percept can bind sensations from multiple senses into a whole. A picture of a talking person on a television screen, for example, is bound to the sound of speech from speakers to form a percept of a talking person. Types of perception Vision Main article: Visual perception In many ways, vision is the primary human sense. Light is taken in through each eye and focused in a way which sorts it on the retina according to direction of origin. A dense surface of photosensitive cells, including rods, cones, and intrinsically photosensitive retinal ganglion cells captures information about the intensity, color, and position of incoming light. Some processing of texture and movement occurs within the neurons on the retina before the information is sent to the brain. In total, about 15 differing types of information are then forwarded to the brain proper via the optic nerve.[15] Anatomy of the human ear. (The length of the auditory canal is exaggerated in this image). Brown is outer ear. Red is middle ear. Purple is inner ear. Sound Main article: Hearing (sense)Hearing (or audition) is the ability to perceive sound by detecting vibrations (i.e., sonic detection). Frequencies capable of being heard by humans are called audio or audible frequencies, the range of which is typically considered to be between 20 Hz and 20,000 Hz.[16] Frequencies higher than audio are referred to as ultrasonic, while frequencies below audio are referred to as infrasonic. The auditory system includes the outer ears, which collect and filter sound waves; the middle ear, which transforms the sound pressure (impedance matching); and the inner ear, which produces neural signals in response to the sound. By the ascending auditory pathway these are led to the primary auditory cortex within the temporal lobe of the human brain, from where the auditory information then goes to the cerebral cortex for further processing. Sound does not usually come from a single source: in real situations, sounds from multiple sources and directions are superimposed as they arrive at the ears. Hearing involves the computationally complex task of separating out sources of interest, identifying them and often estimating their distance and direction.[17] Touch Main article: Haptic perceptionThe process of recognizing objects through touch is known as haptic perception. It involves a combination of somatosensory perception of patterns on the skin surface (e.g., edges, curvature, and texture) and proprioception of hand position and conformation. People can rapidly and accurately identify three-dimensional objects by touch.[18] This involves exploratory procedures, such as moving the fingers over the outer surface of the object or holding the entire object in the hand.[19] Haptic perception relies on the forces experienced during touch.[20] Gibson defined the haptic system as "the sensibility of the individual to the world adjacent to his body by use of his body."[21] Gibson and others emphasized the close link between body movement and haptic perception, where the latter is active exploration. The concept of haptic perception is related to the concept of extended physiological proprioception according to which, when using a tool such as a stick, perceptual experience is transparently transferred to the end of the tool. Taste Main article: TasteTaste (formally known as gustation) is the ability to perceive the flavor of substances, including, but not limited to, food. Humans receive tastes through sensory organs concentrated on the upper surface of the tongue, called taste buds or gustatory calyculi.[22] The human tongue has 100 to 150 taste receptor cells on each of its roughly-ten thousand taste buds.[23] Traditionally, there have been four primary tastes: sweetness, bitterness, sourness, and saltiness. However, the recognition and awareness of umami, which is considered the fifth primary taste, is a relatively recent development in Western cuisine.[24][25] Other tastes can be mimicked by combining these basic tastes,[23][26] all of which contribute only partially to the sensation and flavor of food in the mouth. Other factors include smell, which is detected by the olfactory epithelium of the nose;[7] texture, which is detected through a variety of mechanoreceptors, muscle nerves, etc.;[26][27] and temperature, which is detected by thermoreceptors.[26] All basic tastes are classified as either appetitive or aversive, depending upon whether the things they sense are harmful or beneficial.[28] Smell Main article: Olfaction Smell is the process of absorbing molecules through olfactory organs, which are absorbed by humans through the nose. These molecules diffuse through a thick layer of mucus; come into contact with one of thousands of cilia that are projected from sensory neurons; and are then absorbed into a receptor (one of 347 or so).[29] It is this process that causes humans to understand the concept of smell from a physical standpoint. Smell is also a very interactive sense as scientists have begun to observe that olfaction comes into contact with the other sense in unexpected ways.[30] It is also the most primal of the senses, as it is known to be the first indicator of safety or danger, therefore being the sense that drives the most basic of human survival skills. As such, it can be a catalyst for human behavior on a subconscious and instinctive level.[31] Social Main article: Social perceptionSocial perception is the part of perception that allows people to understand the individuals and groups of their social world. Thus, it is an element of social cognition.[32] Though the phrase "I owe you" can be heard as three distinct words, a spectrogram reveals no clear boundaries. Speech Main article: Speech perception Speech perception is the process by which spoken language is heard, interpreted and understood. Research in this field seeks to understand how human listeners recognize the sound of speech (or phonetics) and use such information to understand spoken language. Listeners manage to perceive words across a wide range of conditions, as the sound of a word can vary widely according to words that surround it and the tempo of the speech, as well as the physical characteristics, accent, tone, and mood of the speaker. Reverberation, signifying the persistence of sound after the sound is produced, can also have a considerable impact on perception. Experiments have shown that people automatically compensate for this effect when hearing speech.[17][33] The process of perceiving speech begins at the level of the sound within the auditory signal and the process of audition. The initial auditory signal is compared with visual information—primarily lip movement—to extract acoustic cues and phonetic information. It is possible other sensory modalities are integrated at this stage as well.[34] This speech information can then be used for higher-level language processes, such as word recognition. Speech perception is not necessarily uni-directional. Higher-level language processes connected with morphology, syntax, and/or semantics may also interact with basic speech perception processes to aid in recognition of speech sounds.[35] It may be the case that it is not necessary (maybe not even possible) for a listener to recognize phonemes before recognizing higher units, such as words. In an experiment, Richard M. Warren replaced one phoneme of a word with a cough-like sound. His subjects restored the missing speech sound perceptually without any difficulty. Moreover, they were not able to accurately identify which phoneme had even been disturbed.[36] Faces Main article: Face perceptionFacial perception refers to cognitive processes specialized in handling human faces (including perceiving the identity of an individual) and facial expressions (such as emotional cues.) Social touch Main article: Somatosensory system § Neural processing of social touchThe somatosensory cortex is a part of the brain that receives and encodes sensory information from receptors of the entire body.[37] Affective touch is a type of sensory information that elicits an emotional reaction and is usually social in nature. Such information is actually coded differently than other sensory information. Though the intensity of affective touch is still encoded in the primary somatosensory cortex, the feeling of pleasantness associated with affective touch is activated more in the anterior cingulate cortex. Increased blood oxygen level-dependent (BOLD) contrast imaging, identified during functional magnetic resonance imaging (fMRI), shows that signals in the anterior cingulate cortex, as well as the prefrontal cortex, are highly correlated with pleasantness scores of affective touch. Inhibitory transcranial magnetic stimulation (TMS) of the primary somatosensory cortex inhibits the perception of affective touch intensity, but not affective touch pleasantness. Therefore, the S1 is not directly involved in processing socially affective touch pleasantness, but still plays a role in discriminating touch location and intensity.[38] Multi-modal perception Multi-modal perception refers to concurrent stimulation in more than one sensory modality and the effect such has on the perception of events and objects in the world.[39] Time (chronoception) Main article: time perception Chronoception refers to how the passage of time is perceived and experienced. Although the sense of time is not associated with a specific sensory system, the work of psychologists and neuroscientists indicates that human brains do have a system governing the perception of time,[40][41] composed of a highly distributed system involving the cerebral cortex, cerebellum, and basal ganglia. One particular component of the brain, the suprachiasmatic nucleus, is responsible for the circadian rhythm (commonly known as one's "internal clock"), while other cell clusters appear to be capable of shorter-range timekeeping, known as an ultradian rhythm. One or more dopaminergic pathways in the central nervous system appear to have a strong modulatory influence on mental chronometry, particularly interval timing.[42] Agency Main article: Sense of agency Sense of agency refers to the subjective feeling of having chosen a particular action. Some conditions, such as schizophrenia, can cause a loss of this sense, which may lead a person into delusions, such as feeling like a machine or like an outside source is controlling them. An opposite extreme can also occur, where people experience everything in their environment as though they had decided that it would happen.[43] Even in non-pathological cases, there is a measurable difference between the making of a decision and the feeling of agency. Through methods such as the Libet experiment, a gap of half a second or more can be detected from the time when there are detectable neurological signs of a decision having been made to the time when the subject actually becomes conscious of the decision. There are also experiments in which an illusion of agency is induced in psychologically normal subjects. In 1999, psychologists Wegner and Wheatley gave subjects instructions to move a mouse around a scene and point to an image about once every thirty seconds. However, a second person—acting as a test subject but actually a confederate—had their hand on the mouse at the same time, and controlled some of the movement. Experimenters were able to arrange for subjects to perceive certain "forced stops" as if they were their own choice.[44][45] Familiarity Recognition memory is sometimes divided into two functions by neuroscientists: familiarity and recollection.[46] A strong sense of familiarity can occur without any recollection, for example in cases of deja vu. The temporal lobe (specifically the perirhinal cortex) responds differently to stimuli that feel novel compared to stimuli that feel familiar. Firing rates in the perirhinal cortex are connected with the sense of familiarity in humans and other mammals. In tests, stimulating this area at 10–15 Hz caused animals to treat even novel images as familiar, and stimulation at 30–40 Hz caused novel images to be partially treated as familiar.[47] In particular, stimulation at 30–40 Hz led to animals looking at a familiar image for longer periods, as they would for an unfamiliar one, though it did not lead to the same exploration behavior normally associated with novelty. Recent studies on lesions in the area concluded that rats with a damaged perirhinal cortex were still more interested in exploring when novel objects were present, but seemed unable to tell novel objects from familiar ones—they examined both equally. Thus, other brain regions are involved with noticing unfamiliarity, while the perirhinal cortex is needed to associate the feeling with a specific source.[48] Sexual stimulation Main article: Sexual stimulation Sexual stimulation is any stimulus (including bodily contact) that leads to, enhances, and maintains sexual arousal, possibly even leading to orgasm. Distinct from the general sense of touch, sexual stimulation is strongly tied to hormonal activity and chemical triggers in the body. Although sexual arousal may arise without physical stimulation, achieving orgasm usually requires physical sexual stimulation (stimulation of the Krause-Finger corpuscles[49] found in erogenous zones of the body.) Other senses Main article: SenseOther senses enable perception of body balance, acceleration, gravity, position of body parts, temperature, and pain. They can also enable perception of internal senses, such as suffocation, gag reflex, abdominal distension, fullness of rectum and urinary bladder, and sensations felt in the throat and lungs. Reality In the case of visual perception, some people can actually see the percept shift in their mind's eye.[50] Others, who are not picture thinkers, may not necessarily perceive the 'shape-shifting' as their world changes. This esemplastic nature has been demonstrated by an experiment that showed that ambiguous images have multiple interpretations on the perceptual level. This confusing ambiguity of perception is exploited in human technologies such as camouflage and biological mimicry. For example, the wings of European peacock butterflies bear eyespots that birds respond to as though they were the eyes of a dangerous predator. There is also evidence that the brain in some ways operates on a slight "delay" in order to allow nerve impulses from distant parts of the body to be integrated into simultaneous signals.[51] Perception is one of the oldest fields in psychology. The oldest quantitative laws in psychology are Weber's law, which states that the smallest noticeable difference in stimulus intensity is proportional to the intensity of the reference; and Fechner's law, which quantifies the relationship between the intensity of the physical stimulus and its perceptual counterpart (e.g., testing how much darker a computer screen can get before the viewer actually notices). The study of perception gave rise to the Gestalt School of Psychology, with an emphasis on holistic approach. Physiology Main article: Sensory systemA sensory system is a part of the nervous system responsible for processing sensory information. A sensory system consists of sensory receptors, neural pathways, and parts of the brain involved in sensory perception. Commonly recognized sensory systems are those for vision, hearing, somatic sensation (touch), taste and olfaction (smell), as listed above. It has been suggested that the immune system is an overlooked sensory modality.[52] In short, senses are transducers from the physical world to the realm of the mind. The receptive field is the specific part of the world to which a receptor organ and receptor cells respond. For instance, the part of the world an eye can see, is its receptive field; the light that each rod or cone can see, is its receptive field.[53] Receptive fields have been identified for the visual system, auditory system and somatosensory system, so far. Research attention is currently focused not only on external perception processes, but also to "interoception", considered as the process of receiving, accessing and appraising internal bodily signals. Maintaining desired physiological states is critical for an organism's well-being and survival. Interoception is an iterative process, requiring the interplay between perception of body states and awareness of these states to generate proper self-regulation. Afferent sensory signals continuously interact with higher order cognitive representations of goals, history, and environment, shaping emotional experience and motivating regulatory behavior.[54] Features Constancy Main article: Subjective constancyPerceptual constancy is the ability of perceptual systems to recognize the same object from widely varying sensory inputs.[5]:118–120[55] For example, individual people can be recognized from views, such as frontal and profile, which form very different shapes on the retina. A coin looked at face-on makes a circular image on the retina, but when held at angle it makes an elliptical image.[17] In normal perception these are recognized as a single three-dimensional object. Without this correction process, an animal approaching from the distance would appear to gain in size.[56][57] One kind of perceptual constancy is color constancy: for example, a white piece of paper can be recognized as such under different colors and intensities of light.[57] Another example is roughness constancy: when a hand is drawn quickly across a surface, the touch nerves are stimulated more intensely. The brain compensates for this, so the speed of contact does not affect the perceived roughness.[57] Other constancies include melody, odor, brightness and words.[58] These constancies are not always total, but the variation in the percept is much less than the variation in the physical stimulus.[57] The perceptual systems of the brain achieve perceptual constancy in a variety of ways, each specialized for the kind of information being processed,[59] with phonemic restoration as a notable example from hearing. Law of Closure. The human brain tends to perceive complete shapes even if those forms are incomplete. Grouping (Gestalt) Main article: Principles of grouping The principles of grouping (or Gestalt laws of grouping) are a set of principles in psychology, first proposed by Gestalt psychologists, to explain how humans naturally perceive objects as organized patterns and objects. Gestalt psychologists argued that these principles exist because the mind has an innate disposition to perceive patterns in the stimulus based on certain rules. These principles are organized into six categories: Proximity: the principle of proximity states that, all else being equal, perception tends to group stimuli that are close together as part of the same object, and stimuli that are far apart as two separate objects. Similarity: the principle of similarity states that, all else being equal, perception lends itself to seeing stimuli that physically resemble each other as part of the same object and that are different as part of a separate object. This allows for people to distinguish between adjacent and overlapping objects based on their visual texture and resemblance. Closure: the principle of closure refers to the mind's tendency to see complete figures or forms even if a picture is incomplete, partially hidden by other objects, or if part of the information needed to make a complete picture in our minds is missing. For example, if part of a shape's border is missing people still tend to see the shape as completely enclosed by the border and ignore the gaps. Good Continuation: the principle of good continuation makes sense of stimuli that overlap: when there is an intersection between two or more objects, people tend to perceive each as a single uninterrupted object. Common Fate: the principle of common fate groups stimuli together on the basis of their movement. When visual elements are seen moving in the same direction at the same rate, perception associates the movement as part of the same stimulus. This allows people to make out moving objects even when other details, such as color or outline, are obscured. The principle of good form refers to the tendency to group together forms of similar shape, pattern, color, etc.[60][61][62][63] Later research has identified additional grouping principles.[64] Contrast effects Main article: Contrast effect A common finding across many different kinds of perception is that the perceived qualities of an object can be affected by the qualities of context. If one object is extreme on some dimension, then neighboring objects are perceived as further away from that extreme. "Simultaneous contrast effect" is the term used when stimuli are presented at the same time, whereas successive contrast applies when stimuli are presented one after another.[65] The contrast effect was noted by the 17th Century philosopher John Locke, who observed that lukewarm water can feel hot or cold depending on whether the hand touching it was previously in hot or cold water.[66] In the early 20th Century, Wilhelm Wundt identified contrast as a fundamental principle of perception, and since then the effect has been confirmed in many different areas.[66] These effects shape not only visual qualities like color and brightness, but other kinds of perception, including how heavy an object feels.[67] One experiment found that thinking of the name "Hitler" led to subjects rating a person as more hostile.[68] Whether a piece of music is perceived as good or bad can depend on whether the music heard before it was pleasant or unpleasant.[69] For the effect to work, the objects being compared need to be similar to each other: a television reporter can seem smaller when interviewing a tall basketball player, but not when standing next to a tall building.[67] In the brain, brightness contrast exerts effects on both neuronal firing rates and neuronal synchrony.[70] Theories Perception as direct perception (Gibson) Cognitive theories of perception assume there is a poverty of stimulus. This is the claim that sensations, by themselves, are unable to provide a unique description of the world.[71] Sensations require 'enriching', which is the role of the mental model. The perceptual ecology approach was introduced by James J. Gibson, who rejected the assumption of a poverty of stimulus and the idea that perception is based upon sensations. Instead, Gibson investigated what information is actually presented to the perceptual systems. His theory "assumes the existence of stable, unbounded, and permanent stimulus-information in the ambient optic array. And it supposes that the visual system can explore and detect this information. The theory is information-based, not sensation-based."[72] He and the psychologists who work within this paradigm detailed how the world could be specified to a mobile, exploring organism via the lawful projection of information about the world into energy arrays.[73] "Specification" would be a 1:1 mapping of some aspect of the world into a perceptual array. Given such a mapping, no enrichment is required and perception is direct.[74] Perception-in-action From Gibson's early work derived an ecological understanding of perception known as perception-in-action, which argues that perception is a requisite property of animate action. It posits that, without perception, action would be unguided, and without action, perception would serve no purpose. Animate actions require both perception and motion, which can be described as "two sides of the same coin, the coin is action." Gibson works from the assumption that singular entities, which he calls invariants, already exist in the real world and that all that the perception process does is home in upon them. The constructivist view, held by such philosophers as Ernst von Glasersfeld, regards the continual adjustment of perception and action to the external input as precisely what constitutes the "entity," which is therefore far from being invariant.[75] Glasersfeld considers an invariant as a target to be homed in upon, and a pragmatic necessity to allow an initial measure of understanding to be established prior to the updating that a statement aims to achieve. The invariant does not, and need not, represent an actuality. Glasersfeld describes it as extremely unlikely that what is desired or feared by an organism will never suffer change as time goes on. This social constructionist theory thus allows for a needful evolutionary adjustment.[76] A mathematical theory of perception-in-action has been devised and investigated in many forms of controlled movement, and has been described in many different species of organism using the General Tau Theory. According to this theory, tau information, or time-to-goal information is the fundamental percept in perception. Evolutionary psychology (EP) Many philosophers, such as Jerry Fodor, write that the purpose of perception is knowledge. However, evolutionary psychologists hold that the primary purpose of perception is to guide action.[77] They give the example of depth perception, which seems to have evolved not to help us know the distances to other objects but rather to help us move around in space.[77] Evolutionary psychologists argue that animals ranging from fiddler crabs to humans use eyesight for collision avoidance, suggesting that vision is basically for directing action, not providing knowledge.[77] Neuropsychologists showed that perception systems evolved along the specifics of animals' activities. This explains why bats and worms can perceive different frequency of auditory and visual systems than, for example, humans. Building and maintaining sense organs is metabolically expensive. More than half the brain is devoted to processing sensory information, and the brain itself consumes roughly one-fourth of one's metabolic resources. Thus, such organs evolve only when they provide exceptional benefits to an organism's fitness.[77] Scientists who study perception and sensation have long understood the human senses as adaptations.[77] Depth perception consists of processing over half a dozen visual cues, each of which is based on a regularity of the physical world.[77] Vision evolved to respond to the narrow range of electromagnetic energy that is plentiful and that does not pass through objects.[77] Sound waves provide useful information about the sources of and distances to objects, with larger animals making and hearing lower-frequency sounds and smaller animals making and hearing higher-frequency sounds.[77] Taste and smell respond to chemicals in the environment that were significant for fitness in the environment of evolutionary adaptedness.[77] The sense of touch is actually many senses, including pressure, heat, cold, tickle, and pain.[77] Pain, while unpleasant, is adaptive.[77] An important adaptation for senses is range shifting, by which the organism becomes temporarily more or less sensitive to sensation.[77] For example, one's eyes automatically adjust to dim or bright ambient light.[77] Sensory abilities of different organisms often co-evolve, as is the case with the hearing of echolocating bats and that of the moths that have evolved to respond to the sounds that the bats make.[77] Evolutionary psychologists claim that perception demonstrates the principle of modularity, with specialized mechanisms handling particular perception tasks.[77] For example, people with damage to a particular part of the brain suffer from the specific defect of not being able to recognize faces (prosopagnosia).[77] EP suggests that this indicates a so-called face-reading module.[77] Closed-loop perception The theory of closed-loop perception proposes dynamic motor-sensory closed-loop process in which information flows through the environment and the brain in continuous loops.[78][79][80][81] Feature Integration Theory Main article: Feature integration theory Anne Treisman's Feature Integration Theory (FIT) attempts to explain how characteristics of a stimulus such as physical location in space, motion, color, and shape are merged to form one percept despite each of these characteristics activating separate areas of the cortex. FIT explains this through a two part system of perception involving the preattentive and focused attention stages.[82][83][84][85][86] The preattentive stage of perception is largely unconscious, and analyzes an object by breaking it down into its basic features, such as the specific color, geometric shape, motion, depth, individual lines, and many others.[82] Studies have shown that, when small groups of objects with different features (e.g., red triangle, blue circle) are briefly flashed in front of human participants, many individuals later report seeing shapes made up of the combined features of two different stimuli, thereby referred to as illusory conjunctions.[82][85] The unconnected features described in the preattentive stage are combined into the objects one normally sees during the focused attention stage.[82] The focused attention stage is based heavily around the idea of attention in perception and 'binds' the features together onto specific objects at specific spatial locations (see the binding problem).[82][86] Other theories of perception Empirical Theory of Perception Enactivism The Interactive Activation and Competition Model Recognition-By-Components Theory (Irving Biederman) Effects on perception Effect of experience Main article: Perceptual learningWith experience, organisms can learn to make finer perceptual distinctions, and learn new kinds of categorization. Wine-tasting, the reading of X-ray images and music appreciation are applications of this process in the human sphere. Research has focused on the relation of this to other kinds of learning, and whether it takes place in peripheral sensory systems or in the brain's processing of sense information.[87] Empirical research show that specific practices (such as yoga, mindfulness, Tai Chi, meditation, Daoshi and other mind-body disciplines) can modify human perceptual modality. Specifically, these practices enable perception skills to switch from the external (exteroceptive field) towards a higher ability to focus on internal signals (proprioception). Also, when asked to provide verticality judgments, highly self-transcendent yoga practitioners were significantly less influenced by a misleading visual context. Increasing self-transcendence may enable yoga practitioners to optimize verticality judgment tasks by relying more on internal (vestibular and proprioceptive) signals coming from their own body, rather than on exteroceptive, visual cues.[88] Past actions and events that transpire right before an encounter or any form of stimulation have a strong degree of influence on how sensory stimuli are processed and perceived. On a basic level, the information our senses receive is often ambiguous and incomplete. However, they are grouped together in order for us to be able to understand the physical world around us. But it is these various forms of stimulation, combined with our previous knowledge and experience that allows us to create our overall perception. For example, when engaging in conversation, we attempt to understand their message and words by not only paying attention to what we hear through our ears but also from the previous shapes we have seen our mouths make. Another example would be if we had a similar topic come up in another conversation, we would use our previous knowledge to guess the direction the conversation is headed in.[89] Effect of motivation and expectation Main article: Set (psychology)A perceptual set, also called perceptual expectancy or just set is a predisposition to perceive things in a certain way.[90] It is an example of how perception can be shaped by "top-down" processes such as drives and expectations.[91] Perceptual sets occur in all the different senses.[56] They can be long term, such as a special sensitivity to hearing one's own name in a crowded room, or short term, as in the ease with which hungry people notice the smell of food.[92] A simple demonstration of the effect involved very brief presentations of non-words such as "sael". Subjects who were told to expect words about animals read it as "seal", but others who were expecting boat-related words read it as "sail".[92] Sets can be created by motivation and so can result in people interpreting ambiguous figures so that they see what they want to see.[91] For instance, how someone perceives what unfolds during a sports game can be biased if they strongly support one of the teams.[93] In one experiment, students were allocated to pleasant or unpleasant tasks by a computer. They were told that either a number or a letter would flash on the screen to say whether they were going to taste an orange juice drink or an unpleasant-tasting health drink. In fact, an ambiguous figure was flashed on screen, which could either be read as the letter B or the number 13. When the letters were associated with the pleasant task, subjects were more likely to perceive a letter B, and when letters were associated with the unpleasant task they tended to perceive a number 13.[90] Perceptual set has been demonstrated in many social contexts. When someone has a reputation for being funny, an audience is more likely to find them amusing.[92] Individual's perceptual sets reflect their own personality traits. For example, people with an aggressive personality are quicker to correctly identify aggressive words or situations.[92] One classic psychological experiment showed slower reaction times and less accurate answers when a deck of playing cards reversed the color of the suit symbol for some cards (e.g. red spades and black hearts).[94] Philosopher Andy Clark explains that perception, although it occurs quickly, is not simply a bottom-up process (where minute details are put together to form larger wholes). Instead, our brains use what he calls predictive coding. It starts with very broad constraints and expectations for the state of the world, and as expectations are met, it makes more detailed predictions (errors lead to new predictions, or learning processes). Clark says this research has various implications; not only can there be no completely "unbiased, unfiltered" perception, but this means that there is a great deal of feedback between perception and expectation (perceptual experiences often shape our beliefs, but those perceptions were based on existing beliefs).[95] Indeed, predictive coding provides an account where this type of feedback assists in stabilizing our inference-making process about the physical world, such as with perceptual constancy examples. See also Philosophy portal Psychology portal Action-specific perception Alice in Wonderland syndrome Apophenia Change blindness Feeling Generic views Ideasthesia Introspection Model-dependent realism Multisensory integration Near sets Neural correlates of consciousness Pareidolia Perceptual paradox Philosophy of perception Proprioception Qualia Recept Samjñā, the Buddhist concept of perception Simulated reality Simulation Visual routine Transsaccadic memory Binding Problem References Citations

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(PDF) External links Perceptionat Wikipedia's sister projectsDefinitions from WiktionaryMedia from Wikimedia CommonsNews from WikinewsQuotations from WikiquoteTexts from WikisourceTextbooks from WikibooksResources from Wikiversity Theories of Perception Several different aspects on perception Richard L Gregory Theories of Richard. L. Gregory. Comprehensive set of optical illusions, presented by Michael Bach. Optical Illusions Examples of well-known optical illusions. The Epistemology of Perception Article in the Internet Encyclopedia of Philosophy Cognitive Penetrability of Perception and Epistemic Justification Article in the Internet Encyclopedia of Philosophy Retrieved from " 2Process of capturing the shape and appearance of real objects For 3D reconstruction in medical imaging, see Iterative reconstruction. For 3D reconstruction of sound sources, see 3D sound reconstruction. This article's factual accuracy may be compromised due to out-of-date information. Please update this article to reflect recent events or newly available information. (October 2019) 3D reconstruction of the general anatomy of the right side view of a small marine slug Pseudunela viatoris. In computer vision and computer graphics, 3D reconstruction is the process of capturing the shape and appearance of real objects. This process can be accomplished either by active or passive methods.[1] If the model is allowed to change its shape in time, this is referred to as non-rigid or spatio-temporal reconstruction.[2] Motivation and applications The research of 3D reconstruction has always been a difficult goal. Using 3D reconstruction one can determine any object's 3D profile, as well as knowing the 3D coordinate of any point on the profile. The 3D reconstruction of objects is a generally scientific problem and core technology of a wide variety of fields, such as Computer Aided Geometric Design (CAGD), computer graphics, computer animation, computer vision, medical imaging, computational science, virtual reality, digital media, etc. For instance, the lesion information of the patients can be presented in 3D on the computer, which offers a new and accurate approach in diagnosis and thus has vital clinical value.[3] Digital elevation models can be reconstructed using methods such as airborne laser altimetry[4] or synthetic aperture radar.[5] Active methods 3D echo sounding map of an underwater canyon Active methods, i.e. range data methods, given the depth map, reconstruct the 3D profile by numerical approximation approach and build the object in scenario based on model. These methods actively interfere with the reconstructed object, either mechanically or radiometrically using rangefinders, in order to acquire the depth map, e.g. structured light, laser range finder and other active sensing techniques. A simple example of a mechanical method would use a depth gauge to measure a distance to a rotating object put on a turntable. More applicable radiometric methods emit radiance towards the object and then measure its reflected part. Examples range from moving light sources, colored visible light, time-of-flight lasers [6] to microwaves or 3D ultrasound. See 3D scanning for more details. Passive methods Passive methods of 3D reconstruction do not interfere with the reconstructed object; they only use a sensor to measure the radiance reflected or emitted by the object's surface to infer its 3D structure through image understanding.[7] Typically, the sensor is an image sensor in a camera sensitive to visible light and the input to the method is a set of digital images (one, two or more) or video. In this case we talk about image-based reconstruction and the output is a 3D model. By comparison to active methods, passive methods can be applied to a wider range of situations.[8] Monocular cues methods Monocular cues methods refer to using one or more images from one viewpoint (camera) to proceed to 3D construction. It makes use of 2D characteristics(e.g. Silhouettes, shading and texture) to measure 3D shape, and that's why it is also named Shape-From-X, where X can be silhouettes, shading, texture etc. 3D reconstruction through monocular cues is simple and quick, and only one appropriate digital image is needed thus only one camera is adequate. Technically, it avoids stereo correspondence, which is fairly complex.[9] Generating and reconstructing 3D shapes from single or multi-view depth maps or silhouettes [10] Shape-from-shading Due to the analysis of the shade information in the image, by using Lambertian reflectance, the depth of normal information of the object surface is restored to reconstruct.[11] Photometric Stereo This approach is more sophisticated than the shape-of-shading method. Images taken in different lighting conditions are used to solve the depth information. It is worth mentioning that more than one image is required by this approach.[12] Shape-from-texture Suppose such an object with smooth surface covered by replicated texture units, and its projection from 3D to 2D causes distortion and perspective. Distortion and perspective measured in 2D images provide the hint for inversely solving depth of normal information of the object surface.[13] Stereo vision Main article: Computer stereo vision It has been suggested that this section be split out into another article titled Computer stereo vision. (Discuss) (December 2020) Stereo vision obtains the 3-dimensional geometric information of an object from multiple images based on the research of human visual system.[14] The results are presented in form of depth maps. Images of an object acquired by two cameras simultaneously in different viewing angles, or by one single camera at different time in different viewing angles, are used to restore its 3D geometric information and reconstruct its 3D profile and location. This is more direct than Monocular methods such as shape-from-shading. Binocular stereo vision method requires two identical cameras with parallel optical axis to observe one same object, acquiring two images from different points of view. In terms of trigonometry relations, depth information can be calculated from disparity. Binocular stereo vision method is well developed and stably contributes to favorable 3D reconstruction, leading to a better performance when compared to other 3D construction. Unfortunately, it is computationally intensive, besides it performs rather poorly when baseline distance is large. Problem statement and basics The approach of using Binocular stereo vision to acquire object's 3D geometric information is on the basis of visual disparity.[15] The following picture provides a simple schematic diagram of horizontally sighted Binocular Stereo Vision, where b is the baseline between projective centers of two cameras. Geometry of a stereoscopic system The origin of the camera's coordinate system is at the optical center of the camera's lens as shown in the figure. Actually, the camera's image plane is behind the optical center of the camera's lens. However, to simplify the calculation, images are drawn in front of the optical center of the lens by f. The u-axis and v-axis of the image's coordinate system O 1 u v {\displaystyle O_{1}uv} are in the same direction with x-axis and y-axis of the camera's coordinate system respectively. The origin of the image's coordinate system is located on the intersection of imaging plane and the optical axis. Suppose such world point P {\displaystyle P} whose corresponding image points are P 1 (u 1 , v 1) {\displaystyle P_{1}(u_{1},v_{1})} and P 2 (u 2 , v 2) {\displaystyle P_{2}(u_{2},v_{2})} respectively on the left and right image plane. Assume two cameras are in the same plane, then y-coordinates of P 1 {\displaystyle P_{1}} and P 2 {\displaystyle P_{2}} are identical, i.e., v 1 = v 2 {\displaystyle v_{1}=v_{2}} . According to trigonometry relations, u 1 = f x p z p {\displaystyle u_{1}=f{\frac {x_{p}}{z_{p}}}} u 2 = f x p − b z p {\displaystyle u_{2}=f{\frac {x_{p}-b}{z_{p}}}} v 1 = v 2 = f y p z p {\displaystyle v_{1}=v_{2}=f{\frac {y_{p}}{z_{p}}}} where (x p , y p , z p) {\displaystyle (x_{p},y_{p},z_{p})} are coordinates of P {\displaystyle P} in the left camera's coordinate system, f {\displaystyle f} is focal length of the camera. Visual disparity is defined as the difference in image point location of a certain world point acquired by two cameras, d = u 1 − u 2 = f b z p {\displaystyle d=u_{1}-u_{2}=f{\frac {b}{z_{p}}}} based on which the coordinates of P {\displaystyle P} can be worked out. Therefore, once the coordinates of image points is known, besides the parameters of two cameras, the 3D coordinate of the point can be determined. x p = b u 1 d {\displaystyle x_{p}={\frac {bu_{1}}{d}}} y p = b v 1 d {\displaystyle y_{p}={\frac {bv_{1}}{d}}} z p = b f d {\displaystyle z_{p}={\frac {bf}{d}}} The 3D reconstruction consists of the following sections: Image acquisition 2D digital image acquisition is the information source of 3D reconstruction. Commonly used 3D reconstruction is based on two or more images, although it may employ only one image in some cases. There are various types of methods for image acquisition that depends on the occasions and purposes of the specific application. Not only the requirements of the application must be met, but also the visual disparity, illumination, performance of camera and the feature of scenario should be considered. Camera calibration Main article: Geometric camera calibration Camera calibration in Binocular Stereo Vision refers to the determination of the mapping relationship between the image points P 1 (u 1 , v 1) {\displaystyle P_{1}(u_{1},v_{1})} and P 2 (u 2 , v 2) {\displaystyle P_{2}(u_{2},v_{2})} , and space coordinate P (x p , y p , z p) {\displaystyle P(x_{p},y_{p},z_{p})} in the 3D scenario. Camera calibration is a basic and essential part in 3D reconstruction via Binocular Stereo Vision. Feature extraction Main article: Feature extraction The aim of feature extraction is to gain the characteristics of the images, through which the stereo correspondence processes. As a result, the characteristics of the images closely link to the choice of matching methods. There is no such universally applicable theory for features extraction, leading to a great diversity of stereo correspondence in Binocular Stereo Vision research. Stereo correspondence Main article: Image registration Stereo correspondence is to establish the correspondence between primitive factors in images, i.e. to match P 1 (u 1 , v 1) {\displaystyle P_{1}(u_{1},v_{1})} and P 2 (u 2 , v 2) {\displaystyle P_{2}(u_{2},v_{2})} from two images. Certain interference factors in the scenario should be noticed, e.g. illumination, noise, surface physical characteristic, etc. Restoration According to precise correspondence, combined with camera location parameters, 3D geometric information can be recovered without difficulties. Due to the fact that accuracy of 3D reconstruction depends on the precision of correspondence, error of camera location parameters and so on, the previous procedures must be done carefully to achieve relatively accurate 3D reconstruction. 3D Reconstruction of medical images Clinical routine of diagnosis, patient follow-up, computer assisted surgery, surgical planning etc. are facilitated by accurate 3D models of the desired part of human anatomy. Main motivation behind 3D reconstruction includes Improved accuracy due to multi view aggregation. Detailed surface estimates. Can be used to plan, simulate, guide, or otherwise assist a surgeon in performing a medical procedure. The precise position and orientation of the patient's anatomy can be determined. Helps in a number of clinical areas, such as radiotherapy planning and treatment verification, spinal surgery, hip replacement, neurointerventions and aortic stenting. Applications: 3D reconstruction has applications in many fields. They are: Pavement engineering[6][16] Medicine[3] Free-viewpoint video reconstruction[17] Robotic mapping[18] City planning[19] Tomographic reconstruction[20] Gaming[21] Virtual environments and virtual tourism[21] Earth observation Archaeology[22] Augmented reality[23] Reverse engineering[24] Motion capture[25] 3D object recognition,[26] gesture recognition and hand tracking[27] Problem Statement: Mostly algorithms available for 3D reconstruction are extremely slow and cannot be used in real-time. Though the algorithms presented are still in infancy but they have the potential for fast computation. Existing Approaches: Delaunay triangulation (25 Points) Delaunay and alpha-shapes Delaunay method involves extraction of tetrahedron surfaces from initial point cloud. The idea of 'shape' for a set of points in space is given by concept of alpha-shapes. Given a finite point set S, and the real parameter alpha, the alpha-shape of S is a polytope (the generalization to any dimension of a two dimensional polygon and a three-dimensional polyhedron) which is neither convex nor necessarily connected.[28] For a large value, the alpha-shape is identical to the convex-hull of S. The algorithm proposed by Edelsbrunner and Mucke[29] eliminates all tetrahedrons which are delimited by a surrounding sphere smaller than α. The surface is then obtained with the external triangles from the resulting tetrahedron.[29] Another algorithm called Tight Cocone[30] labels the initial tetrahedrons as interior and exterior. The triangles found in and out generate the resulting surface. Both methods have been recently extended for reconstructing point clouds with noise.[30] In this method the quality of points determines the feasibility of the method. For precise triangulation since we are using the whole point cloud set, the points on the surface with the error above the threshold will be explicitly represented on reconstructed geometry.[28] Marching Cubes Zero set Methods Reconstruction of the surface is performed using a distance function which assigns to each point in the space a signed distance to the surface S. A contour algorithm is used to extracting a zero-set which is used to obtain polygonal representation of the object. Thus, the problem of reconstructing a surface from a disorganized point cloud is reduced to the definition of the appropriate function f with a zero value for the sampled points and different to zero value for the rest. An algorithm called marching cubes established the use of such methods.[31] There are different variants for given algorithm, some use a discrete function f, while other use a polyharmonic radial basis function is used to adjust the initial point set.[32][33] Functions like Moving Least Squares, basic functions with local support,[34] based on the Poisson equation have also been used. Loss of the geometry precision in areas with extreme curvature, i.e., corners, edges is one of the main issues encountered. Furthermore, pretreatment of information, by applying some kind of filtering technique, also affects the definition of the corners by softening them. There are several studies related to post-processing techniques used in the reconstruction for the detection and refinement of corners but these methods increase the complexity of the solution.[35] Solid geometry with volume rendering Image courtesy of Patrick Chris Fragile Ph.D., UC Santa Barbara VR Technique Entire volume transparence of the object is visualized using VR technique. Images will be performed by projecting rays through volume data. Along each ray, opacity and color need to be calculated at every voxel. Then information calculated along each ray will to be aggregated to a pixel on image plane. This technique helps us to see comprehensively an entire compact structure of the object. Since the technique needs enormous amount of calculations, which requires strong configuration computers is appropriate for low contrast data. Two main methods for rays projecting can be considered as follows: Object-order method: Projecting rays go through volume from back to front (from volume to image plane). Image-order or ray-casting method: Projecting rays go through volume from front to back (from image plane to volume).There exists some other methods to composite image, appropriate methods depending on the user's purposes. Some usual methods in medical image are MIP (maximum intensity projection), MinIP (minimum intensity projection), AC (alpha compositing) and NPVR (non-photorealistic volume rendering). Tracing a ray through a voxel grid. The voxels which are traversed in addition to those selected using a standard 8-connected algorithm are shown hatched. Voxel Grid In this filtering technique input space is sampled using a grid of 3D voxels to reduce the number of points.[36] For each voxel, a centroid is chosen as the representative of all points. There are two approaches, the selection of the voxel centroid or select the centroid of the points lying within the voxel. To obtain internal points average has a higher computational cost, but offers better results. Thus, a subset of the input space is obtained that roughly represents the underlying surface. The Voxel Grid method presents the same problems as other filtering techniques: impossibility of defining the final number of points that represent the surface, geometric information loss due to the reduction of the points inside a voxel and sensitivity to noisy input spaces. See also 3D modeling 3D data acquisition and object reconstruction 3D reconstruction from multiple images 3D scanner 3D SEM surface reconstruction 4D reconstruction Depth map Kinect Photogrammetry Stereoscopy Structure from motion References ^ Moons, Theo, Luc Van Gool, and Maarten Vergauwen. "3D reconstruction from multiple images part 1: Principles." 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