

Dictionary of Perspective 2.1

FULL INVENTORY OF NEW AND REFINED CONCEPTS

Prepared as the source inventory for the later 87-source teaching audit

Perspective Research Centre | 13 August 2026

Scope and inclusion rule

Purpose. This document is the first-stage search inventory for a later audit of how widely the PRC's new and refined concepts are taught across the same 87-source evidence set used in the One-Point Perspective Teaching Audit. This stage does not perform that teaching audit; it establishes the concept list and dictionary definitions to be searched later.

Source. Alan Stuart Radley, Dictionary of Perspective, Second Edition 2.1 (Perspective Research Centre, 2026).

Inclusion rule. Every dictionary item explicitly marked NEW TERM, REFINED TERM, NEW / REFINED TERM, NEW THEORY or NEW / REFINED CLASSIFICATION was extracted. The single REFINED DEFINITION marker is incorporated within its parent concept rather than counted as a separate concept. The dictionary explains that these labels indicate that a definition, classification or usage extends beyond standard accounts; the labels do not by themselves claim that no comparable idea has appeared previously.

Result. The dictionary contains 312 marked occurrences. After consolidating repeated placements of the same concept (principally repeated horizon/vanishing-limit classifications and their standalone entries), this inventory contains 305 unique concept entries.

Definitions. For each concept, the defining and explanatory text has been taken from the dictionary entry. Routine "See" cross-references and bibliographic routing lines are omitted so that the document functions as a clean search inventory; substantive definition, distinctions, numbered senses and explanatory clauses are retained.

Inventory summary

Dictionary marker	Unique concepts
NEW / REFINED TERM	253
NEW TERM	48
NEW / REFINED CLASSIFICATION	2
NEW THEORY	1
REFINED TERM	1
TOTAL UNIQUE CONCEPTS	305

Note on the selected PRC concept diagram. The one-page "Selected New Concepts in Perspective Research" diagram is an overview only. The detailed inventory below is derived from the Dictionary itself using the explicit new/refined markers, so it is substantially larger than the selected diagram.

Detailed concept inventory

Entries follow the order of the Dictionary. Each concept is a searchable heading in Word. Dictionary page numbers refer to the printed page number shown in the Dictionary, not the PDF file page number.

1. 1-D Perspective

Status: **NEW TERM** | Dictionary page: 16

Perspective image of a point (rare term: singular projection of a 1-D point) One-dimensional (1-D) perspective representation of a point (possibly aberration-free projection), being a 1-D perspective view/image/measurement/calculation, or 1-D plan/elevation projection, etc., of one-dimensional (1-D) object point, present in a 2-D or 3-D object space, and represented in a 2-D or 3-D image space. See: 1-D, 2-D, 3-D Perspective.

2. 2-D Perspective

Status: **NEW TERM** | Dictionary page: 16

Perspective image of a 2-D form (rare term: e.g., 2-D line projected as 1-D point or 2-D line) One or two-dimensional (1-D/2-D) perspective representation of a 2-D form (line or planar shape), being a 1-D/2-D perspective view/image/measurement/calculation, or 1-D/2-D plan/elevation projection, etc., of a two-dimensional (2-D) object form, present in a 2-D or 3-D object space, and represented in a 2-D or 3-D image space. See: 1-D, 2-D, 3-D Perspective.

3. 2.5-D Perspective (A): Computer Games: Sky-box or Sky-dome 3-D

Status: **NEW / REFINED TERM** | Dictionary page: 16

In video games, 2.5-D perspective describes movement or representation largely restricted to a two-dimensional plane within an environment that appears three-dimensional. Early examples often used plan or side-elevation views with sprite-like characters. A common technique is the skybox, in which distant scenery is mapped onto the faces of a cube to create the illusion of a surrounding 3-D world. A skydome uses a sphere or hemisphere instead. Both are forms of fixed 3-D, where real-time foreground objects appear against a relatively static background.

4. 2.5-D Perspective (B): Techniques: 3/4 Perspective; Pseudo-3-D

Status: **NEW TERM** | Dictionary page: 16

So-called 2.5-D, 3/4 perspective, and pseudo-3-D describe graphical projections and techniques that try to give an impression of spatial depth, typically using parallel projection. Examples of other pseudo-3-D techniques include billboard (textured objects that face the camera), parallax scrolling, and scaling (approximation of perspective recession).

5. 3-D (Artificial Representation) [1, 2, 3, 4, 5]

Status: **NEW TERM** | Dictionary page: 16

Within artificial perspective, there are at least five kinds of 3-D representation: [1] Uni-angular, monocular representation of a spatial scene/object A 1-D/2-D/3-D image/view/measurement/calculation of a spatial scene/object captured/depicted from a single viewpoint or viewing angle. A 2-D linear perspective image of a spatial scene/object projected onto a 2-D surface or picture plane is one example, captured from a fixed viewing angle. [2] Uni-angular, binocular representation of a spatial scene/object A 1-D/2-D/3-D image/view/measurement/calculation of a spatial scene/object captured from a fixed central viewing angle, using a binocular method (twin apertures looking at very slightly different viewing angles). Viewing a stereoscopic image of a spatial scene/object is one example, employing monocular perspective depth cues and certain binocular depth cues. [3] Multi-angular, monocular, or binocular representation of a spatial scene/object A 1-D/2-D/3-D image/view/measurement/calculation of a spatial scene/object captured from multiple viewing angles, using either a monocular or binocular method. Viewing a hologram image is an example of multi-angular binocular 3-D, employing depth cues such as monocular perspective, focusing plus (partial) natural scaling and variable resolution effects, binocular vergence and parallax, plus 3-D shape changes due to (a narrow range of) multiple viewing angles, etc. [4] Unlimited-angle representation of a spatial scene (monocular or binocular, includes mirrors) A 1-D/2-D/3-D image/view/measurement/calculation/model of a spatial scene/object captured/modelled from (ostensibly) every viewing angle, using either a monocular or binocular method. Viewing/exploring a digital model (CAD computer modelling), or a Virtual Reality world, is an example of either unlimited viewing-angle monocular or unlimited viewing-angle binocular 3-D. With binocular 3-D, employed can be depth cues such as monocular perspective (looking out/around plus looking in/at), possibly focusing, and (fully) natural scaling, variable resolution effects (zooming perspective), binocular vergence and parallax, plus 3-D shape changes due to multiple viewing angles, etc. [5] Omnidirectional representation of 2-D scene/object (monocular) or 3-D scene/object (binocular) For example, a type of 3-D perspective that enables a flat 2-D image to project the same aspect or geometry from omnidirectional viewpoints. See Androtrope, Zoetrope, and 3-D/2-D Perspective. The above list is by no means exhaustive. Any of the monocular/binocular depth cues are available to aid in the representation of 3-D, depending upon the limitations of the method/media employed.

6. 3-D (Natural Space - Viewing / Imaging / Representing)

Status: **NEW THEORY** | Dictionary page: 17

Perspective categories, classes, types, forms and 3-D Three-dimensional space is a mathematical and physical space in which three values or coordinates are normally required to determine the position of a point. In perspective, 3-D may refer to physical object space, to an optical or visual experience of depth, or to a graphical, instrument-generated, simulated or computational representation of spatial reality. Visual Perspective Type 1 is the broad category encompassing the visual presentation or appearance of spatial objects, scenes, views and images. It includes both direct visual appearances and represented images used to depict spatial objects and scenes or create an impression of depth and three-dimensional space. Visual Perspective Type 2 is the human retinal-perceptual subclass within Type 1 and concerns perspective as formed and experienced through the human visual system. Optical perspective uses light or other electromagnetic radiation to form, transmit, reflect, refract, focus or project views and images of spatial reality. Instrument perspective concerns views and images produced, modified, measured or displayed through cameras, lenses, microscopes, telescopes, mirrors, projectors, surveying devices and related instruments. Technical perspective may be used as a broad descriptive term for systematic methods of viewing, imaging, measuring, constructing, projecting or representing spatial objects and scenes, but it is not treated here as a separate principal category. Within the Viewing or Imaging Class, perspective commonly operates in the backward or image-forming direction: light, visual information or spatial data passes from an object or scene towards an eye, sensor, image plane or imaging system, where a view or image is formed, captured, measured or perceived. Within the Projecting Class, perspective may operate in the forward direction: light, images, shadows, lines or spatial information are projected from a source, eye point, projector, image plane or representational system into physical, graphical, optical or simulated space. Some perspective systems employ both directions. Perspective Category Theory distinguishes the principal source or mode of a perspective process from its principal direction. The principal categories are Natural, Visual, Optical, Mathematical, Graphical, Instrument, Simulated and New Media Perspective. The two basic directional classes are Viewing or Imaging, and Projecting. Representing, measuring, modelling, illusion and immersion are treated as functions, goals or outcomes rather than as additional basic classes. More than one category is often involved in producing, displaying or viewing a perspective image. When categories operate sequentially, the process is called category chaining. The resulting multi-category process, system or image may be described as composite perspective. For example: Natural scene -> optical and instrument imaging -> New Media processing -> instrument or New Media display -> Visual Perspective Type 2 This sequence may involve Natural Perspective within the original physical scene, Optical and Instrument Perspective within the camera, New Media Perspective during digital processing, Instrument or New Media Perspective during display, and Visual Perspective Type 2 when the resulting image is viewed and perceived by a human observer. The same perspective term, type or process may also legitimately belong to more than one top-level category. This is called category overloading. A linear-perspective drawing, for

example, may be mathematical because it is governed by geometrical relations and graphical because it is constructed in a drawing. A digitally rendered linear-perspective image may also belong to New Media Perspective, while a similar convergence appearing in a camera image may belong to Optical and Instrument Perspective. A perspective type may also name both a method and the visible form produced by that method. Linear perspective, for example, may refer to a mathematical or graphical construction process and also to the resulting geometrical arrangement of lines, apparent sizes, shapes and positions. Perspective must therefore be understood as both a process and an outcome: Perspective = method or process + resulting image, view or spatial appearance. At least four principal divisions of perspective form can be distinguished: Perspective of Form <GEOMETRICAL FACETS>: changes in apparent geometry, outline, size, shape, • position or orientation. Linear perspective is one example. Gradient of Colour Perspective <OPTICAL FACETS>: changes in colour, hue or saturation associated • with distance or optical conditions; aerial perspective is one example. Gradient of Acuity Perspective <OPTICAL AND GEOMETRICAL FACETS>: changes in clarity, sharpness, • resolution or visible detail. Gradient of Chiaroscuro Perspective <OPTICAL FACETS>: changes in light, shade and contrast that • contribute to depth or spatial recession. The graphical type of linear perspective, or perspective of lines and outlines, provides a structured method for depicting on a surface the apparent size, shape and relative position of objects within a three-dimensional scene. It is used to represent physical space through such familiar elements as the horizon line, eye point, perspective window, vanishing point and geometrical or checkerboard grid. Graphical linear perspective is, however, only one of at least three broad types or applications of linear perspective: Graphical or Artificial Linear Perspective: construction of a drawing or image of a spatial object or • scene according to one-point, two-point, three-point or related perspective systems. Natural, Visual or Optical Linear Perspective: the apparent convergence and geometrical transformation • of lines and forms when a spatial object or scene is viewed directly or imaged through an optical instrument. A metric grid or regularly constructed object space may make these effects especially clear. Physically Constructed or Simulated Linear Perspective: modification of the physical environment • through forced or simulated perspective so that objects and spaces conform to, exaggerate or counteract the apparent rules of one-point, two-point or three-point perspective. Perspective relates three-dimensional object or target space to visual, optical, graphical or represented image space. Perfect one-to-one correspondence is often impossible because viewpoint, apparent size and aspect, scale, optical aberration and limited resolution may reduce, conceal, compress or distort spatial information. Real-world viewing and camera imaging may therefore differ from ideal geometrical models, especially towards the edges of wide-field eye or lens images, where curvilinear, spherical and other wide-angle effects can arise. Controlling this correspondence problem is a major goal of visual, optical, graphical and technical perspective. Where accurate dimensions or spatial relations are more important than natural appearance, parallel projection, orthographic systems, calibrated imaging, cartographic methods and other corrective procedures may be used to preserve selected properties and reduce viewpoint-based distortion. In conclusion, natural, visual and artificial perspective systems produce structured spatial appearances that arise partly from the object or target space, partly from the perspective process or system, and partly from the scale, resolution, viewpoint and medium involved. The resulting 3-D view or image may therefore combine Natural, Visual, Optical, Mathematical, Graphical, Instrument, Simulated and New Media processes. It should be understood by distinguishing its categories, two directional classes, particular types and visible forms.

7. 3-D Display - Design (1, 2, 3, 4, 5, 6)

Status: **NEW TERM** | Dictionary page: 19

A surface 3-D display device, or other type of optical/volume 3-D display, can convey depth using binocular cues from film or digital images, and/or by application of one or more other depth cues. There are at least six basic kinds of 3-D surface displays used for binocular vision: [1] Stereoscopic surface display (uni-angular, multi-angular, VR/AR [plus BOOM]) Stereoscopic displays produce a 3-D effect using stereopsis, but can cause eye strain and visual fatigue. Stereoscopic 3-D displays are commonly used in VR/AR. Also, a BOOM AR overlays a digital universe onto the physical universe. Holographic images may provide binocular and multi-angular depth information without requiring stereoscopic glasses. [2] Light field 3-D surface display (mostly uni-angular type) A light field display produces a realistic 3-D effect by combining uni-angular stereopsis and accurate focusing depth cues for the displayed content. [3] Lenticular auto-stereoscopic 3-D surface display (uni-angular parallel type) A lenticular 3-D display produces a parallax-type 3-D stereoscopic image/view. [4] Holographic 3-D surface display (multi-angular type) A holographic display produces a more realistic 3-D effect using interactive holograms (holographic images of motion type), by combining multi-angular stereopsis and accurate focusing depth cues, moving station point, variable-resolution effects (zooming), binocular vergence and parallax, plus 3-D shape changes due to multiple viewing angles for the displayed content. At the time of writing, no widely available holographic displays have been invented or adopted for widespread use (excluding mirror images of all types). [5] Swept Plane 3-D Display: a motion technique that creates a light volume illusion using a rotating 2-D semi-translucent surface. This volumetric display allows a 360-degree viewing angle. [6] Virtual 3-D Display (projected field of view): generation of a 3-D display using a VR headset.

8. 3-D Display - Views (1, 2, 3, 4)

Status: **NEW TERM** | Dictionary page: 20

For an artificial perspective image display system, there are four kinds of 3-D view: [1] Uni-angular view of uni-angular image of spatial scene/object An ordinary 2-D perspective image displayed on a surface display or computer monitor. [2] Multi-angular view of uni-angular image of spatial scene/object (see: panoramic perspective (2A)) The term "3-D" is used for a volumetric display that shows uni-angular images of a spatial scene taken from multiple viewing angles (camera changes direction of observation), whereupon the images taken from different angles have been 'stitched together', and are notionally viewed in a 3-D space, but without experiencing true observer-based angular perspective changes. Only (uni-angular) perspective depth cues are available (from observer perspective). Example: 2-D images viewed/presented in a 3-D space. [3] Multi-angular view of multi-angular image of spatial scene/object (see: panoramic perspective (2B)) The term "3-D" is also used for a volumetric display that generates content viewed from multiple angles, i.e. multi-angular images captured/generated by/for viewing from multiple viewing angles, whereupon the onlooker (may) experience multi-angular perspective depth cues (on directional screen canvas). Example: 3-D images viewed from multiple angles. See: Volume display. [4] Omnidirectional representation of 2-D scene/object (monocular) A type of 3-D perspective that enables a flat 2-D image to project the same aspect or geometry from omnidirectional viewpoints. See Andrope, Zoetrope, and 3-D/2-D Perspective.

9. 3-D Perspective

Status: **NEW TERM** | Dictionary page: 20

Perspective image of a 1-D, 2-D, or 3-D form (ordinary definition of perspective) One, two, or three-dimensional (1-D/2-D/3-D) perspective representation of 1-D/2-D/3-D form, being a 1-D/2-D/ 3-D view/image/measurement/calculation, or 1-D/2-D/3-D plan/elevation projection, etc., of 1-D/2-D/3-D spatial form, present in a 3-D object space, and represented in a 2-D or 3-D image space. See: 1-D, 2-D, 3-D Perspective. 3-D Perspective (1): Depth Illusion Types: A, B, C, D. (Illusion (general); Illusion of Depth; Illusion of 3-D; Immersion in 3-D; Graphical Perspective; Instrument Perspective) 3-D Perspective Illusion: [1] Illusion of depth in a spatial object/scene Depth illusion of spatial forms present in a natural, artificial, or synthetic spatial reality. The four principal types of perspective 'depth' illusion are: A. Flat/plane picture plane: Spatial illusion by perspective representation on a 2-D surface (monocular depth cues). Includes swept-plane displays/fan holograms. B. 3-D modelling perspective: Spatial illusion by physical or computer modelling (monocular/binocular depth cues - may employ multiple or changing eye, station, or viewpoint). C. Stereoscopic views using mirror images, or virtual reality stereoscopic views/images: Spatial illusion by stereoscopic views of mirror or virtual reality (binocular depth cues). D. Stereoscopic views of a false reality: construction or representation of an artificial 3-D stereoscopic image/view of a spatial reality, formed by an adjusted, illusive, or false reality perspective which is also called 'false' or 'trick' perspective (views of natural/built world)—being visual illusion by the construction of a false spatial reality, or by the representation of a false spatial reality (distorted/transposed scene/ physical geometry).

10. 3-D Perspective (2): Illusion Types: A, B, C, D

Status: **NEW TERM** | Dictionary page: 21

Perspective illusion: [2] False visual impression of scene geometry or optical facets Perspective techniques are sometimes used to create optical illusions. Typically, a perspective illusion makes false impressions of size, depth, position, place (immersion), or transparency for objects/people. One example is when dimensionality is adjusted within a scene, making an object appear farther away, closer, larger, or smaller than it is. The four principal types of 'optical' perspective illusion are: A. Visual Perspective Illusion: illusion by perceptually adjusted appearance (false direct view of physical reality); B. Graphical Perspective Illusion (includes perspective drawings/paintings): illusion by graphically constructed appearance (false apparent view of spatial scene); C. Instrument Perspective Illusion: illusion by secondary visual images (cinema, holograms, etc), and/or projected appearance (false-formed view of 3-D scene); D. Simulated (Forced) and/or Synthetic Perspective Illusion: illusion by physical construction of a false physical reality (apparent), or by the representation of a false physical reality (distorted/ transposed scene geometry with apparent illusive effects).

11. 3-D Perspective (3): Representation (A, B, C)

Status: **NEW TERM** | Dictionary page: 21

3-D Perspective: [3] Perspective as a representation of a spatial reality We can define perspective as the formation of an image/view—or a representational pattern—of a state of affairs in a spatial reality, which can be produced by a range of natural, artificial, or synthetic processes. Ergo, we can consider perspective to be a representation of a spatial form present in a natural, artificial, or synthetic spatial reality. The three principal viewing-angle types of perspective representation are: A. Uni-angular image: monocular or fixed-angle binocular Fixed viewing-angle monocular representation, or notionally fixed central viewing-angle binocular representation; being an (apparent or real) 3-D view/image/measurement/calculation (optical/geometric projection) of a spatial form. Includes all types of perspective that exhibit spatial recession on 2-D surface (e.g., linear perspective), and also fixed central viewing-angle stereoscopy and auto-stereoscopy. Normally, this class of perspective representation has a fixed/real, or fixed/simulated, viewing position/scale. B. Multi-angular image: holograms (limited multi-angular binocular images) Multiple viewing-angle stereoscopic image, or a limited multi-angular binocular image, being a view/image/ measurement/calculation/representation (holographic projection), of a two or three-dimensional spatial form. Normally, this class of perspective representation has a limited range of viewing position(s)/scale(s). C. Unlimited-angle image: virtual reality (unlimited binocular), or mirror images Unlimited viewing-angle(s), plus roaming station point(s), image, of stereoscopic type, being a binocular three-dimensional perspective view/image/measurement/calculation/representation (holographic projection), of two or three-dimensional spatial form. This perspective representation offers unlimited viewing positions and is often a new media system.

12. 3-D Perspective (4): Spherical Panorama

Status: **NEW TERM** | Dictionary page: 22

3-D Perspective: 4. Spherical panorama: monocular vision Imaging/projecting (mixed perspective) type of technical perspective that captures/represents/projects a full 360-degree spherical panorama for a surrounding visual scene.

13. 3-D Space - General Types Relating to Perspective (abbreviated list)

Status: **NEW / REFINED TERM** | Dictionary page: 23

Accelerated Space, Anamorphic Space, Blended Scene Space, Blended View Space, Category Chained Space, Category Overloaded Space, Cleft Space, Combined Space, Complex Space, Composite Space, Compositional Space, Convergent Space, Divergent Space, Double Space, Fragmented Space, Manifold Space, Mixed Space, Multi-Plane Space, Multi-Scene Space, Multi-View Space, Parallel Space, Simple Space, Split Space, Synthetic Space, Universal-Particular Space, 3-D Spaces (Visual Types), 1-2-3-4-5-6 Point Space(s), 3-D Modelled Space, 360-Degree Space, Aberrated Space, Abstracted Space, Space, Algorithmic Space, Animated Space, Astronomical Space: General / Tilted, Astronomical Space: Gnomonic, Astronomical Space: Orthographic, Astronomical Space: Stereographic, Augmented Reality Space, Axonometric Space, Bifocal Space, Binocular Space, Bitmap Space, Black-Mirror Space, Box Space, Camera Space, Captured Space (Image), Celestial Space, CGI Space, Chequerboard / Chessboard Space, Cinematic Space, Circle of Revolution Space, Circle of Vision Space, Correct / True Space, Cube Space, Cube-Grid Space, Cubist Space, Cyclopic Eye Space, Decelerated Space, Descriptive Geometry Space, Digital Space, Double Axonometric Space, Double Exposure Perspective, Double Horizon Perspective, Exterior Space, Fish-Eye Lens Space, Flat Sphere Space, Flattened / Compressed Space, Forced Space, Foreshortened Space (1,2), Four-Dimensional Perspective, Fractal Space, Front-Projection Space, Geographic Space, Geometrical Space, Gestalt Space, Glass Ball Space, Glass Camera Shot Space, Globe Space, Gott Space (map projection), Holographic Space, Homogenous Space, Hyperspace, Illuminated Space,

Illusive Space, Image Space, Imaginary Space, Interior Space, Intermediary Space, Invisible Space, Lenticular Auto-Stereoscopic 3-D Space, Mapping Perspective, Matte Camera Shot Space, Measured Space, Microscopic Space, Mirror Ball Space, Mirror Camera Shot Space, Mirror Space, Mixed Reality Space, Modular Space, Monkey Bar Space, Monocular Space, Montage Space, Multi-Aspect Space, Multi-Layer Space, Natural Space, Negative Space, Opaque Space, Optical Printing Space, Orthographic Space, Overlaid Space, Overlapping Space, Panoramic Space, Parallax Display Space, Parallax Space, Paralane Space, Patchwork Space, Perspective Space, Photographic Space, Physical Space, Picture Space, Projected Space, Projective Geometry Space (Desargues), Psychological Space, Random Dot Picture Space, Rear-Projection Space, Reverse Perspective Space, Shadow Space, Substituted Space, Swept Plane 3-D Space, System Space of Renaissance Perspective, Tactile / Haptic Space, Target / Object Space, Telescopic Space, Tilted Camera Shot Space, Transparent Space, Vector Space, Virtual Reality Headset Space, Virtual Reality Space, Virtual Space, Visual / Optical Space (live view), Volume Display Space (Concave), Volume Display Space (Convex), Wire Frame Space, Zero-Point Space, Zoomable Space (Digital), Zoomable Space (Optical).

14. 3-D Space - Perspective Categories of

Status: **NEW TERM** | Dictionary page: 24

In Perspective Category Theory, a category identifies the principal source or mode of a perspective process. One or more categories may transform an object or target space into an image or perspective space. When several categories operate in sequence, this is category chaining and may produce composite perspective. When one term or process belongs to more than one category, this is category overloading. Kinds of perspective space associated with the principal categories [Most may be 2-D or 3-D; Visual Perspective Type 2 may be monocular or binocular.] Physical or Natural Space — Natural Perspective • Visual Space — Visual Perspective Type 1 or Type 2 • Optical Space — Optical Perspective • Mathematical Space — Mathematical Perspective • Graphical or Represented Space — Graphical Perspective • Instrument Space — Instrument Perspective • Simulated or Illusory Space — Simulated Perspective • Digital or New Media Space — New Media Perspective • These spaces are not always separate. A camera system, for example, may transform a natural object space through optical and instrument processes into a digital image space that is finally experienced as Visual Perspective Type 2.

15. 3-D Space - Perspective Invisibility Methods / Systems

Status: **NEW TERM** | Dictionary page: 24

Perspective methods can create an apparently invisible region of space containing hidden objects, presenting an unobstructed view. There are many invisibility techniques, but the basic classes are: • Optically produced invisibility (live image viewing); • Filmic or digital/New-Media-produced invisibility (live or recorded image viewing); • Combined optical and digital/New-Media-produced invisibility (live or recorded image viewing). We can list some optically produced invisibility methods: • Angled mirrors can make objects appear 'invisible' by diverting light rays and creating a (secretly) split, fragmented or diverted view. • Specially arranged mirrors/prisms can make objects appear 'invisible' by diverting light rays and creating a (secretly) split, fragmented or diverted view. • Lenticular 'invisibility cloaks' can make objects appear 'invisible' by diverting light rays and creating a (secretly) split, fragmented or diverted view. • Double/blended space illusion (physically adjusted environment): manipulation of false vanishing points can result in a multi-scale space in which objects can potentially be hidden. • Rotated/diverted view Illusion: in 1983, magician David Copperfield famously made the Statue of Liberty disappear in a massive televised illusion using a rotating platform to shift the audience's view while obscured by a curtain. Different apparent and true viewing directions.

16. 3-D Space - Transformed Perspective Space(s)

Status: **NEW / REFINED TERM** | Dictionary page: 25

Perspective spaces may be systematically transformed to support viewing, matching, representation, illusion, immersion and visual effects. The following representative examples group closely related forms under broader headings. Transformed perspective space(s) (natural / artificial) - [all may be 2-D/3-D (apart visual)] • Accelerated or Forced Space — physical, graphical or simulated space adjusted so that distance, scale or perspective recession appears increased, reduced or otherwise altered. • Anamorphic Space — space represented through deliberate geometrical distortion, normally designed to appear coherent from a particular viewpoint or through a particular optical device. • Blended Space — two or more spatial scenes, views or image spaces blended so that their boundaries are partly or wholly indistinct. • Combined Space — two or more distinct views, scenes or forms of space presented together within one image or environment. • Composite Space — perspective space produced through several categories, processes or image-forming stages operating together or in sequence. • Compositional Space — spatial organisation constructed through the deliberate arrangement of graphical, natural, optical or represented elements. • Convergent Space — space in which lines, forms or apparent sizes converge or diminish with distance. • Divergent Space — space in which lines, forms or apparent sizes diverge or increase with represented distance. • Fragmented or Split Space — space divided into separate regions, planes, viewpoints or distances; cleft space is one example. • Invisible Space — an apparently empty or unobstructed region that conceals objects or spatial information from the observer. • Manifold Space — two or more spatial views occupying the same visual field, such as reflection and transmission seen simultaneously through glass. • Mirror or Virtual Space — the apparent space formed behind, within or around a reflecting surface, including plane, concave, convex and artificial mirror effects. • Multi-Plane Space — space represented through several distinct image, focus or depth planes. • Multi-Scene Space — two or more scenes combined into a single represented environment, either with distinct or blended boundaries. • Multi-View Space — one object or scene represented from several viewpoints, directions or viewing positions within a single image, model or interactive system. • Parallel or Paralane Space — represented space in which principal sets of parallel lines remain parallel rather than converging towards vanishing points. • Simulated Space — artificial space constructed physically, graphically or computationally to reproduce or alter the appearance of spatial reality. • Spherical Space — space organised, viewed or represented in relation to a spherical field, surface or system. • Synthetic Space — a spatial environment assembled from separately created, captured or generated elements. • Virtual-Reality Space — computationally generated interactive space through which the observer can move, look or act from changing viewpoints. • Augmented-Reality Space — combined space in which digital objects or information are registered with a view of the physical environment. Volume-Display Space — three-dimensional or apparently three-dimensional space presented through a • volumetric, convex, concave or related display system.

17. 3-D Visual Perspective: Classes

Status: **NEW TERM** | Dictionary page: 26

Perspective Category Theory identifies two basic directional classes: Viewing or Imaging, in which views, images, measurements or representations are formed or captured from spatial reality; and Projecting, in which light, images or spatial information are projected forwards. Representing, measuring, modelling, illusion and immersion are functions, goals or outcomes rather than additional basic classes. Other distinctions, such as natural/artificial and monocular/binocular, form separate binary or non-binary classifications. Sequential operation of the two classes is termed class chaining; their simultaneous operation within one system may be termed class overloading.

18. Aberrations: Classes (1, 2 [A, B])

Status: **NEW / REFINED TERM** | Dictionary page: 28

[1] Optical aberration: image point defects: An optical defect in which rays from a point object do not form a perfect point after passing through an optical system (eye, lens, camera, etc). This class of aberration can be accurately assessed or measured relative to paraxial optics, or pin-hole lens/camera optics. Common monochromatic types include: spherical, coma, astigmatism, and higher-order aberrations. Plus all aberration types can vary with the wavelength of light, named as chromatic aberrations (colour). [2] Distortion: image shape/form/structure defects that arise due to viewpoint geometry relative to object structures in the environment or object space (i.e. aberrations not due to imaging system characteristics alone): Distortion or incorrect image shape can (often) be classed as a perspective image distortion, in which the projected image shape is incorrectly structured/proportioned, scaled, and/or incorrectly positioned, etc. Many times this class of aberration, or distortion, in a perspective image cannot be objectively measured, because: [A] Shape/form is subjective and/or dependent on perspective type: it may be unclear what the correct or most natural shape for an image/view is, and in relation to which types of perspective. For example, is a visual, linear, curvilinear, spherical projection more or less real than other types. [B] Shape/form is multi-faceted: image shape depends on a number of different factors, including viewpoint, viewing angle, projection surface shape/position, projection scale, and projection scale resolution, etc. N.B. Parallel or primary views may resist or preclude distortions in image size/shape/position.

19. Abstract Perspective

Status: **NEW / REFINED TERM** | Dictionary page: 30

Any perspective method/system or view/image that has not been directly captured/imaged from physical reality, or a perspective image/view that has been altered, changed, or processed in some way, and does not directly relate to physical or an optically true/correct reality (partially, wholly, or in actuality). Resultant perspective views/ images are judged to be (at least partially) mathematical, fictional, or (physically) unreal, or possess related aspects/features. It has been claimed by some experts that all types of visual/optical/technical perspective are at least partly abstract, or that perspective may be fundamentally an abstract or subjective method.

20. Acuity Perspective (Gradient of Acuity Perspective)

Status: **NEW / REFINED TERM** | Dictionary page: 32

Changes in clarity, sharpness, resolution or visible detail associated with distance, focus, optical conditions or representation. In art, the effect may be produced by reducing detail, softening contours or blurring distant forms.

21. Aerial Perspective (1, 2, 3)

Status: **NEW / REFINED TERM** | Dictionary page: 32

Aerial perspective concerns the appearance of spatial objects/scenes as affected by the air, light and shade, and colour. [1] Sophisticated representation or model of diminution of colour and contrast Aerial Perspective (in terms of graphical perspective) is the art of giving due diminution of the (represented) strength of light, shade, and colour of objects, according to their distances and the quantity of light received by them, and to the medium through which the object is seen or presented as seen. It is the graduation of light and shade on various objects as they recede from the eye. [2] Natural space diminution of Colour and Contrast Refers to the combined visual effects of the diminution of colour and contrast with increasing distance from the viewer; and as a result of the interaction of light rays with the atmosphere due to the effects of light extinction (absorption + scattering of light rays by atmospheric molecules). [3] Three-Point Linear perspective Synonym for three-point linear perspective view/image in which we observe, or represent a view as seen, from a high vantage point relative to (for example) a cubic-shaped object.

22. All-Over Perspective (1, 2, 3)

Status: **NEW / REFINED TERM** | Dictionary page: 36

[1] Abstract Expressionism: generalises pictorial energy across the whole canvas, creating a 'plenum' or rigorous continuum. [2] Synonym for pigeon-hole perspective. [3] Synonym for multi-view perspective or cubist perspective.

23. Ambiguous Perspective (1, 2)

Status: **NEW / REFINED TERM** | Dictionary page: 37

[1] Ambiguous image form Perspective that employs ambiguous images or reversible figures that create ambiguity in terms of viewpoint for a perspective view. See rabbit-duck Illusion. [2] Ambiguous viewpoint A general property of classic perspective methods (ref. linear, graphical perspective, etc) relates to the use of a stationary or established single viewpoint from which the perspective view/image is correctly formed. However, the ambiguous perspective refers to a class of perspectives that fail to establish (or perhaps require) a single viewpoint for the depicted scene (ref. A type of graphical perspective experimented with by Leonardo da Vinci, and named multi-view flat perspective).

24. Andotrope, 360-Degree Identical Views of 2-D Object

Status: **NEW / REFINED TERM** | Dictionary page: 42

Mike Andos invented a modern zoetrope that uses two back-to-back iPhones displaying synchronised videos. Mounted in a vertical obscuring tube with slits, the device spins up to 1200 RPM, creating a moving image at 40 frames per second. This setup allows

viewers from any angle to see an identical 2-D image, effectively providing a 360-degree perspective. The Andotrope delivers an omnidirectional video experience resembling a flat hologram to multiple viewers simultaneously. The result is a flat or 2-D moving image that can be seen in the same aspect or appears identical from every fixed viewing direction, but as seen from omnidirectional viewpoints or multiple station points, that is the 2-D image looks identical in perspective projectional terms from a full 360-degree point of view. This device uses a principle similar to the persistence of vision effect, whereby you perceive a single stable but moving image. You can say that this is a type of 3-D display that presents an unchanged 2-D image perspective projection from all directions. Another way of describing such a 3-D/2-D perspective is that it produces 360-degree identical views of a flat or 2-D object or scene. An Andotrope provides an omnidirectional, billboarding holographic video to multiple simultaneous viewers in all directions.

25. Projection-Angle Distortion Classes

Status: **NEW / REFINED CLASSIFICATION** | Dictionary page: 43

These concern the backward formation of a 2-D image from a 3-D object. A. Object Angle of Projection — Object-Aspect Distortion Class: change caused mainly by the angle from which the object is viewed or projected. B. Image-Plane Angle of Projection — Image-Plane Distortion Class: change caused mainly by the angle, orientation or shape of the image plane; it may be reduced by viewing or recording along the intended line of sight. C. Combined Projection-Angle Distortion Class: the usual wide-field case, in which distortion results from the combined relation between object aspect and image-plane angle, orientation or shape.

26. Appearing Point (1, 2, 3)

Status: **NEW TERM** | Dictionary page: 47

1. An appearing point due to perspective phenomena (optical source in image space) An appearing point is the antonym of a vanishing point, and refers to an apparent point in a spatial reality (being a far distant point viewed from image space) out of which a set of mutually parallel lines (in object space) appear to emerge from (ostensibly), whereby the parallel lines could also be light-rays and said rays may also emit/gleam and/or move in space/time. Said appearing point typically differs from a vanishing point in that it is not assumed to be located at notional infinity, but is only at or close to the limits of observable distance. Divergence of lines/rays is wholly caused by perspective phenomena, or a combination of aspect and the size/distance law. 2. An appearing point from a diverging light beam (physical source in object space) An appearing point due to a physical light-beam radiating point, or the origin of a light source, for a spotlight or beam of physically diverging light rays. The apparent divergence of the light rays in the beam is caused by either actual diverging rays or the expanding projected beam footprint. 3. Appearing point due to combined optical/physical phenomena An appearing point from a physical/apparent light-beam radiating point, whereby the divergent effect of rays/ lines is partly due to physical geometry and partly from perspective phenomena (ref. both A, B appearing point effects). This is when a set of (physically) divergent lines/rays is viewed or projected, with evident Appearing Point (1, 2, 3) (continued) perspective phenomena. Evidently, when the diverging light beam extends/radiates into the depth dimension, then a combined appearance or geometry is the normal case.

27. Applications of Perspective - Technical

Status: **NEW / REFINED TERM** | Dictionary page: 48

Perspective is central to key developments in various technical subjects, including photography, television, cinema, cartography/ maps, astronomy, topology, photogrammetry, scenography, archaeology, architecture, gardens and environment, etc. Recent developments also have strong links to perspective, such as Geographical Information Systems (GIS), Global Positioning Systems (GPS), Virtual Reality (VR), Computer Graphics (CG), Computer-Generated Imagery (CGI), Computer Vision (CV), Artificial Intelligence (AI), digital filmmaking / virtual production, medical imaging, robotics, stereography, panoramas, holograms, and space flight.

28. Artificial Perspective (1, 2)

Status: **NEW / REFINED TERM** | Dictionary page: 51

1. Human-made perspective representation (PRC Theory) Artificial Perspective is a general term for perspective produced, modified, measured, projected, simulated or represented through deliberately designed methods, systems, instruments or spatial arrangements created or operated by humans, Artificial Intelligence systems, machines, or combinations of these. It may operate within the Viewing or Imaging Class, the Projecting Class, or through both classes in sequence, and may serve functions or goals such as viewing, matching, representing, creating illusion or producing immersion. It may include graphical, mathematical, instrument, simulated and New Media processes where these are intentionally constructed, generated or employed by humans, Artificial Intelligence systems or machines. An example may nevertheless incorporate natural, visual, optical or other perspective categories; Artificial Perspective identifies the artificial or constructed element of the process and does not imply that the complete perspective chain is exclusively artificial. 2. Moniker for linear perspective Another name for linear perspective.

29. Artistic Method of Central Perspective

Status: **NEW / REFINED TERM** | Dictionary page: 52

Let us consider how an artist produces a perspective drawing or painting of a three-dimensional scene by the ordinary central method. The artist first selects a subject or scene to be viewed from a fixed location, the station point or viewpoint. A central direction of vision, or viewing angle relative to the scene, must also be established, together with a field of view, because every change of eye position, viewing direction/angle or visual field presents a somewhat different aspect. Although an artist may begin by sketching freely, a consistent central-perspective representation normally requires these conditions to remain reasonably stable. The central axis of vision runs from the eye towards the centre of the selected view. The directing plane passes through the eye, perpendicular to this axis and normally parallel to the picture plane; it may consciously or unconsciously help stabilise the head, gaze and field of view. In this ordinary case, the perspective window is the same as the picture plane, the plane upon which the image is notionally or actually constructed. Thus, perspective window and picture plane are two names for the same plane, considered in its viewing and representational functions. This plane is normally parallel to the directing plane and approximately perpendicular to the central axis of vision. The perspective window or picture plane may be wholly imaginary, or may take the form

of a real glass pane, framed opening, grid or semi-transparent veil. When the artist draws directly upon a glass window, the perspective window, picture plane and physical drawing surface coincide. When the artist draws upon paper or canvas, that surface is treated notionally as the same plane. In special oblique or tilted arrangements, the picture plane and directing plane remain parallel to one another, but may be inclined relative to the selected scene or ground plane. In the ideal geometrical model, each point in the drawing or painting is determined by the intersection of the picture plane with an imaginary visual ray extending from the corresponding point in the scene towards the artist's eye. The resulting image is therefore a two-dimensional projection formed upon the plane, not necessarily a scaled-down copy. Graphical perspective works by representing where visual rays from the scene intersect the chosen plane. In photography, the same basic principle operates automatically. The camera's optical axis broadly corresponds to the central axis of vision, while the film or sensor plane is the image plane and functions as the camera's picture plane. In an ordinary camera with the image plane perpendicular to the optical axis, this plane is geometrically analogous to the perspective window or picture plane of artistic perspective, although it lies behind the lens and receives an inverted optical projection. What happens when another person looks at a picture created in this way? It is as though the viewer looks through the same perspective window into the represented scene. If the picture is viewed monocularly from the original station point, the directions from the viewer's eye to points in the image correspond geometrically to the directions from the artist's eye to the represented points in the original scene. The picture may therefore reproduce the same ideal monocular projection, although it is not completely identical to viewing the real scene, because binocular disparity, accommodation, motion parallax and other visual factors are absent or altered. In practice, the picture plane is both the physical surface of the artwork and the apparent window through which the represented spatial reality is seen. See book: *Drawing Systems* by Fred Dubery and John Willats (1972).

30. Aspect Perspective (1, 2)

Status: **NEW / REFINED TERM** | Dictionary page: 53

1. Distance-independent length/shape/angle/position distortions (e.g. pure aspect foreshortening) Refers to natural/artificial aspect perspective or a geometrical projection in which object features positioned along the viewing direction are uniformly contracted in apparent length (notionally irrespective of relative distance), and experience proportional perspective shape distortions accordingly (e.g. object parts becoming equally contracted in length along the same direction). This is a representation foreshortening technique that can occur (to a greater or lesser degree) with all forms of optical/technical perspective, depending on circumstances, including recession-of-form perspective or the linear/circular/curvilinear/spherical types, as well as all parallel types of perspective.

2. Distance-dependent length/shape/angle/position distortions (e.g. optical foreshortening) Refers to natural or artificial perspective in which object features positioned closer to the station point, and along the viewing direction, experience non-proportional or exaggerated perspective length/shape distortions (e.g. becoming elongated to a greater degree when closer to the viewpoint). It is the result of the classic optical size-distance law or diminution of size perspective. This is a pure optical perspectival foreshortening (type 2) technique often used by artists and comic-book artists to enhance the feeling of the third dimension, depth, or dimensionality within a drawing (including moving action in a 3-D space). An example is when a drawing of an outstretched arm shows exaggerated length or scale distortions of the hand/fingers, being an example of non-uniform perspectival or optical foreshortening. This is an optical/representation foreshortening technique that can occur with diminution of size perspective or the central/linear/circular/ curvilinear/spherical forms of visual/optical/technical depending on circumstances. Note that both types of foreshortening (1, 2) can combine or be operating together, depending upon circumstances, and within an image/view projected according to a diminution of size perspective, for example, as with a linear perspective image or view.

31. Atomistic Perspective

Status: **NEW TERM** | Dictionary page: 55

A philosophical term that refers to the possibility of large numbers of multiple, separate, and mini perspective viewpoint(s) (real and potential), each one providing a unique (localised) view of a spatial world/reality/scene. Whereby all perspective 'atoms', being inherently subjective fragments, or multiple views, can/could be combined to form a single coherent image space and thus representing/indicating a coherent or objective whole for the notional object space.

32. Blended Perspective (1, 2)

Status: **NEW TERM** | Dictionary page: 69

1. Blended scene perspective (multi-scene transformed to single-scene) Blended or multi-scene perspective is an image/view of a spatial scene that comprises two or more separate (and differently scaled/structured) spatial geometries; whereby the resultant scene appears to (falsely) consist of a homogenous or single-scale spatial geometry; however, in reality, two or more uniquely scaled/structured geometries have been combined (often seen as such from only a single viewpoint) to appear as a fully united and integrated spatial geometry.

33. Cancelling Perspective

Status: **NEW / REFINED TERM** | Dictionary page: 77

The human visual system is adept at recognising perspective phenomena such as diminution of size perspective, converging parallels, aspect perspective, foreshortening, etc. However, the physiological and psychological opposite is also true: the human visual perceptual system is adept at removing and cancelling perspective phenomena to 'see' spatial objects/scenes as true figures. For example, even though we see the size of objects as diminishing with distance, we also 'see' these same objects as unchanging forms of a specific/fixed size. Also, we 'see' apparently converging sets of parallel lines as truly parallel lines, for example.

34. Captured Perspective Image

Status: **NEW TERM** | Dictionary page: 77

Optical perspective is a process that produces visual images of a spatial reality; and we have two basic classes of perspective image (or perspective directions); namely: • Captured perspective Image: formation of an image or representation 'backwards' from a spatial reality. • Projected perspective Image/beam: sending images 'forwards' into a physical reality, or projecting light-pencils/shadows onto physical objects (2-D or 3-D). A captured perspective image refers to the formation of 'optical' images 'backwards'

from a spatial reality onto an image or picture plane, or that result from the generation of a perspective representation of the visual appearance of a spatial object/scene (ref. viewpoint geometries). Captured perspective images include perspective drawings, paintings, computer graphics, and images formed by optical instruments such as eyes, lenses, cameras, telescopes, etc.

35. Category Chaining

Status: **NEW / REFINED TERM** | Dictionary page: 79

Category chaining occurs when two or more perspective categories operate sequentially in forming, processing, displaying or viewing an image. A scene may pass from Natural Perspective through Optical and Instrument Perspective, New Media processing and display, and finally Visual Perspective Type 2.

36. Category Chaining vs Class Chaining

Status: **NEW / REFINED TERM** | Dictionary page: 79

Distinction: Category chaining describes a sequence of perspective categories, identifying the means or modes involved; class chaining describes the sequential operation of the two directional classes. Thus, one system may involve the category chain Optical -> Instrument -> New Media and the class chain Viewing or Imaging -> Projecting.

37. Category Overloading

Status: **NEW / REFINED TERM** | Dictionary page: 79

Occurs when one perspective term, type or process belongs to more than one top-level category; linear perspective, for example, may be both mathematical and graphical.

38. Category Overloading vs. Class Overloading

Status: **NEW / REFINED TERM** | Dictionary page: 80

Distinction: Category overloading concerns a perspective process belonging to more than one category or mode, whereas class overloading concerns a process or system operating in both directional classes at the same time. A system may therefore be category-overloaded, class-overloaded, or both.

39. Celestial Perspective (1, 2)

Status: **NEW TERM** | Dictionary page: 82

1. Celestial Perspective: Visual / Optical / Technical Class (synonym: astronomical perspective) "Celestial perspective" refers to the process and outcome of obtaining a view/image of the celestial sphere, which is an imaginary, vast, concentric sphere with an arbitrary or infinite radius centred on the Earth, upon which all celestial bodies (stars, planets, Sun, Moon) appear projected. It is a vital tool for positional astronomy and navigation, allowing astronomers to map the sky using a coordinate system similar to Earth's latitude and longitude. The celestial perspective concerns capturing views/images of objects or matter existing, and processes taking place, at astronomical distances in outer space; which has implications for the perception of the apparent and also implied object forms, distances, sizes, locations, angles, etc. In terms of perspective processes/outcomes involved, to begin, we must consider the class of perspective, whereby Astronomy is broadly divided into observational astronomy (using telescopes to gather data across electromagnetic spectrums like radio, optical, X-ray, and infrared) and theoretical astronomy (using models to understand celestial phenomena). We also have gravitational telescopes and particle detectors for astronomical observations. In terms of optical and visual perspective (2nd type), we note that celestial or astronomical perspectives have different kinds; from observations of seasons (seasonal perspective), to planetary motions, stellar distances (for example parallax (A)), shape/morphology of galaxies (galaxy perspective), etc. A key difference from Earth-bound perspective, is that astronomical objects - and especially stars are incredibly large and distant - and that A) the object (e.g. a star) may not be resolved sufficiently to measure size/distance directly, and B) the light rays emanating from such an object (e.g. a star) are effectively parallel and unresolved, one relative to another, and C) stellar objects or stars are typically not related in structural terms - or at the same distance from Earth, and thus within each constellation the stars are at vastly different distances and so only apparently visually connected. Accordingly, typical convergence, as seen with linear perspective (size/distance law), may not be applicable in many cases. Unless the imaged stellar objects are at the same approximate (or relative) distance, the rules of degradation of form perspective will not apply; but sometimes they will apply, as with a true circular galaxy that appears elliptical when seen edge on (aspect foreshortening).

40. Central Perspective (1, 2)

Status: **NEW / REFINED TERM** | Dictionary page: 84

1. Central Perspective: Unidirectional perspective form << REFINED DEFINITION >> Central Perspective is a unidirectional perspective form in which a spatial scene or object is viewed along a single principal optical line of sight, producing a unified cone or pyramid of vision directed towards the scene and projected onto a flat or curved picture plane. It commonly includes one-point, two-point and three-point linear perspective, together with certain unidirectional curvilinear forms. Central Perspective should not be confused with the broader mathematical category of central projection, in which projection rays merely pass through a common finite centre. In this dictionary, a common projection centre alone is insufficient: Central Perspective additionally requires a unified principal viewing direction. Multidirectional spherical forms, including Sphere-of-Vision and Sphere-of-Revolution Perspective, are therefore excluded. Frontal Perspective is a particular square-on orientation that may occur within Central Perspective; it is not an exact synonym for Central Perspective. 2. Central Perspective: Synonym for Central Vanishing Point << non-standard definition >> << Some people use the term in this way - but it seems false/incorrect! >> Refers to a graphical perspective image exhibiting perspective recession, such as with a linear perspective image, and being one in which each set of parallel orthogonal lines converge towards a centrally located vanishing point that is located directly opposite a centrally located eye point.

41. Certification of Vision

Status: **NEW TERM** | Dictionary page: 89

A diverse class of techniques that have the goal of certifying, or establishing the truth of, the views/images that are observed from physical reality. For example, validation of ordinal, determinative, and subsumptive data as extracted from images. May include

certification of views/images obtained by direct human vision, optical instruments, new media systems, or any combination of the same.

42. Circle of Revolution Perspective

Status: **NEW TERM** | Dictionary page: 93

Synonym for Cylinder of Revolution Perspective. The capability of a circular perspective system to produce multiple views of a 3-D object by orbiting or revolving in a circle around the 3-D object in question (looking in/ looking at perspective).

43. Circle of View (1, 2 [A, B])

Status: **NEW / REFINED TERM** | Dictionary page: 94

Circle of View has two possible meanings in relation to technical perspective.

44. Circle of Vision Perspective

Status: **NEW TERM** | Dictionary page: 94

Circle of Vision Perspective: Synonym for Cylinder of Vision Perspective. Circular system producing a complete circle-of-vision (looking-out/looking-around perspective).

45. Circular Perspective (A, B)

Status: **NEW / REFINED TERM** | Dictionary page: 94

A. Circular image Any circular or (horizontal) multi-directional image that comprises 3-4 primary vanishing points (corresponding to 3-4 of the 6 cardinal directions), and towards which everything is laid out. B. Panoramic cinema system/theatre Circular perspective refers to a type of panoramic image capture and projection method in which the images observe a full (horizontal) 360-degree vista, later displayed on a 360-degree circular theatre.

46. Class Chaining

Status: **NEW TERM** | Dictionary page: 95

Class chaining occurs when the two basic directional classes operate sequentially within one perspective process or system; for example, a camera may form or capture an image that is subsequently projected or displayed on a surface.

47. Class Chaining vs Category Chaining

Status: **NEW / REFINED TERM** | Dictionary page: 95

Distinction: Class chaining describes the sequential operation of the two directional classes, whereas category chaining describes a sequence of perspective categories identifying the means or modes involved. Thus, one system may involve the class chain Viewing or Imaging -> Projecting and the category chain Optical -> Instrument -> New Media.

48. Class Overloading

Status: **NEW / REFINED TERM** | Dictionary page: 95

Class overloading occurs when one perspective process or system performs both image-forming or capturing and image-projecting roles at the same time.

49. Class Overloading vs. Category Overloading

Status: **NEW / REFINED TERM** | Dictionary page: 95

Distinction: Class overloading concerns a process or system operating in both directional classes at the same time, whereas category overloading concerns a process belonging to more than one category or mode. A system may therefore be class-overloaded, category-overloaded, or both.

50. Combined Perspective

Status: **NEW / REFINED TERM** | Dictionary page: 97

Combined Perspective is a subtype of Composite Perspective in which two or more distinct views, images, perspective methods or spatial constructions are intentionally joined, superimposed or presented together within one view or image. 1. Combined real and represented views. A direct view of physical reality combined with a represented image, symbol or optical overlay. A gun sight or augmented-reality display may combine a direct view of the external scene with superimposed graphical information. The components normally remain visually distinguishable. 2. Combined scenes or perspective spaces. Two or more natural, artificial, graphical, optical or simulated scene spaces are intentionally conjoined to produce an apparently unified view. Forced perspective, image compositing, mirrors, mattes or projected backgrounds may be used. The component spaces may appear unified, but retain different sources, geometries, scales or methods. Combined Perspective (continued) 3. Combined universal and particular views. A broad scene or spatial framework combined with the individual perspective appearances of objects viewed from their particular positions or angles within that scene.

51. Composite Perspective (1)

Status: **NEW / REFINED TERM** | Dictionary page: 100

A multi-category perspective process, system or image produced when several categories operate in sequence or combination. A photographed scene, for example, may involve Natural, Optical and Instrument Perspective, digital processing and display, and Visual Perspective Type 2.

52. Composite Perspective Image (1, 2, 3, 4)

Status: **NEW TERM** | Dictionary page: 100

• A perspective image formed by more than one category of perspective. See Composite Perspective (1). • A mosaic perspective image or apparently single depicted space, comprised of multiple image segments or views; each captured separately and then combined using image or spatial overlays/relays/masks; including optical or graphical 'segmented' field of view combinations or

using mirrors/masks, etc., or alternatively the same process achieved using digital techniques. • Split / fragmented spaces: Use layered or multi-view approaches, for example, a cleft space for spatial manipulation, with actors at two different distances or planes from the camera. • A combined perspective image (alternative name for composite perspective (1, 2, 3, 4)).

53. Compositional Perspective (1)

Status: **NEW / REFINED TERM** | Dictionary page: 101

In his notebook writings, Leonardo da Vinci identifies what he calls composite or synthetic perspective, which is a combination of perspective derived partly from art (graphics) and partly from nature (vision/optics). In this latter form of perspective, we may take into account that spatial objects/scenes viewed by natural perspective can differ (by design) from artificial perspective in distinct ways (e.g. by adjusting the geometry within a drawing to create a 'synthetic' perspective comprising elements of both kinds of perspective). One example, identified by Leonardo is anamorphosis, when 'wholly distorted' drawings are projected by optical perspective methods onto steeply angled and/or cylindrical- shaped surfaces, and thus transformed into entirely different, but often realistically proportioned, image forms.

54. Compositional Perspective (2)

Status: **NEW / REFINED TERM** | Dictionary page: 101

Combined perspective image/view in which we see both a 'universal' perspective wide-field image of a spatial scene, for example consisting of a ground-plan chequerboard perspective framework, and horizon line in the distance; plus being combined into a single image along with a 'particular' perspective image of (for example) foreshortened objects present in the aforementioned object space.

55. Constructed Perspective

Status: **NEW / REFINED TERM** | Dictionary page: 105

Synonym for a bifocal linear perspective construction, or early, somewhat inaccurate Renaissance perspective graphical constructions, that differ from modern "true" one-point or "true" two-point perspective by using two, usually centred, "false" vanishing points for a single, generally flat, subject. This method, seen in works like Uccello's Nativity, often features a central, somewhat distorted, grid and two main vanishing points, often with a "horizontal" set of lines.

56. Coordinated Integrated Perspective

Status: **NEW / REFINED TERM** | Dictionary page: 107

Co-ordinated perspective is a term that refers to the linking, joining-up or merging of multiple perspectives to form an integrated whole. There are many techniques for creating coordinated perspectives. For example, we can link or merge views from a single station point whereby techniques such as spherical perspective are used to obtain a full hemisphere of views from every direction surrounding an observation point of a dimensional reality. Other types are known that link motion perspectives etc. including multi-view, multi-scale, and multi- time perspective, etc. Notionally cinema is a coordinated perspective technique in which multiple perspectives (image frame sets) are captured as a sequence and later projected in the same sequence order creating a type of multi-timemotion perspective. Perspective images held on digital media lend themselves to being linked and combined in a near-limitless number of different ways.

57. Correct Perspective (B)

Status: **NEW / REFINED TERM** | Dictionary page: 108

The term correct perspective refers to the generation or application of a 'correct' or 'realistic' perspective view/ image; whereby said projection is assumed to reflect the 'true' shape or most realistic/naturalistic appearance of the object/scene; the same being implicitly an image chosen from several other less-realistic images/views that are possible. Patently most real-world perspective images/representations (central, axiomatic, etc) involve visual distortion according to vanishing point position and hence changes to the appearance of depicted scene/object shapes, scales, positions, etc. Accordingly, a quest ensued to impose geometrical regularity to depicted forms in general, in an attempt to impose order, repeatability and to certify sight, measurement, and representation.

58. Curved and Split Projection

Status: **NEW / REFINED TERM** | Dictionary page: 112

Curved and split projection perspective techniques are used to manipulate 3-D scenes for immersive viewing, artistic distortion, optical/visual illusion, or to fit wide-angle views onto surfaces without extreme edge stretching. These methods range from artistic drawing techniques to complex computer graphics rendering for curved displays. Key Concepts • Curvilinear Perspective: This technique uses curved lines to mimic the fisheye view of the human eye, providing a more accurate representation of space than linear perspective. It often involves four vanishing points around a centre point, causing vertical lines to bend at the top and bottom. • Split Projection: In computer graphics, split projection involves breaking a complex, non-planar scene into multiple, smaller, connected perspective projection pieces (frusta). This allows for the rendering of large, immersive, or curved scenes without the distortion that would occur with a single, straight-line projection. • Curved Screen Projection: Used in home theatres and simulation, curved screens (e.g., Elite Screens Lunette) use a constant focal distance to increase immersion, reduce the "pincushion" distortion effect (where corners appear stretched), and provide a more uniform reflection. • Applications: In 3-D software (like CAD), this involves projecting curves onto a surface, which can be split at points of intersection or self-intersection.

59. Curved Perspective (1, 2, 3, 4, 5, 6, 7)

Status: **NEW / REFINED TERM** | Dictionary page: 112

Curved Perspective may refer to (at least) one of six possible visual effects. 1. Curved / spherical picture plane - sphere-of-revolution (object); or sphere-of-vision (scene) First we have the use of a curved projection or picture plane; combined with imaging forming lens/camera, etc; whereby two geometric effects are the result; firstly, the objects tend to be sampled from multiple angles simultaneously (sphere-of-revolution or partial multi-view), and secondly, the entire scene exists on a circular or cylinder-shaped

canvas (sphere-of-vision for display of scene). 2. Curved Image distortions (flat picture plane - wide-field projection) Curved perspective produces images that may suffer distortions resulting in a curvilinear shape to the images (especially at the outer field). 3. Curved ray perspective: see this dictionary entry. 4. Curved space perspective: non-Euclidean object space, or image space. 5. Curved vanishing line perspective (object space sourced). 6. Curved vanishing line perspective (projection method sourced). 7. Visual perspective (2nd type) is curved due to inward curved retina.

60. Cybernetic Perspective

Status: **NEW / REFINED TERM** | Dictionary page: 114

A way of thinking about complex systems that uses the idea of feedback and communication to understand how parts of a system interact. It can be applied to a variety of fields, including design, learning, and personality. Principles • Cybernetics is the study of how systems communicate and control each other. • It's based on the idea that systems are constantly exchanging information, and that the effects of a system's actions are returned to the system as inputs. • The term comes from the Greek word *kybernetes*, which means "helmsman" or "cox". Applications • Design: Can help guide the design process by modelling it as a cybernetic system. • Learning: Can be applied to learning by drawing on insights from the study of living systems. • Personality: Can be used to organise personality factors into a cybernetic cycle.

61. Cylinder of Revolution Perspective

Status: **NEW TERM** | Dictionary page: 115

Cylinder of Revolution Perspective: Synonym for Circle of Revolution Perspective. The capability of a perspective system to produce multiple views of a 3-D object by orbiting or revolving in a cylindrical fashion around the 3-D object in question (looking-in/looking-at perspective).

62. Cylinder of Vision Perspective

Status: **NEW TERM** | Dictionary page: 116

Cylinder of Vision Perspective: Synonym for Circle of Vision Perspective. Perspective system producing a complete cylinder-of-vision (looking-out/looking-around perspective).

63. Cylindrical Perspective ([A: 1, 2], B)

Status: **NEW / REFINED TERM** | Dictionary page: 116

A: Cylindrical Perspective: Concave Screen / Display. See: Volume Screen / Display (1,2,3,4). Any method of perspective that employs a cylindrical picture plane to form images of a spatial reality, or else being a method that in one way or another, employs a cylinder of vision, or a cylinder of revolution, to observe/represent an object or spatial reality, or else being one that creates a distorted cylindrical image in the lateral object plane but with the vertical plane parallel to the picture plane left unchanged/undistorted. Also refers to a large, concave, horizontal filming backdrop that surrounds foreground actors and staged content, allowing for the creation of distant scenic backgrounds. 1. Central / Multi-view / Cylindrical Perspective A type of cylindrical perspective whereby the view is formed by looking in one cardinal direction, before rotating the viewpoint to another cardinal direction using a circular motion (or cylindrical motion); whereby 'conjoined' but actually separate cylindrical vistas can be explored. See patchwork perspective. 2. Unfolding / Curvilinear / Cylindrical Perspective A type of cylindrical perspective whereby the view is formed by observing a view/image of a total cylindrical perspective scene such as one formed by looking through a glass ball, before then moving the viewpoint to another cardinal direction, and by moving the ball (and your own viewpoint) in a circular (or cylindrical motion); whilst looking at the image formed by the glass ball, whereby a smoothly infolding curvilinear and 'cylindrical' vista is produced. See curvilinear, spherical, glass and metal ball perspectives. B: Cylindrical Perspective: Convex Screen / Display. See: Volume Screen / Display (1,2,3,4). Refers to a large, convex, horizontal filming backdrop, shaped to enable digital object-like elements to project into the physical space of the foreground actors and staged content.

64. Depth Components

Status: **NEW / REFINED TERM** | Dictionary page: 119

Size Diminution in All Directions and the Formation of Vanishing Points In a standard linear-perspective construction using a vertical picture plane, object-space verticals are parallel to the picture plane. Their vanishing point therefore lies at infinity, and they remain parallel in the image. If the viewing or imaging system is tilted so that its picture plane is no longer parallel to those verticals, the vertical direction acquires a finite vanishing point and the lines appear to converge. The same principle applies to every family of parallel lines. Lines whose direction is parallel to the picture plane have a vanishing point at infinity; lines whose direction includes a depth component perpendicular to the picture plane converge towards a finite vanishing point. In optical viewing, equal-sized objects, forms or intervals generally subtend smaller visual angles as their distance from the viewpoint increases. This diminution may occur for objects receding along any spatial direction, but projected size is not produced by three independent X-, Y- and Z-components of diminution. It depends upon distance, orientation and the geometry of the viewing or imaging system. A distinction must therefore be maintained between optical size diminution, which concerns changes in apparent or angular size, and graphical vanishing-point formation, which concerns the projected direction of parallel lines. Optical-Space Vanishing Limit in the Vertical Dimension With a vertical picture plane and level viewing direction, object-space verticals remain parallel and their graphical vanishing limit lies at infinity. Tilting the picture plane or imaging system so that it is no longer parallel to the object-space vertical direction produces a finite vertical vanishing point. Optical-Space Vanishing Limit in the Lateral Dimension Horizontal parallels that are parallel to the picture plane have vanishing limits at infinity. Horizontal lines that recede obliquely through depth converge towards finite lateral vanishing points (or limits). Implications of Depth Components and Size Diminution in All Directions The following references identify related concepts, principles and phenomena affected by depth components and size diminution in different spatial directions.

65. Diminution of Form Perspective (1, 2, 3, 4)

Status: **NEW / REFINED TERM** | Dictionary page: 128

1. Loss of object outline detail due to contrast blurring (atmospheric effects) The apparent object outline length becomes smaller (outline appears less bumpy) as optical depth increases (contrast blurring). This is blurring of object outline or loss of detail with distance, and is due to atmospheric effects (aerial perspective). 2. Loss of outline detail due to reduced projection scale resolution (detector limitations) The apparent object outline length becomes smaller (outline appears less bumpy) as projection scale or size of the image is reduced (due to lower projection scale resolution). Hence, we have a loss of apparent object outline or detail with reduced projection scale resolution. Technical Note: Consider that a 'pebble's circumference' can be viewed (microscopically) at an increased magnification or projection scale, and by 'zooming-in' on the outline it will appear more 'jagged' in shape. In this manner, we obtain a higher projection scale resolution, with finer measuring intervals, which can then closely match the tiny pebble crevices previously invisible or missed. As a result, the 'pebble's outer circumference measurement(s) will be longer (in object space units)!

66. Directing Plane (1, 2) - Scenarios: A, B, C, D

Status: **NEW / REFINED TERM** | Dictionary page: 130

1. Directing Plane orthogonal to angle of view (1) [always true]: An imaginary plane drawn through the spectator's eye, and orthogonal to the angle of view (1) or line of sight. 2. Directing Plane parallel to picture plane [sometimes true]: An imaginary plane drawn through the spectator's eye parallel to the picture plane. N.B. Sometimes both [1] and [2] will be true; when directing plane is parallel to picture plane, but sometimes the directing plane will make an angle related to the picture plane and so only [1] is true. N.B. Directing Plane is always orthogonal to the angle of view or line of sight (that is how it is defined).

67. Double Horizon Perspective

Status: **NEW TERM** | Dictionary page: 137

Double Horizon Perspective: Synonym for Axial Perspective (twin view type). Use of vanishing axis perspective or vanishing trace perspective leads to two 'horizontal' or alternatively two 'vertical' horizons [horizon = vanishing line of vanishing points], one for each of the left and right walls respectively (in a room), or alternatively one for the ground plane and one for the ceiling plane (in a room). It is a false or artificial/graphical form of perspective that combines two separate viewpoints, and is used to 'open up' the view (falsely in optical terms) and thus to make extra room in a spatial scene for the artist to place/depict spatial objects.

68. Double Perspective (1, 2, 3)

Status: **NEW / REFINED TERM** | Dictionary page: 138

1. Double Perspective: Combined perspective illusion. See: Perspective (Double) [2]. A type of combined perspective illusion in which two separate perspective spaces are combined into an apparent direct or simulated real-space view that exhibits illusive properties and this space is created by having a type of forced perspective in which two falsely receding metric grids are conjoined visually enabling either: A) an apparently varying scale space similar to an Ames room, and B) the ability to hide/render-invisible objects or people behind apparently falsely positioned, or falsely scaled, objects.

69. Drawdown Perspective (1, 2, 3)

Status: **NEW / REFINED TERM** | Dictionary page: 139

1: Camera / lens distortion: A high-angle or downward-looking view may produce pronounced changes in apparent size and shape, especially when the camera is close to the subject and a wide field of view is used. This projective effect should be distinguished from barrel or pincushion distortion, which are lens or image- processing distortions. Drawdown Perspective (continued) 2: "Drawdown" or "top-down" camera shots (often referred to as overhead or flat-lay shots) are designed to capture a subject from directly above, perpendicular to the floor. 3: A drawdown zoom camera shot, more commonly known as a dolly zoom, Vertigo effect, or Hitchcock zoom, is a cinematic technique where the camera moves toward or away from a subject while simultaneously zooming the lens in the opposite direction. This action keeps the subject at a constant size in the frame while the background stretches or compresses, creating a surreal, disorienting, or intense emotional effect.

70. Elements of Perspective

Status: **NEW / REFINED CLASSIFICATION** | Dictionary page: 147

point, a picture or projection plane, and a spatial object/scene. However, we can further identify detailed elements that comprise the key method of linear perspective: A linear perspective method has 5 key elements: • Eye/camera at a fixed point (single point of sight) • Pyramid of Vision / Visual Cone (theory of appearances) • Pyramid of Spatial Recession (size/distance law) • Flat picture or projection plane (2-D image surface) • Spatial object or scene that extends into depth In terms of the linear perspective object form we can have 6 geometric elements (1-3 are key requirements; 4-6 are optional): • Object / scene outlines are visible (depth dimension) • Where present, object-space parallel lines form directionally related sets (depth dimension) • A ground plane, baseline or another reference plane may provide a spatial register • Square / rectangular forms present (depth dimension) • Ground plane may extend out to apparent 'infinity' • Metric grid exists on/parallel-to ground plane (checkerboard pattern) In terms of the linear perspective image form we have 12 perspective phenomena (all are key apart from optional elements 8-12): • Diminution of Size (size/distance formula) • Aspect of Form (shape changes with viewing angle) • Degradation of Form (size/shape with aspect/distance) • Foreshortening (projected size reduction + distance/size or optical foreshortening) • Parallel lines (extending into depth) appear to converge • Single vanishing point (VP) for each set of parallels (unified space) • Central or primary vanishing point for orthogonal parallel lines • Further parts of the ground plane appear higher up • Perspective of proportion / disappearance / magnitude • Horizon line formed by infinite extent of ground plane • Metric grid appears with vanishing points (1,2 or 3 for visible parallels) • Diminution of Form (outline structure disappears)

71. Environmental Factors

Status: **NEW TERM** | Dictionary page: 149

Refers to perspective phenomena (appearance facets within a perspective image) that relate to, or emanate from, environmental factors.

72. Environmental Perspective

Status: **NEW / REFINED TERM** | Dictionary page: 149

PCT term not directly related to James J. Gibson's environmental theory. Environmental perspective includes viewpoint geometries, or naturally occurring optical effects such as projection of light-beams, shadows/outlines, line of sight problems, translucency/reflection/colour effects, astronomical, atmospheric, underwater optics, etc; environmental perspective includes (aspects of) human- designed vistas (e.g., architecture, gardens, etc.). See: natural perspective.

73. Extrinsic Factors

Status: **NEW TERM** | Dictionary page: 156

Refers to perspective phenomena (appearance facets within a perspective image) that relate to, or emanate from, light ray direction, and also light ray wavelength plus intensity.

74. Flower Perspective (A, B)

Status: **NEW TERM** | Dictionary page: 168

Flower Perspective A: Making a perspective drawing/painting of a flower is notoriously difficult for an artist to achieve with spatial realism; likewise, flower/plant/tree structures can be difficult for the observer to perceive correctly in terms of layout, structure, plus direction/interrelation of a constellation of visual elements. This is partly because the flower/plant/tree perspective is complex or irregular, without any easily discernible perspective framework structures, such as a metric grid. Flower Perspective B: Undefined at present, and related to an older term of the same name, or usage of the same. [Possible reference to a form of flat/unfolded perspective.]

75. Fragmented Perspective (1)

Status: **NEW / REFINED TERM** | Dictionary page: 175

1: Fragmented Perspective (1): Synonym for a Fragmented View (true / coherent global image) Type of perspective in which the image is fragmented, splintered, and/or segmented into multiple parts/ forms, or multiple reflections, etc. For example, an infinity mirror or kaleidoscope images, etc. See Jewel and mirror ball perspective, optical special effects.

76. Fragmented Perspective (2)

Status: **NEW / REFINED TERM** | Dictionary page: 175

2: Fragmented Perspective (2): Synonym for a Fragmented View (false / incoherent global image) When the perspective view is not a true, realistic, or unified / integrated view, whereby the arrangement and assemblage of fragments of views or partial views of objects or parts of a scene/object are considered separately, and thus (only) to some extent can be traced back to the notion of a single view of a scene and so of perspective.

77. Geometrical Perspective [A] (1, 2, 3)

Status: **NEW / REFINED TERM** | Dictionary page: 184

Geometrical perspective is a type of artificial, mathematical, and graphical perspective representation that is created by following a specific set of construction rules, depending upon the geometrical subtype. The two principal families of geometrical projection are: 1. Central or perspective projection: projection in which the projectors converge at a finite centre of projection. 2. Parallel projection: projection in which the projectors remain parallel, including orthographic and oblique projection. Both are mathematical forms of projection.

78. Geometrical Vanishing Limit

Status: **NEW / REFINED TERM** | Dictionary pages: 184, 198, 201 | Repeated marked occurrence: 3 placements consolidated

the geometrically determined limit towards which parallel lines, directions, planes or spatial forms appear to converge within a perspective projection. Depending upon the geometry, it may be represented by a vanishing point, vanishing line, vanishing curve, vanishing plane or another limiting form.

79. Geometry

Status: **NEW / REFINED TERM** | Dictionary page: 185

Geometry is the branch of mathematics concerned with the properties and relations of points, lines, surfaces, shapes, sizes, positions and spaces. Knowledge of geometrical form(s) enables systematic prescription of real- world physical form(s)/structure(s)—and this is the source of the accurate modelling powers for all of the quantitative science(s). It is only by functioning at a certain (abstract) level of reality that geometry (line) and arithmetic (number) can become a vehicle for scientific contemplation, understanding, and finally knowledge. The rise of descriptive geometry (parallel perspective) in the 18th century, which claimed to offer universal principles for representation, led to the first serious claims that representation and (human) vision must be co-incident. However, in the 19th century, physiologists such as Helmholtz became aware of serious problems with earlier analogies between the eye and camera obscura (see: Leonardo, Kepler, Scheiner). Helmholtz also discovered that curved lines, when seen from nearby, appear straight and hence suggested a distinction between physical space, which was Euclidean (or strictly flat), and visual space, which was non-Euclidean (or curved). Art historian Sir Ernst Gombrich, for example, referred to visual space as the optical world or the mirror and to geometrical space as the physical world, the experienced world, or the map. The psychologist J. J. Gibson called visual space the visual field and linked geometrical space with the visual world. In the 19th century it was assumed that visual space was subjective and geometrical space was objective. In Gibson's 20th-century approach, both are susceptible to measurement and hence, in a sense objective. Kim Veltman said that: "Perspective is a halfway station where geometry and physical reality meet—it is a link between the ideal and the actual." Hence, our views of physical reality are limited because data is inevitably lost when capturing the visual details of a spatial scene or object, and when analysing and interpreting it.

80. Glide Perspective

Status: **NEW TERM** | Dictionary page: 187

Type of artificial and parallel perspective projection in which the picture surface is allowed to (geometrically/ graphically) scan itself through object space, registering images along the way, forming 2-D scans of 3-D object space.

81. Graphical Perspective

Status: **NEW / REFINED TERM** | Dictionary page: 189

Perspective constructed or represented through drawing, painting, diagramming, drafting or other graphic methods. Linear perspective, axonometry and parallel projection are principal examples. Computer-generated imagery belongs primarily to New Media Perspective, although it may reproduce graphical methods.

82. Graphical Space

Status: **NEW TERM** | Dictionary page: 189

The term graphical space (artificial perspective sense or a perspective construction) is considered as the opposite of the optical space or visual perspective, whereby in this sense graphical space obeys, and is limited by, purely the projective rules of geometry as opposed to the rules of optics or visual perspective (retinal vision). See entry for lateral vanishing points for visual/optical space as opposed to graphical space, whereby vanishing points can occur for mutually parallel lines running parallel or laterally to the view-frame/picture window in visual/optical space but not with graphical space.

83. History of Perspective

Status: **NEW TERM** | Dictionary page: 194

Perspective, in one form or another, has long been known and used, at least since the civilisations of ancient China, Egypt, Greece and Rome. The history of perspective has been written about in a vast number of publications. However, the best overall summary of the history of perspective is in Kim Veltman's Encyclopaedia of Perspective [2020] (the Sources and Literature of Perspective), and in his Studies on Leonardo da Vinci; Linear Perspective and the Visual Dimensions of Science and Art [1986].

84. Hitchcock Zoom

Status: **NEW / REFINED TERM** | Dictionary page: 195

A dolly zoom, also known as the Vertigo effect or Hitchcock zoom, is a cinematic technique where the camera moves toward or away from a subject while simultaneously zooming the lens in the opposite direction. This action keeps the subject at a constant size in the frame while the background stretches or compresses, creating a surreal, disorienting, or intense emotional effect.

85. Hologram Mirror

Status: **NEW / REFINED TERM** | Dictionary page: 196

As an aside the author (Alan Radley) has invented a new type of mirror, named the "Hologram Mirror", that produces an image of the self/face which "floats" in space in front of the mirror's surface. Here, unlike with holograms, image occlusion effects are created, and the viewer obtains a strong and realistic impression of 3-D. See: reflection hologram (2), hologram.

86. Horizon — Types: Master Classification

Status: **NEW / REFINED TERM** | Dictionary page: 197

The following classification distinguishes established horizon terminology from new, extended or refined terms used in this dictionary. A. Standard or Established Horizon Terms [1] Astronomical Horizon / Celestial Horizon / Rational Horizon — Standard term: the great circle of the celestial sphere whose plane passes through the centre of the Earth. [2] Eye Level / Eye-Level Line — Standard term: the height of the observer's eyes or its represented equivalent. [3] Geometrical Horizon — Standard term: a terrestrial horizon calculated from the form of the Earth and the observer's position. [4] Geometrical Horizon Line — Standard term: the vanishing line of horizontal planes in a perspective projection. [5] Horizon Line — Standard term: either the geometrical vanishing line of horizontal planes or, in less technical usage, the represented boundary where land or sea appears to meet the sky. [6] Sensible Horizon — Standard term: the horizontal plane passing through the observer's eye. [7] Skyline — Standard term: the visible outline of land, buildings, trees or other objects against the sky. [8] Terrestrial Horizon — Standard term: a broad term for a horizon associated with the surface of the Earth. [9] Vanishing Line of a Plane — Standard term: the line containing the vanishing points of all directions lying within a particular plane. [10] Vertical Vanishing Point — Standard term: the vanishing point of a set of mutually parallel vertical lines when those lines recede relative to the picture plane. [11] Visible / Apparent Horizon — Standard term: the observed boundary where the Earth, sea or landscape appears to meet the sky. B. Circular and Observer-Distance Horizon Types

87. Circular Horizon Type A — Earth-Curvature-Influenced Horizon

Status: **NEW / REFINED TERM** | Dictionary page: 197

the terrestrial horizon as influenced by the spherical curvature of the Earth.

88. Circular Horizon Type B — Complete 360-Degree Horizon

Status: **NEW / REFINED TERM** | Dictionary page: 197

the complete horizon circle surrounding an observer in all horizontal directions.

89. Circular Horizon Type C — Osculating-Sphere Horizon

Status: **NEW / REFINED TERM** | Dictionary page: 197

a horizon or limb formed where sight lines are tangent to a sphere or locally approximating spherical surface.

90. Apparently Infinite Horizon Line

Status: **NEW / REFINED TERM** | Dictionary page: 197

the projective horizon line representing horizontal directions at geometrical infinity.

91. Local Horizon Type A — Physical Eye-Plane Boundary

Status: **NEW / REFINED TERM** | Dictionary page: 197

the trace of the observer's horizontal eye plane upon nearby enclosing surfaces.

92. Local Horizon Type B — Geometrical or Represented Form

Status: **NEW / REFINED TERM** | Dictionary page: 197

the graphical or represented equivalent of the local eye-plane boundary.

93. Local Horizon Type C — Occlusion Boundary

Status: **NEW / REFINED TERM** | Dictionary page: 197

a nearby frame, wall, surface or object that limits part of the observer's view.

94. Medium-Distance Horizon

Status: **NEW / REFINED TERM** | Dictionary page: 197

an intermediate visual boundary formed by a hill, ridge, inclined road or other terrain.

95. Non-Infinite Horizon

Status: **NEW / REFINED TERM** | Dictionary page: 197

a physical, optical or apparent horizon occurring at a finite distance.

96. Osculating-Sphere Horizon Line

Status: **NEW / REFINED TERM** | Dictionary page: 197

the circular or curved apparent horizon produced by sight lines tangent to an approximating sphere.

97. Actual Primary Horizon Line — Physical or Optical Type

Status: **NEW / REFINED TERM** | Dictionary page: 197

the principal visible horizon directly observed within a physical scene.

98. Artificial Primary Horizon Line — Represented Type

Status: **NEW / REFINED TERM** | Dictionary page: 197

the principal visible or geometrical horizon represented within an image.

99. Geometrical Primary Horizon Line

Status: **NEW / REFINED TERM** | Dictionary page: 198

the principal geometrical vanishing line of the horizontal ground plane.

100. Secondary / Auxiliary Horizon Line — Physical or Optical Type

Status: **NEW / REFINED TERM** | Dictionary page: 198

a subsidiary apparent boundary associated with an inclined surface, reflection, optical system, secondary spatial field or local visual boundary.

101. Secondary / Auxiliary Horizon Line — Geometrical Type

Status: **NEW / REFINED TERM** | Dictionary page: 198

the vanishing line of an inclined, declined or oblique plane.

102. Transverse / Vertical Horizon Line — Physical or Optical Type

Status: **NEW / REFINED TERM** | Dictionary page: 198

a vertically or transversely oriented apparent boundary within a physical or optically formed field.

103. Transverse / Vertical Horizon Line — Geometrical Type

Status: **NEW / REFINED TERM** | Dictionary page: 198

the vanishing line of a vertical plane.

104. Optical Horizon Line

Status: **NEW / REFINED TERM** | Dictionary page: 198

the directly observed or optically imaged boundary where an extended surface appears to meet the sky.

105. Optical Vanishing Limit

Status: **NEW TERM** | Dictionary pages: 198, 201, 305 | Repeated marked occurrence: 3 placements consolidated

the optical or visual limit at which a specified object, line, pattern or detail ceases to be distinguishable because its image becomes too small, faint, blurred or low in contrast to be resolved. It may occur as a point, line, boundary, region, distance or gradual transition.

106. Multiple Horizon Lines

Status: **NEW / REFINED TERM** | Dictionary page: 198

several vanishing lines associated with different plane orientations, viewpoints or perspective systems.

107. Horizon-Line Isocephaly

Status: **NEW / REFINED TERM** | Dictionary pages: 198, 204 | Repeated marked occurrence: 2 placements consolidated

A perspective application of isocephaly in which corresponding points upon figures of equal height, standing upon the same level ground plane, align along common receding construction lines. The eyes of the figures lie upon the horizon line only when their eyes are at the same physical height as the observer's eyes. The tops of their heads do not automatically lie upon the horizon line; they normally follow a separate receding line above it.

108. Horizon, Dual Reality

Status: **NEW / REFINED TERM** | Dictionary pages: 198, 200 | Repeated marked occurrence: 2 placements consolidated

A represented horizon may operate simultaneously in two spaces: [1] Virtual or represented image space: the horizon functions as the geometrical vanishing line towards which horizontal directions appear to converge. [2] Physical picture space: the same horizon exists as an actual line, mark or boundary upon the flat surface of a drawing, painting, photograph, screen or other image. The first belongs to the depicted spatial world; the second belongs to the physical structure and composition of the image.

109. Horizon, Apparently Infinite

Status: **NEW / REFINED TERM** | Dictionary page: 199

A geometrical horizon line representing the vanishing line of an indefinitely extended horizontal plane. Parallel horizontal directions appear to converge towards points upon this line, although the line represents a projective limit rather than a physical boundary at a measurable distance. It is different from the visible terrestrial horizon, which occurs at a finite distance because of the curvature of the Earth, terrain or other obstructions.

110. Horizon, Circular: Types A, B and C

Status: **NEW / REFINED TERM** | Dictionary page: 199

A classification of circular horizons associated with the spherical Earth, a globe or another curved body. [1] Circular Horizon Type A — Earth-Curvature-Influenced Horizon: the terrestrial horizon produced by the spherical form of the Earth. A short section normally appears nearly straight from a low viewpoint because the Earth is extremely large relative to the observer. [2] Circular Horizon Type B — Complete 360-Degree Horizon: the complete horizon circle surrounding an observer in all horizontal directions. It is most clearly experienced over an unobstructed sea, open plain or comparable environment. [3] Circular Horizon Type C — Osculating-Sphere Horizon: the apparent horizon or limb formed where sight lines are tangent to a sphere or locally approximating spherical surface. It may apply to the Earth viewed from high altitude or space, or to a globe or other spherical model.

111. Horizon, Local: Types A and B

Status: **NEW / REFINED TERM** | Dictionary page: 200

[1] Local Horizon Type A — Physical Eye-Plane Boundary: the trace of the observer's horizontal eye plane upon nearby enclosing surfaces. In a room, it may be imagined as an eye-level line continuing around the walls. [2] Local Horizon Type A — Geometrical or Represented Form: the line representing the local eye plane within a drawing, model or perspective construction. [3] Local Horizon Type B — Occlusion Boundary: a nearby edge, frame, surface or object that limits part of the observer's view, such as a window frame, wall or foreground object. These are extended uses of horizon. Type A concerns the observer's eye plane, while Type B is more precisely a local visual or occlusion boundary. Neither should be confused with the distant terrestrial horizon.

112. Horizon, Medium-Distance

Status: **NEW / REFINED TERM** | Dictionary page: 201

A visible boundary formed at an intermediate distance by the crest of a hill, mountain, inclined road, ridge or other raised terrain. It separates visible foreground terrain from the sky or from a more distant part of the scene. It is normally a terrain skyline or occlusion boundary rather than the unobstructed terrestrial horizon.

113. Horizon, Non-Infinite

Status: **NEW / REFINED TERM** | Dictionary page: 201

A physical, optical or apparent horizon occurring at a finite physical or observer-relative distance rather than at the notional infinity of projective geometry. Examples include: • the visible terrestrial horizon; • Circular Horizon Types A, B and C; • a local eye-plane or occlusion boundary; • the crest of a hill or other medium-distance terrain boundary; • a finite visual boundary formed by a nearby object or surface. A drawn segment representing a geometrical horizon line is physically finite upon the page but still represents a projective line at infinity. It should not therefore be classified as geometrically non-infinite merely because the drawn line has endpoints.

114. Horizon Line, Local: Types A and B

Status: **NEW / REFINED TERM** | Dictionary page: 204

[1] Local Horizon Line Type A — Physical Eye-Plane Boundary: the trace of the observer's horizontal eye plane upon nearby enclosing surfaces, such as an eye-level line imagined around the walls of a room. [2] Local Horizon Line Type A — Geometrical or Represented Form: the graphical equivalent of the local eye-plane boundary within a drawing, model or perspective construction. [3] Local Horizon Line Type B — Occlusion Boundary: a nearby frame, edge, surface or object that limits part of the observer's visual field. The physical local horizon, its graphical representation and the distant outdoor visible horizon should not be treated as identical.

115. Horizon Lines, Multiple

Status: **NEW / REFINED TERM** | Dictionary page: 204

A term for the several vanishing lines that may occur when a scene contains planes of different orientations, several independent perspective systems or several viewpoints. Each set of mutually parallel lines extending into depth has a vanishing point. The vanishing points of the different line directions lying within one plane form that plane's vanishing line. Every plane orientation

therefore has a corresponding vanishing line. Only the vanishing line of horizontal planes is ordinarily called the horizon line; other examples are more precisely called vanishing lines of planes.

116. Horizon Line, Optical

Status: **NEW / REFINED TERM** | Dictionary page: 204

The directly observed or optically imaged boundary where the Earth, sea, landscape or another extended surface appears to meet the sky. It may be curved, irregular, obscured or displaced by terrain, observer height, atmospheric refraction, lens characteristics and image processing. It may approximately coincide with the geometrical horizon line in a level, unobstructed view, but the two are conceptually different. The optical horizon line is also different from the optical vanishing limit: the first is a visible scene boundary, whereas the second is a resolution-dependent limit at which specified visual information disappears.

117. Horizon Line, Osculating-Sphere

Status: **NEW / REFINED TERM** | Dictionary page: 205

The apparent circular or curved horizon formed where sight lines from an observer are tangent to an osculating sphere: a sphere used to approximate a curved surface locally. The term may apply to a terrestrial horizon represented using a spherical approximation of the Earth, the limb of the Earth viewed from high altitude or space, or the horizon of a globe or other spherical model.

118. Horizon Line, Primary / Principal: Types A, B and C

Status: **NEW / REFINED TERM** | Dictionary page: 205

A classification of the principal horizon associated with a scene or perspective system. [1] Actual Primary Horizon Line — Physical or Optical Type: the principal visible horizon directly observed within a physical scene. [2] Artificial Primary Horizon Line — Represented Type: the principal visible or geometrical horizon shown within a drawing, photograph, film, model or computer-generated image. [3] Geometrical Primary Horizon Line: the vanishing line of the horizontal ground plane and all planes parallel to it. It contains the central or principal vanishing point of one-point perspective and the horizontal vanishing points used in two-point and related constructions. The third meaning corresponds to the standard geometrical horizon line.

119. Horizon Line, Secondary / Auxiliary: Types A and B

Status: **NEW / REFINED TERM** | Dictionary page: 205

[1] Physical or Optical Type: a subsidiary apparent boundary associated with an inclined surface, reflection, optical system, secondary spatial field or local visual boundary. [2] Geometrical Type: the vanishing line of an inclined, declined or oblique plane. It contains the vanishing points of all line directions lying within that plane. Because horizon line is conventionally reserved for the horizontal ground-plane vanishing line, the preferred standard expression for Type 2 is Vanishing Line of an Inclined Plane. An individual secondary or auxiliary vanishing point is one point upon such a line; it is not the complete vanishing line.

120. Horizon Line, Transverse / Vertical: Types A and B

Status: **NEW / REFINED TERM** | Dictionary page: 206

[1] Physical or Optical Type: a vertically or transversely oriented apparent boundary or visual limit occurring within a physical or optically formed field. [2] Geometrical Type: the vanishing line of a vertical plane. Depending upon the orientation of that plane and the picture plane, its image may be vertical, oblique or, in a limiting case, at infinity. A vertical horizon line must not be confused with a vertical vanishing point. A vanishing line belongs to a plane and contains many possible vanishing points; a vertical vanishing point belongs to one set of mutually parallel vertical lines. With an upright vertical picture plane, ordinary vertical lines remain parallel. When the viewing arrangement causes them to recede relative to the picture plane, they converge towards a vertical vanishing point. Preferred standard term for Type 2: Vanishing Line of a Vertical Plane.

121. Horizontal Oblique View

Status: **REFINED TERM** | Dictionary page: 208

A view looking obliquely across a scene while extending broadly in the horizontal direction. The expression may be applied to wide or panoramic representations, including certain Chinese and Japanese scroll images, in which the view progresses laterally and may use parallel or oblique projection rather than a single fixed central viewpoint.

122. Human Perspective / Unaided Human Perspective

Status: **NEW / REFINED TERM** | Dictionary page: 210

Perspective formed or experienced through unaided human vision, without the voluntary use of optical, electronic or computational imaging equipment.

123. Illusion (function of perspective)

Status: **NEW TERM** | Dictionary page: 213

Refers to a basic function of perspective, which is to produce the illusion of viewing, or interacting with, a 3-D space for the observer.

124. Illusion or Immersion Function

Status: **NEW / REFINED TERM** | Dictionary page: 214

A perspective function or goal that creates an impression of spatial depth, altered geometry, presence or immersion within an artificial, simulated or represented environment.

125. Image

Status: **NEW / REFINED TERM** | Dictionary page: 214

A visual image is a visual representation of a spatial reality, whereby we have an object or target space that may have two independent dimensions (2-D), or three independent dimensions (3-D), and a corresponding image space that may likewise be 2-D or 3-D. A perspective image is a visual image formed, transformed or represented through one or more perspective categories, including Optical, Mathematical, Graphical, Instrument, Simulated or New Media Perspective, and may serve such goals as viewing, matching, representing, creating illusion or producing apparent immersion within spatial reality. Perspective goals within the Viewing or Imaging Class: • View: look at a spatial reality—capture/prescribe/observe perspective images of a 3-D scene. • Match: measure a spatial reality—figure/survey/classify/ match/cross-match perspective images of a 3-D scene. • Represent: copy a spatial reality—model/index/link/mix/ explore perspective images of a 3-D scene. • Illusion/Immersion: false impression of viewer place, false object dimensionality: size, depth, transparency, etc. An image form can be two-dimensional or 2-D, such as a drawing, painting, or photograph, or a three-dimensional form, such as a carving, 3-D model, or sculpture (or even a 3-D computer CAD model). Images may be created, stored, transferred, and displayed on various optical and physical media, including images captured by a film camera and subsequently displayed or projected upon a physical surface. Images can be reproduced through mechanical means, such as photography, printmaking, or photocopying, or they can be created/reproduced on optical and digital media, for example existing as digital or CGI images/data on a computer system. Images can also be moving images or be animated images through digital or physical processes. A volatile image exists briefly and may arise from a mirror, camera obscura, or display. A fixed image, or hard copy, is recorded on material like paper, while a mental image exists in one's mind as memory or imagination.

126. Image Chain (Optical)

Status: **NEW / REFINED TERM** | Dictionary page: 215

A series of things/ processes involved in image formation, capture, display, processing, analysis and storage/ transmission, etc. Elements • Object: The object being imaged (in object space) • Imager: The device that images (or purports to image) the object, such as an eye/camera Image Chain (Optical) (continued) • Sensor: A device that converts incident optical or other physical energy into an electrical, chemical or digital signal from which an image may be formed or recorded • Image: The perspective image (in image space) • Processor: A device that processes the image data • Display: A device that displays the image • Analysis: A process of analysing the image • Storage/transmission: A process of storing or transmitting the image or image data

127. Image Facets

Status: **NEW TERM** | Dictionary page: 216

A perspective Image Facet refers to Image Form aspects related to either geometrical or optical aspects, serving as contributing factors in the production of a perspective image.

128. Image Form - Perspective View/Image

Status: **NEW / REFINED TERM** | Dictionary page: 216

The shape of a perspective image is (ostensibly) determined by the relationship between three elements, the station point, the picture plane, and the object. The imaging system employed, or representation method, may also introduce geometric distortions that affect image shape.

129. Image Form

Status: **NEW TERM** | Dictionary page: 216

Typically, each perspective image may be produced through one or more perspective categories that relate to the optical/mathematical/graphical/computer processes involved. A perspective image form (geometric aspects) is the image shape or geometrical outcome(s) of said process, and refers to the overall (apparently transformed) geometry of a perspective image, including (for example) the number and position of any vanishing points, horizon lines, etc. Also, one or more standard operating phenomena can be identified that have produced an overall perspective-image form (geometric aspects), including intrinsic, extrinsic, and environmental kinds of perspective phenomena. Examples of geometric image facets include diminution of size, aspect perspective, degradation of form, diminution of form, foreshortening, etc.

130. Image Form (optical aspects)

Status: **NEW TERM** | Dictionary page: 216

A perspective image form (optical aspects) refers to the overall (possibly transformed) light ray intensity/ wavelength detected features or colour/contrast facets of a perspective image/view. Also, one or more standard operating perspective phenomena can be identified that have produced an overall perspective image form (optical aspects); including the intrinsic, extrinsic, and environmental kinds of perspective phenomena. Examples of optical image facets include the influence of the diminution of colour/contrast, aerial perspective, etc.

131. Image Space

Status: **NEW / REFINED TERM** | Dictionary page: 216

Synonymous with perspective space. The space in which a resulting image, view, model or representation is formed, located or perceived. It may be optical, visual, graphical, mathematical, instrument-generated or digital.

132. Imaging or Viewing Perspective

Status: **NEW / REFINED TERM** | Dictionary page: 217

A process through which a spatial object, scene or existing image is directly viewed, or through which a new view or image is formed, captured or presented.

133. Immersion (function of perspective)

Status: **NEW TERM** | Dictionary page: 217

Refers to a basic function of perspective, which is to produce the illusion of being immersed in, or inside of, a 3-D space for the observer.

134. Impossible Perspective

Status: **NEW / REFINED TERM** | Dictionary page: 218

Refers to any perspective view/image of a spatial reality that incorporates partially or wholly unreal visual/ optical/geometric elements, or else is unreal in some other sense. Many different types and forms of impossible perspective views and images are known; including images/views depicted from impossible photographic or visual viewpoints, and/or images that depict objects and scenes that are not physically/ visually/optically/geometrically possible to achieve in reality such as juxtaposed objects, differently scaled objects, impossible viewpoints, distorted and twisted image shapes, and false horizons, etc. High-speed and time-lapse imaging are physically possible, even when the events cannot be perceived unaided. Often, the methods of computer graphic images (CGI) and/or digital special effects can produce (otherwise) impossible perspective views/images (at least in an image capture sense at that location); such as when using an LED wall for digital film production. Impossible Perspective refers to any perspective view/image of a spatial scene that adopts: • An impossible to reach/attain viewpoint for observing a scene. • A distorted, or incorrectly projected, image of a scene • An object or scene that is comprised of apparently 'impossible', false, illusive, or highly unusual spatial structures, such as anamorphic objects, forced perspectives, or synthetic perspectives. Applies also to blended or combined perspectives, or spatial structures that appear unified, but are in fact not.

135. Instrument Perspective

Status: **NEW / REFINED TERM** | Dictionary page: 222

Perspective produced, modified, measured or viewed through an instrument, including cameras, lenses, microscopes, telescopes, mirrors, projectors and surveying devices.

136. Instrument Space

Status: **NEW TERM** | Dictionary page: 222

Instrument space refers to an image or perspective space transformed from a physical or other reality into a reality defined by an instrument or by an image-capture, display or processing system.

137. Instruments (perspective)

Status: **NEW / REFINED TERM** | Dictionary page: 223

Instrument Perspective (views of natural and built worlds) concerns looking at, capturing, and measuring reality; and projecting appearance(s). Ergo we have at least 7 types of perspective instrument: • Image capture: lens, camera obscura, camera, telescope, perspective window, etc. • Measuring reality: sundial, quadrant, sector, sextant, computer, etc. • Modelling reality: globe, map, orrery, planisphere, astrolabe, computer, etc. • Representation: perspective windows, drawing frames and ray-tracing or ray-construction methods. • Representation: projection: magic lantern, film, and digital projector, television. • Illusion: cinema, spherical theatre, television, mirrors, VR/AR, etc. • Immersion: 3-D cinema, stereoscopic pictures, volume displays, VR/AR, etc.

138. Intermediate Perspective

Status: **NEW TERM** | Dictionary page: 224

Refers to a perspective projection that exists in the middle of an optical image chain from target space to final image spaces.

139. Intermediate Space

Status: **NEW TERM** | Dictionary page: 224

An intermediate representation of a perspective target space (named an intermediate spatial reality).

140. Intermediate Spatial Reality

Status: **NEW TERM** | Dictionary page: 224

In a composite perspective system, the three-dimensional target space is often a region of physical reality containing the objects or scene under investigation. This region forms the object or target space from which one or more intermediate images or representations may be produced. These intermediate representations form stages within the optical image chain and may be described as intermediate spatial realities. For example, a camera produces a two-dimensional instrument or image space representing the three-dimensional target space through a particular optical projection. Under an ideal projection model, the mapping from 3-D target space to 2-D image space is geometrically defined, although lenses, sensors, processing and display may introduce distortion, information loss or other perspective effects. When a person views the resulting photograph, the photograph remains an intermediate perspective image, while a further optical image is formed on the viewer's retinas, creating the final retinal-image stage of the chain.

141. Intrinsic Factors (1)

Status: **NEW TERM** | Dictionary page: 225

Refers to perspective phenomena (appearance facets within a perspective image) that relate to, or emanate from, a perspective method. Intrinsic appearance facets include: • Parallax • Retinal Disparity • Dissimilar Images • Binocular Image Combination • Depth, shape and size cues • Stereopsis • Monocular Transforms • Uniocular depth perception • Scale-dependent resolution • Monocular perspective • Perspective of disappearance • Motion parallax • Focus visual effects • Superposition

142. Invisible Worlds

Status: **NEW / REFINED TERM** | Dictionary page: 227

Humans miss an infinity of sights, related to an object's/scene's structure/composition, because forms are too small/large, too far, too dim, too fast, or hidden within opaque material(s); and we are normally unaware of electromagnetic radiation outside the visible spectrum. Today, through precise modern cameras attached to microscopes, telescopes, satellites, drones, strobe lights, radiation detectors, and computers, our conception of the world is undergoing a remarkable transformation. Modern perspective methods/systems/instruments allow us to move far beyond the limitations of natural vision. On all scales, from the submicroscopic to the cosmic, they expand our limited vision, revealing vanishingly faint images, invisible radiation, events imperceptibly swift or slow, remote realms of space, and landscapes/oceans we cannot capture unaided.

143. Levels of Abstraction

Status: **NEW / REFINED TERM** | Dictionary page: 241

Perspective is how we humans, internally and externally, 'spatialise' reality; whether overtly recognised or not. Technical perspective refers to the process/ results of probing a spatial reality to produce an accurate image or 'systematised' representation of said reality. Patently, and regardless of type, perspective is an abstraction of reality. Levels of abstraction systematically operate as a bridge between the concreteness of nature and abstractions of mathematics. Today new media systems have greatly expedited and improved such processes; whereby new kinds of perspective, systems, and related visual user interfaces, enable users to navigate all of the different layers of abstraction from ideas to physical objects in all their layers of magnification (and combination/abstraction). Modern perspective instruments/methods/systems let us move from universals to particulars, and explore wholes, parts, inside/outside, and relations few and many, scales big and small, etc. This can be seen as a continued development in the role of Renaissance or linear perspective which introduced an objective method for recording or copying the physical world at different levels of abstraction in photographs, cinema, engineering drawings, computer images, maps, etc.

144. Limits of Exactness in Perspective

Status: **NEW / REFINED TERM** | Dictionary page: 245

Any class of visual/optical/technical perspective, either of the natural, visual (2nd type) or artificial class, has certain limits in terms of the exactness of the results obtained by the method employed, which may also include certain limitations in any instruments (including the human eye) that are used to capture a perspective image or view. We have explained these under the monikers: the Shape/Form Sufficiency, the Scale / Shape / Form problem(s) of perspective, and diminution of form (1,2,3,4).

145. Looking At / In Perspective

Status: **NEW TERM** | Dictionary page: 251

Looking-in or looking-at perspective uses an eye/camera/representation to explore close-up/narrow-field perspective images of a spatial object/area; whereby the viewpoint (real or virtual viewpoint), angle-of-view, and field of view are all fixed for each image snapshot/frame/picture (aperture or oculus takes fixed snapshot). Next, it is possible to move around (or revolve around) the object, and so to explore the same from multiple viewpoints, viewing positions/directions. Ergo the latter form of 'revolving' looking-at/in perspective can be equated with circle/cylinder of revolution perspective and sphere-of-revolution perspective.

146. Looking Out / Up / Around Perspective

Status: **NEW TERM** | Dictionary page: 252

Looking-out/around perspective uses an eye/camera/representation to explore distant, wide-angle, multi- angular, or multi-view images of a panoramic or complete spherical spatial scene. Whereby the notional imager and/or coordinated imager(s) are located at a fixed viewpoint location, but can take multi-view images (either simultaneously or in sequence) and across all possible viewing directions, thus all angles-of-view are sampled from this fixed location, resulting in a 360-degree field of view image for the entire optical scene. The result is a perspective system producing a complete circle/cylinder of vision or sphere-of-vision perspective.

147. Manifold Perspective

Status: **NEW TERM** | Dictionary page: 256

The invention of transparent plane windows, plane mirrors, etc., has enabled all kinds of reflection and transparency effects to be produced in perspective images, which just happen as we move about in the built environment. Whereby multiple images and/or optical overlays happen, in which several images can be seen along a single line-of-sight. There are many examples, such as when you see your own reflection in a shop window while simultaneously seeing the shop's interior, or when multiple reflected images form in an Infinity mirror setup.

148. Match (function of perspective)

Status: **NEW TERM** | Dictionary page: 258

One of the fundamental functions of perspective, whereby a method like linear perspective rationalises vision by prescribing, segmenting, ordering, indexing, gauging, and ultimately matching or measuring physical space against known measuring scales (shape/outline and size/ proportion).

149. Matching

Status: **NEW / REFINED TERM** | Dictionary page: 258

Matching means measuring or evaluating images/views in relation to known impressions experienced in our spatial environment. Related processes include obtaining size, shape or compositional measurements, or classifying, figuring, surveying, segmenting, comparing/identifying, mapping, matching, indexing/gauging, cross-matching, calculating, orienting/navigating and prescribing/certifying, plus establishing the measured facets of a 1-D/2-D/3-D image/view in relation to a spatial object/scene.

150. Mathematical Perspective (A)

Status: **NEW / REFINED TERM** | Dictionary page: 258

Perspective based on mathematical relations, geometry, measurements, coordinates, transformations or calculations used to analyse or represent spatial objects, scenes, views or images.

151. Mathematical Perspective (B)

Status: **NEW / REFINED TERM** | Dictionary page: 258

We have three kinds of mathematical perspective: • Algebraic Perspective [non-visual class]: involves the application of algebraic formulae. • Geometrical Perspective [analytical visual class]: employs graphical calculation. • Projection Perspective [projective visual class]: employs spatial projection. Algebraic perspective refers to mathematical images composed (solely) of letters and symbols. Accordingly, we have categorised this as symbolic perspective; hence, it is a non-visual class of perspective [discrete analysis]. Geometrical perspective employs analytic geometry, also called coordinate geometry, or the use of algebraic symbolism and methods to represent and solve spatial problems [continuous analysis]. Analytic geometry refers to spatial modelling using graphical points, lines, and multi-dimensional objects and shapes, surfaces, and solids. Ergo, due to the inherent links with analytical geometry, we have categorised geometrical perspective as a form of visual perspective (1st type). Another form of visual perspective (1st type) is projection perspective, which refers to applying projective principles to create an image or view of a spatial scene or object. This type employs either descriptive geometry (i.e. parallel perspective: plan, front-elevation, side-elevation views within a machine/technical drawing), or projective geometry (e.g. linear perspective), to produce images of spatial reality.

152. Mathematically Equivalent Perspective(s)

Status: **NEW / REFINED TERM** | Dictionary page: 259

Refers to the mathematical equivalence (or not) of different types/forms of optical perspective projection, or method/system and/or perspective image. Whereby if two methods are entirely equivalent in mathematical terms, such that given the right mathematical transformation algorithm/method, then one perspective image taken from a specific viewpoint (of a particular spatial object/scene) that has been output from a first method/ system can be counter or reverse-transformed (by using a particular algorithm) to produce an identical perspective image of the same spatial scene/object geometrically and visually identical to, as if it had been produced by the second method/system from the identical vantage or viewpoint. If we have perfect equivalence, then the output images from either method can be repeatedly transformed back and forth between the two methods without any image degradation (changes in geometrical form) occurring in any way whatsoever.

153. Mirror Ball Perspective (1, 2)

Status: **NEW / REFINED TERM** | Dictionary page: 271

1. Metal ball type Images or views formed by reflection from a metal ball or polished mirror ball, which tend to exhibit extreme perspective distortions similar to the geometry of spherical perspective images (often with 5 vanishing points seen from a single station point). A 360-degree scene is captured. 2. Disco / glitter ball type A disco ball (also known as a mirror ball or glitter ball) is a spherical object with a mirrored surface made of numerous facets that reflects light in various directions, creating complex lighting displays.

154. Mixed Perspective

Status: **NEW / REFINED TERM** | Dictionary page: 272

A combination of image and projection perspective types, in particular a physical interaction between them, includes a cinema projector, hologram and a Virtual Reality system, in which a projector produces an image in the real world environment. Technical Note: In the Viewing or Imaging Class, light or visual information passes from a physical reality towards an eye, sensor or picture plane, where a perspective image is formed. This is an example of imaging perspective. However, this same physical reality typically contains one or more light sources - of the natural and artificial types - which produce a variety of optical lighting and shading effects; whereby often visible light-beams and shadows are cast onto various spatial objects, surfaces, and structures within the environment: each being an example of <projection perspective>. Ergo, what at first you think of as an example of imaging perspective is comprised of, and contains, many examples of projection perspective!

155. Multi-Directional Perspective

Status: **NEW / REFINED TERM** | Dictionary page: 278

Multi-directional perspective is any perspective image/view in which the spatial scene is captured, projected, or viewed, from multiple optical lines-of-sight, aspects, angle(s)-of-vision, or viewing direction(s); whereby each view is taken from the same, or else a different station point, but is viewed along a different line-of-sight. The resultant multi-view perspective is (often) combined into a single image space and projected (for example) onto the internal or external surface of a sphere (sphere of vision - looking-around; or sphere of revolution - looking-at perspective), and so the main type is spherical perspective (sphere of vision or sphere of revolution). Another type of unlimited viewpoint perspective is Virtual Reality, in which the user is free to adopt any station point and viewing angle whatsoever within the image space. Several types of multi-directional perspective are possible, including viewpoints separated in time or combined motion viewpoints, as in Cinema or a CAD system. It is also important to realise that we can classify multi-directional and multi-view perspectives into two types: first, multi-view perspectives of the overall scene or a perspective panorama; and second, multi-view perspectives of individual objects within the scene (see multi-view types A and B).

156. Multi-View Perspective (1, 2, 3, 4)

Status: **NEW / REFINED TERM** | Dictionary page: 281

1. Single scene perspective Refers to a perspective image (or image(s)) that provides for a changing viewpoint in which new scene details become visible as the aspect changes. Normally CAD/Computer-Games inherently provide multi-view snapshot or else moving viewpoint images. Normally we think of an image as taken from a single point and angle of view. A classic example is a mobile movie camera filming from different viewpoints. 2. Multiple object perspectives Refers to a perspective scene (or single perspective image) that contains multiple objects, each object being (often randomly) arranged within its own reference space, which is projected at a slightly different angular direction (for example laterally or vertically from the line-of-sight depending upon object position within the overall space), whereby each object is viewed from a slightly different aspect, relative to its neighbours. Ergo one overall perspective of a scene can contain virtually unlimited numbers of component perspectives for multiple contained objects! 3. Orthographic multi-view: first/third angle projection Refers to an orthographic multi-view perspective of the first or third-angle type. Within such a system, the primary types of multi-views are: plan view, elevation view, sectional view, auxiliary view, and inclined view. 4. New Media perspective system providing linked/explorable multi-views Refers to a New Media and/or hypermedia perspective system that provides linkage and interactive exploration of a physical/digital world containing nearly countless images/views taken/observed/projected from a (nearly) unlimited number of individual viewpoints. Navigation, way-finding, scales/metres, throttles, and contextualising instruments etc., plus multi-scale and multi-time perspective may also be provided. An example of such a system is Google Maps.

157. Natural Perspective

Status: **NEW / REFINED TERM** | Dictionary page: 284

Perspective arising from the physical organisation and visible appearance of objects and scenes in natural space. It includes spatial recession, relative size, overlap, atmospheric effects, shadows and other naturally occurring relations that influence appearance.

158. New Media and Multi-View Perspective

Status: **NEW TERM** | Dictionary page: 286

Images/views of a spatial reality as created by a new media system, by connecting/linking, ordering, constructing, matching, mixing, exploring, and cross-matching: multiple images of a spatial reality.

159. New Media Perspective

Status: **NEW / REFINED TERM** | Dictionary page: 286

Perspective generated, processed, displayed or explored through computational and electronic media, including computer graphics, digital imaging, computer vision, artificial intelligence, virtual reality, augmented reality, mixed reality and interactive three-dimensional environments.

160. New Perspective (1, 2)

Status: **NEW / REFINED TERM** | Dictionary page: 286

1. Rejection of linear perspective principles Any type of artificial or graphical perspective projection or image/view of a spatial scene that rejects Renaissance or linear perspective. Often refers to non-linear and non-Euclidean perspective forms including curvilinear and spherical types, or even multi-view types such as cubist or David Hockney's photomontages. 2. New Media perspective system or related images/views Any new perspective image/view of a spatial scene captured, stored, linked, communicated, explored, or viewed on a digital new media system.

161. Non-Linear Perspective (1,2,3)

Status: **NEW / REFINED TERM** | Dictionary page: 287

1. Non-linear perspective - relates to light ray intensity/wavelength (gradients of colour, clarity, and apparent relief) Non-linear perspective imitates the effects of distance on the colour, clarity and apparent relief of spatial forms. In this first sense, the term does not identify one standard mathematical projection, although its component optical effects can be measured and modelled. Linear perspective, by contrast, concerns the geometrical projection of lines and outlines, including gradients of diminution of size and degradation of form. This first definition covers artificial or graphical methods that model the effects of distance on colour, clarity and apparent relief. It should not be taken to mean that nonlinear projections generally lack mathematical definition: curvilinear, cylindrical, spherical and other nonlinear projection systems may be rigorously quantified. Non-Linear Perspective (continued) 2. Non-linear object space (natural or artificial target space) Any perspective image or view of a spatial scene in which the relevant object forms or paths are curved rather than straight. This may occur in ordinary Euclidean space; the absence of visible straight lines does not by itself make the object space non-Euclidean. 3. Non-linear image space (natural or artificial perspective category) Any perspective image/view of a spatial scene in which straight lines in object space are projected as non-straight lines, or curved lines, in image space. For example, curvilinear, cylindrical and spherical perspective and related methods/ image-spaces, etc.

162. Non-Technical Perspective

Status: **NEW / REFINED TERM** | Dictionary page: 288

Non-technical perspective is any non-systematic process producing a visual image, view, representation or model, of a 3-D object or scene. Non-technical perspective is formed using optically, mathematically, geometrically, or logically incorrect/unknown/ inconsistent principles (including by processes such as drawing, painting, etc).

163. Object Perspective (1, 2)

Status: **NEW / REFINED TERM** | Dictionary page: 290

1. External Aspect (sphere of revolution) Refers to a perspective image/view of a spatial object as taken from an external aspect or particular viewpoint and a unique viewing direction. It may imply viewing an object from a standard distance, at a particular magnification or scale, and in a specified viewing direction (ref. central perspective projection or possibly first- angle projection, etc). 2. Internal Aspect (sphere of vision) Refers to an object-specific aspect of a spatial scene, or how the world appears from an object-specific point of view (an observer, real or imaged, looks at the world from the object's unique 'perspective'). Patently inanimate objects cannot look around, but even so, it is possible to adopt such a viewpoint, and indeed this would seem to be the whole basis of physics, mechanics, engineering, etc., whereby we employ imaginary perspective(s) to understand physical matters.

164. Object Space

Status: **NEW / REFINED TERM** | Dictionary page: 291

The physical, artificial, simulated or imagined space containing the object, scene or spatial information to be viewed, measured or represented. Also called target space.

165. Occlusion Principle

Status: **NEW / REFINED TERM** | Dictionary page: 294

The occlusion principle of perspective refers to the fact that, to visualise a region of 'transparent' 3-D space, there must be some kind of spatial framework or metric grid, and in which regions of the space serve the purpose of occluding or blocking light or projection rays from reaching infinity, whereby the outer boundaries or edges of objects are visible and available for perspective distortions. The occlusion principle is embodied in lines and planes of various geometrical structures, angles, and layouts, etc, and this leads to the framing functions of the occlusion principles, which enable the principles of perspective projection, including various perspective phenomena, such as aspect, diminution of size, foreshortening, vanishing points, etc, to become visible. Opposite of the opening principle of perspective.

166. Ontology of Perspective

Status: **NEW / REFINED TERM** | Dictionary page: 297

At the Perspective Research Centre, we are developing a comprehensive ontology of perspective to accurately reflect all known classes/branches of the subject discipline of visual/optical/technical perspective. A primary goal is to produce a detailed taxonomic breakdown of the field of visual/optical perspective, including identification of all branches/sub-branches, and thus to define all perspective types including the various perspective systems, visual forms, and associated optical phenomena relating to perspective images, and to identify/map related perspective principles, methods, functions, calculations, measurements, instruments, etc. We wish to use the desired ontology to develop a fundamental, widely applicable theory of visual/optical perspective and to answer questions such as: how does a visual image, such as a linear perspective image, arise? What are its key features? What are the sub-types? How does linear perspective differ from the curvilinear or spherical types? Which perspective processes/methods give rise to which visual forms and perspective phenomena within a perspective image, and when/ how/why? To some people perspective is a relatively straightforward visual phenomenon, and indeed this may be true if one limits the subject to linear perspective drawings (for example). However, in truth, the field of optical perspective encompasses a vast array of complex visual methods/phenomena, as evidenced by the over 1200 perspective types listed in this Dictionary of

Perspective. Accordingly, it is desired to develop a comprehensive class hierarchy for the subject of optical perspective, along with related concepts, processes, and associated terms, to define an ontology for the subject as a whole.

167. Optical Artificial Intelligence (2: Imaging Technology)

Status: **NEW / REFINED TERM** | Dictionary page: 298

A second type of Optical AI refers to the application of AI to advanced imaging capabilities, used for: • Generation of Video and Synthetic 3-D/Visual Training Data for Robots/Cars Use of AI to generate Synthetic Training Data sets for advanced cars and robotic systems: to train neural nets we need visual and physical models for long-tail examination of robotic and autonomous vehicle edge cases: whereby millions of simulated worlds are created to train robotic systems, for example to develop a robot's ability to "predict the future", for example when a person moving in an odd way jumps from behind a bus when a car overtakes, or a cat jumping on a child who in turn jumps into the street, etc. There are millions of these edge cases, and the robots need to be able to visually recognise these and react appropriately. • Generation of Video and Moving Images - Full Movie Generation (super-realism). • Generation of Real-time Interactive VR worlds - for full immersion. • Analysis of the Visual/Physical World and Providing Human Assistance - AR glasses etc. • Aid Scientific Geometrical Analysis on all Physical Scales (cosmic / macro / micro).

168. Optical Facet

Status: **NEW / REFINED TERM** | Dictionary page: 298

In compositional terms, each category of perspective exhibits certain perspective facets; defined as: • Optical Assembly: perspective method(s)/system(s) and scene structure(s), perspective direction, lighting, etc. • Projection Mode: frame/aperture, field of view, image scale/resolution, shutter-speed, frame-rate, etc. • Observation Mode: camera observation scenario such as sphere of revolution, sphere of vision, planned setup(s), etc. • Image Facets: image elements such as image form, optical image form, etc; leading to perspective phenomena. A perspective image form (or geometric image form) refers to the overall (apparently transformed) geometry of a perspective image/view; including (for example) the number and position of any vanishing points, horizon lines, etc A perspective optical image form refers to the overall (possibly transformed) light ray intensity/wavelength detected features or colour/contrast facets of a perspective image/view.

169. Optical Perspective (1)

Status: **NEW / REFINED TERM** | Dictionary page: 300

Perspective formed through light or other electromagnetic radiation, including direct optical views and images produced through reflection, refraction, focusing, transmission or projection.

170. Optical Space

Status: **NEW / REFINED TERM** | Dictionary page: 301

The term optical space (natural perspective sense or optical world) is considered as the opposite of the graphical space or artificial perspective, whereby in this sense optical space obeys, and is limited by the rules of optics as opposed to the rules of graphical projection.

171. Optical World

Status: **NEW / REFINED TERM** | Dictionary page: 305

Ernst Gombrich referred to visual space (1:B) as the optical world, or the mirror, being the geometrical space of physical space/world, and being the target space or object space that is projected by a particular perspective method such as linear perspective. He also referred to the optical world as the experienced world or the map. Synonyms: optical world, physical space/world, mirror, target or object space, geometrical space, experienced world, map. Antonyms: visual space (1:A), visual field.

172. Panoramic Perspective (1, 2, 3, 4) - Observing

Status: **NEW / REFINED TERM** | Dictionary page: 311

We can define four ways to observe a panorama as follows: 1. Natural View Panoramic Perspective (direct wide-angle view of an expansive scene) A wide-angle perspective view of a spatial scene (e.g. natural scene and visual perspective (2nd type). 2. Internal View Panoramic Perspective (image on a large-format circular/spherical screen) The representation of objects upon the walls of a rotundo, or circular building, or else circular/spherical screen, and the spectator either sitting or standing at the centre of the screen, or else moving around the centre of the same. We have two kinds of internal view panoramas: A) Multi-angular view of uni-angular image of spatial scene/object The term "3-D" is used for a volumetric display that shows uni-angular images of a spatial scene taken from multiple viewing angles (camera changes direction of observation), whereupon the images taken from different angles have been 'stitched together', and are notionally viewed in a 3-D space, but without experiencing true observer-based angular perspective changes. Only (uni-angular) perspective depth cues are available (from observer perspective). Example: multiple flat or 2-D images viewed/projected onto a circular screen and viewed internally. Many projection systems have been used to produce panoramas from wide-screen cinema formats such as CircleVision, IMAX and the Sphere theatre in Las Vegas. Panoramic Perspective (continued) B) Multi-angular view of multi-angular image of spatial scene/object: The term "3-D" is also used for a volumetric display that generates content viewed from multiple angles, i.e. multi-angular images captured/ generated by/for viewing a spatial scene from multiple viewing angles, whereupon the onlooker (may) experience true observer/camera-based multi-angular perspective depth cues (on a directional screen canvas). Example: spatial or 3-D images/views that are projected onto a circular screen that creates an apparent 3-D space, and said views are (apparently) presented/viewed from multiple or changing viewpoints (or viewing angles) depending upon observer/camera position and viewing angle. One example is an LED volume screen used in a virtual production system, allowing in-camera visual effects, realistic lighting and reflections on actors, and enabling immediate, camera-synced perspective shifts (phenomena). 3. External View Panoramic Perspective (image projected onto the external surface of a sphere) One example is a terrestrial globe of Earth that allows the user to rotate the view. 4. Flat View Panoramic Perspective (spherical / cylindrical / curvilinear perspective) Any wide-angle perspective image, of any type, displayed on a flat picture plane.

173. Panoramic Perspective (A, B, C, D) - Capturing

Status: **NEW / REFINED TERM** | Dictionary page: 312

We can define four ways of capturing a panoramic perspective view/image: A. Fixed Viewpoint or single 'Snapshot' Panorama (fixed viewpoint): A wide-angle snapshot of 3-D object space is taken from a fixed position and viewing angle, with the eye/ camera existing within a visual sphere/cylinder of potential viewing directions. Uni-angular, monocular representation of a spatial scene/object A 2-D/3-D image/view of a spatial scene/object captured from a single viewpoint or viewing angle. A 2-D linear perspective image of a spatial scene/object projected onto a 2-D surface or picture plane is one example, captured from a fixed viewing angle.

174. Parallax (A)

Status: **NEW / REFINED TERM** | Dictionary page: 315

Parallax is the apparent displacement or shift in position of an object when viewed from two different, non- aligned lines of sight. It is a foundational method for calculating distances, particularly in astronomy and computer vision. Key aspects of parallax include: • Distance Measurement (Stellar/Astronomy): Nearby objects have a larger parallax (shift) than distant ones. Astronomers use this to determine the distance to stars by observing them from opposite sides of Earth's orbit (annual parallax). • Depth Perception (Stereopsis): Human eyes use parallax to perceive depth, as each eye views objects from slightly different angles. • Motion Parallax: Objects closer to an observer appear to move faster than distant objects when the observer is in motion. • Parallax Error in Measurement: In instruments, this error occurs when a pointer and scale are not in the same plane, causing a different reading based on the viewing angle (e.g., in a car speedometer or analogue gauge). • Visual Effects: Used in computer graphics and web design to create an illusion of depth by scrolling background layers at different speeds. • Imaging & Technology: Used in camera viewfinders, microscopes, and to correct image stitching in photography. Astronomical Calculation The distance to an astronomical object such as a star or planet can be calculated as the reciprocal of its parallax angle ($d = 1/p$), where d is the distance in parsecs and p is the angle in arc-seconds.

175. Parallax (B: 1, 2, 3, 4, 5)

Status: **NEW / REFINED TERM** | Dictionary page: 315

Parallax is the apparent shift in an object's position viewed from two angles, measured by the angle between those lines. Nearby objects show greater parallax than distant ones, allowing for depth or distance determination. • Stellar Parallax (1): Astronomical technique to measure the distance of the closest neighbour stars and objects that are sufficiently close that the Earth's orbit around the Sun allows for changes in viewing angle. Can be used for close stars. • Visual Parallax (2): A visual illusion that makes an object appear to change position when the observer's position changes. It occurs when an object's position or direction appears different from different vantage points. • Motion Parallax (3): Objects closer to an observer appear to move faster than distant objects when the observer is in motion. • Measurement Parallax (4): Pointer (projection axis) and scale not in the same plane. • Camera Multi-Image Parallax (5): Images taken from different points of view have different projection angles (relative to a linear object) and hence image sections project at different sizes. Misconception: Supposed Camera Parallax confused with Perspective Size/Aspect Diminution A supposed optical parallax effect that is claimed to occur for long straight objects located relatively close to the camera lens, or similarly shaped objects located in a straight line, located parallel to the image plane (approximately). Whereby sections further out to the side in the lateral direction are (supposedly) viewed from two different angles (on separate optical axes) and thus appear to change shape/size, and thus are differently scaled, shaped, or angled relative to their true shape, and one part/ object relative to another suffers a different degree of angular size aberration. But in fact, camera parallax does not occur in a single undistorted image, and because a typical camera lens works (largely) like a pinhole camera over a relatively narrow field of view (less than 90-degrees), according to the rules of single-optical-axis perspective projection. Parallax as normally defined involves two separate viewing directions; whereas any size reduction for a single camera image is due to a combination of size/ distance law (size diminution away from the viewpoint) and aspect foreshortening, or to a combined depth component size change (see depth components entry). Parallax (continued) Single-Image Fish-Eye Lens Camera Distortion: Curvilinear / Spherical Projection (FACT) It is possible that a single-image camera perspective can show distortions in the apparent size of different object/ scene regions due to projection angle, and when the angle of view is very large - say around 100-180 degrees - and as projected by a fish-eye type short focal length lens, resulting in a curvilinear perspective image distortion. In this case, large-scale curvilinear distortions in the image include optical image-shape distortion phenomena within a single image (varying scale across different image regions), although such effects may be non-linear and difficult to quantify in a simple equation. Likewise, wide-field images projected according to the rules of spherical perspective may show similar image distortions.

176. Perspective (double) 1, 2, 3)

Status: **NEW / REFINED TERM** | Dictionary page: 332

Double Perspective: Synonym for Double Perspective (1): Combined perspective illusion.

177. Perspective Category (B) - Principal Categories

Status: **NEW / REFINED TERM** | Dictionary page: 336

A perspective category identifies the principal source or mode of a perspective process: the means by which an object, scene, image or view is observed, formed, calculated, constructed, projected, simulated or represented. The principal categories are Natural, Visual, Optical, Mathematical, Graphical, Instrument, Simulated and New Media Perspective. A process or image may belong to more than one category.

178. Perspective Category Theory

Status: **NEW / REFINED TERM** | Dictionary page: 337

A framework for organising perspective processes, systems, images, representations and phenomena by distinguishing perspective categories, directional classes, types and forms, and by relating these to perspective goals, methods, functions, processes and outcomes.

179. Perspective Category Theory — Categories and Classes

Status: **NEW / REFINED TERM** | Dictionary page: 337

Perspective categories identify the principal source or mode of a perspective process. Perspective classes identify one of the two principal directions in which that process operates.

180. Perspective Category Theory — Ambiguities of Definition

Status: **NEW / REFINED TERM** | Dictionary page: 337

Perspective terminology is frequently ambiguous because the same word may identify a method, process, system, instrument, function, image form, outcome or phenomenon. Conversely, one concept may possess several names. The catalogue therefore distinguishes: • category — the principal source or mode of a perspective process; • class — one of the two principal directions of the process: Viewing or Imaging, and Projecting; • type — a particular method, system, process or subdivision; • form — the visual, optical, geometrical or spatial appearance produced; Perspective Category Theory (continued) • function or goal — what the perspective process is intended to achieve, such as viewing, imaging, measuring, matching, representing, illusion or immersion; • outcome or product — the resulting image, view, representation, measurement, model or spatial appearance. Category chaining occurs when several categories operate sequentially. Category overloading occurs when one term, type, process or image legitimately belongs to more than one category. Composite perspective is the resulting multi-category process, system, image or environment.

181. Perspective Class

Status: **NEW / REFINED TERM** | Dictionary page: 339

A perspective class identifies one of the two principal directions in which a perspective process operates. The two basic classes are: • Viewing or Imaging Class — light, visual information or spatial data passes from an object, scene or existing image towards an eye, sensor, image plane or imaging system, where a view, image, measurement or representation is formed, captured, presented or perceived. • Projecting Class — light, images, shadows, lines or spatial information are projected from a source, eye point, projector, picture plane or representational system into physical, graphical, optical or simulated space. A system may employ either class separately or may combine both classes. A camera-projector system, for example, first captures an image and then projects or displays it. Representing, measuring, modelling, matching, creating illusion and producing immersion are functions, goals or outcomes rather than additional basic Perspective Classes.

182. Perspective Direction

Status: **NEW / REFINED TERM** | Dictionary page: 340

Perspective direction identifies whether a perspective process operates principally towards an eye, sensor or image-forming system, or forwards from a source or representational system into physical, graphical, optical or simulated space.

183. Perspective Form

Status: **NEW / REFINED TERM** | Dictionary page: 344

The visual, optical, geometrical or spatial appearance produced by a perspective process. It may involve changes in size, shape, position, orientation, line convergence, colour, clarity, contrast, curvature, compression, expansion, depth or immersion. Principal divisions are Perspective of Form, Gradient of Colour, Gradient of Acuity and Gradient of Chiaroscuro Perspective. Perspective Form (Optical) A perspective optical image form refers to the overall (possibly transformed) light-ray intensity/wavelength detected features or colour/contrast facets of a perspective image/view.

184. Perspective Framework

Status: **NEW / REFINED TERM** | Dictionary page: 345

Refers to regular object space physical or geometric structures and/or metric grids, sets of parallel and orthogonal lines, etc, or representations of the same. Useful interpretation/understanding or decoding of a perspective image, involves correctly interpreting image projected shape/size distortions. This is where a method such as linear perspective comes into its own; whereby (often) we employ known perspective framework structures, including known ground plane geometry, upright picture plane, plus parallel lines and/ or a metric grid, etc.; all helping humans to accurately decode the perspective image in geometric terms. Not every object space contains such structures, but many artistic/photographic linear perspective Images reflect spaces that do contain (at least partial) framework structures enabling us to readily quantify/decode the perspective image and realistically picture spatial reality. A standard example of a framework structure is a metric grid, where we employ chequered planes of known size/structure to segment, order, index, measure, and gauge physical/pictured space.

185. Perspective Function

Status: **NEW / REFINED TERM** | Dictionary page: 345

Perspective, in general, enables capturing, observing, prescribing, measuring, calculating, classifying, modelling, surveying, mapping, indexing, gauging, certifying, linking, mixing, exploring, displaying, and projecting perspective images of the physical world. These are the functions of perspective. According to the status and fulfilment of these various functions, the products of perspective are a detailed visual image, measurement, calculation, representation, model, or view, of a three-dimensional object or scene. Perspective Function (Combined)

186. Perspective Goal (1)

Status: **NEW / REFINED TERM** | Dictionary page: 346

The principal goals of perspective are viewing, imaging, projecting, measuring, matching, representing, creating illusion and producing immersion. A single system may pursue several goals.

187. Perspective Image (A)

Status: **NEW / REFINED TERM** | Dictionary page: 347

Representation of a spatial object/scene in image-space (i.e. perspective image on the picture plane/surface). A visual representation of a spatial scene/object formed by a perspective method/system/instrument.

188. Perspective Image (B)

Status: **NEW / REFINED TERM** | Dictionary page: 347

A visual representation of a spatial scene/object formed by a perspective method/system/instrument, being a 1-D/2-D/3-D Image on picture surface S, in or on a medium of representation. Real / virtual Image. 1-D/2-D/3-D image. Related optical characteristics include viewpoint, view-angle, field of view, aspect-of-view, optical depth (varies), projection scale (varies with depth/field/angle of view), projection scale resolution (varies with depth/ field/angle of view), magnification factor, image facets (geometrical / optical phenomena).

189. Perspective Image (Captured)

Status: **NEW / REFINED TERM** | Dictionary page: 347

A captured perspective image refers to the formation of 'optical' images 'backwards' from a spatial reality onto an image or picture plane, or that result from generation of a perspective representation of the visual appearance of a spatial object/scene (ref. viewpoint geometries). Captured perspective images include perspective drawings, paintings, computer graphics, and images formed by optical instruments such as eyes, lenses, cameras, telescopes, etc. Such images include also certain kinds of simulated, mathematical, non-real or purely modelled images, such as those produced by mathematical modelling and computer ray-tracing images, etc. The key point being that a captured perspective image is a 2-D or 3-D representation of a 3-D spatial reality produced according to the rules of one or multiple kinds of visual/optical/technical perspective.

190. Perspective Image (Projected)

Status: **NEW / REFINED TERM** | Dictionary page: 347

A projected perspective image is the projection of an image/light-beam/pencil/shadow 'forwards' into a 3-D spatial reality (image is overlaid onto spatial scene/ objects)—and in such a manner that the same reality is altered in a visually apparent way. Examples include images formed by Virtual/Augmented/Mixed Reality, holograms, cinema projectors, light beams, and shadows cast by lights, candles, the sun, etc.

191. Perspective Image Facet (1, 2)

Status: **NEW / REFINED TERM** | Dictionary page: 347

Perspective Image Facet (Type 1: GEOMETRY: transformed image in geometrical terms) [geometrical facet = light-ray direction or geometrical-based measurements] A perspective image facet (geometrical class) refers to the overall (apparently transformed) geometry of a perspective image/view; including (for example) the number and position of any vanishing points, horizon lines, etc. Example types include linear, curvilinear, and spherical perspective. Sometimes a perspective type/ name appears to be both a category and an image facet at the same time. But why is this so? The answer is that (for example) linear perspective is a name that applies to both a perspective category (a method/process) and a perspective facet (output image geometry/optics) simultaneously. This may seem a little confusing, but if we consider that the optical perspective is defined as an image-making process, it becomes clear that we can refer to either the process or the outcome as required.

192. Perspective Imager / Ray Sorter (Perspective System)

Status: **NEW / REFINED TERM** | Dictionary page: 348

A perspective system is a unit of perspective image-making capability, and is often a combination of one or more perspective categories (or systems) working across the image chain to capture/produce/record/display an image of a spatial object or scene existing in a spatial reality. In the case of physical reality, at least one of these perspective systems (normally the first in the chain) has the job of being an imager or ray-sorter for the visual scene, or, in a spatial reality, as a sharp image-former of the target reality. Whereby the imager operates like a pinhole camera, in a sense, sorting each ray that diverges from each object point and focusing only rays from that particular point to a corresponding image point in the image plane. In the normal physical environment, light rays bounce in every direction, and ray sorting is required to form a sharp image; this is the job of the lens in the human eye or a camera.

193. Perspective Method

Status: **NEW / REFINED TERM** | Dictionary page: 353

A perspective method is a repeatable procedure for viewing, forming, capturing, calculating, constructing, projecting, measuring, transferring, checking or representing a perspective image, view or spatial appearance. A method should be distinguished from a perspective category, class, type and form. A category identifies the principal source or mode of the process; a class identifies its principal direction; a type identifies a particular system or subdivision; and a form is the visual, optical, geometrical or spatial appearance produced. A perspective method describes how an operation is carried out. Perspective methods may operate within either of the two basic directional classes: • Viewing or Imaging Class — light, visual information or spatial data passes from an object, scene or existing image towards an eye, sensor, image plane or imaging system. • Projecting Class — light, lines, images, shadows or spatial information are projected from a source, station point, projector, picture plane or representational system into physical, graphical, optical or simulated space. Some methods combine or chain both directions. Representing, measuring, matching, modelling, creating illusion and producing immersion are functions, goals or outcomes rather than additional basic classes. One-point, two-point and three-point perspective identify geometrical configurations or types of central projection. They are not, by themselves, complete drawing methods. Different construction methods may be used to produce any one of these configurations.

194. Perspective Model (B)

Status: **NEW / REFINED TERM** | Dictionary page: 360

A graphical/mathematical model (or a three-dimensional representation) of a visual/optical/technical perspective system for viewing, matching, representing, or creating the illusion of, or immersion into, a spatial reality. See book: Linear Perspective by Willy A. Bartschi.

195. Perspective of Form

Status: **NEW / REFINED TERM** | Dictionary page: 362

Changes in the apparent geometry, outline, size, shape, position or orientation of objects. It is a principal division of perspective form and should be distinguished from gradients of colour, acuity and chiaroscuro. Perspective of Forms (Appearance Transformations) The perspective of forms refers to the projected appearance (or outline) of geometric forms present in a spatial reality, and includes the perspective of points, lines, planes, solids, etc. Whereby the apparent shape of an object/scene is defined/captured in geometrical terms, relating to appearance transformations/distortions tied to a particular category/form of perspective. Relates also to perspective phenomena such as aspect of form, diminution of size, diminution of form, degradation of form/proportion, plus formation of vanishing points, and a horizon line, etc. N.B. Perspective of Forms has a different meaning from Perspective Form (geometrical or optical) that refers to the overall (apparently transformed) geometry (e.g. linear or parallel perspective, etc) or optical facets of a perspective image/view. See: Perspective Form (Geometrical) and Perspective Form (Optical).

196. Perspective of Lateral Distortion (1–5)

Status: **NEW / REFINED TERM** | Dictionary page: 362

Perspective of lateral distortion is a collective term used in this dictionary for changes in the apparent or projected size, shape and proportion of objects situated away from the central axis of a view or image. The word distortion is used descriptively. Some lateral changes are exact consequences of a particular projection; some result from viewing the finished image from an unintended position; some arise from camera position or orientation; and others are optical lens aberrations. Although called lateral distortion, comparable effects may occur above, below or diagonally away from the image centre. Marginal or peripheral distortion is therefore a broader alternative term. The following five types should be distinguished.

197. Perspective of Lateral Distortion (1): Visual Lateral Diminution

Status: **NEW / REFINED TERM** | Dictionary page: 363

With the eye and head fixed, equal objects progressively farther from the central visual axis may occupy a reduced angular or retinal image extent and undergo shape change. Visual Lateral Distortion has three conjoined components: Type A — Angular or Curved-Retinal Mapping: the eye maps visual directions onto its curved retina without the increasing tangent-plane expansion of flat rectilinear projection. Type B — Egocentric-Distance Diminution: objects at the same perpendicular depth but greater lateral distance are farther radially from the eye and subtend smaller visual angles. Type C — Orientation or Obliquity Foreshortening: lateral displacement makes an unchanged object increasingly oblique to the line of sight, producing additional directional foreshortening. Types B and C principally produce the diminution; Type A is the non-planar mapping through which their combined result is expressed. All three occur together and are separated only for analysis. Turning the eye or head establishes a new visual axis.

198. Perspective of Lateral Distortion (3): Graphical Lateral Distortion

Status: **NEW / REFINED TERM** | Dictionary page: 363

Graphical Lateral Distortion is the enlargement or skewing of forms towards the margins when a wide field is projected from a fixed centre onto one flat rectilinear plane. It is especially noticeable in: human heads and figures; • spheres and rounded objects; • objects close to the camera; • repeated forms across a wide field; • forms crossing the outer image boundaries. • Rectilinear projection converts angular direction into tangent-plane distance, so local planar scale per degree of visual angle increases towards the margins. Straight object lines remain straight, but rounded and volumetric forms may appear enlarged, elongated or asymmetric. This is an inherent effect of mathematically exact rectilinear projection, not necessarily a lens defect. Perspective of Lateral Distortion (3): Graphical Lateral Distortion (continued) Viewed monocularly from the prescribed centre and distance, the second projection from picture to eye geometrically restores the original ray directions. Under ordinary viewing conditions—incorrect distance or position, binocular viewing, eye movement or successive local fixation—this compensation may be perceptually incomplete. Curvilinear, cylindrical, spherical and multi-perspective projections redistribute the field differently and may reduce edge stretching, but generally curve some straight scene lines.

199. Perspective of Lateral Distortion (4): Camera Perspective and Optical Distortion

Status: **NEW / REFINED TERM** | Dictionary page: 364

Photographic lateral distortion may arise from different variables and should not be confused with Visual or Graphical Lateral Distortion. [1] Viewpoint or camera-position perspective The position of the camera determines the relative apparent sizes, overlaps and spatial relationships of objects in the scene. Moving the camera closer exaggerates differences between near and far objects. Moving it farther away reduces those differences. A short-focal-length lens does not by itself change perspective when the camera centre remains fixed. It records a wider field of view. However, photographers commonly move closer when using a wide-angle lens in order to fill the frame, and that movement changes the perspective. [2] Focal length and field of view For a fixed image or sensor format, a shorter focal length records a wider field and a longer focal length records a narrower field. If camera position remains unchanged, changing focal length chiefly changes image scale and framing. An image made with a longer focal length resembles a central crop and enlargement of an image made with a shorter focal length, apart from differences caused by lens behaviour, focus, resolution and depth of field. [3] Rectilinear edge stretching A rectilinear wide-angle lens projects a wide field onto a flat image plane while keeping straight object lines straight. Rounded objects and figures near the edges may consequently appear stretched. [4] Camera tilt and converging verticals When a camera is tilted upwards or downwards, the image plane is no longer parallel to vertical lines in the scene. Those verticals then converge towards a finite vanishing point. Converging building verticals are

therefore primarily caused by camera orientation, not by the wide-angle lens itself. A wider field merely makes the effect easier to include or more conspicuous. [5] Optical lens distortion Real lenses may introduce departures from the ideal central-projection model. • Barrel distortion causes straight lines to bow outwards. • Pincushion distortion causes straight lines to bend inwards. • Moustache or wave distortion combines more than one radial pattern. • Decentring or tangential distortion can arise when lens elements are imperfectly aligned. These are optical lens distortions and should be distinguished from geometrical perspective effects.

200. Perspective of Lateral Distortion (5): Control and Correction

Status: NEW / REFINED TERM | Dictionary page: 365

Visual and Graphical Lateral Distortion have different causes, so no single correction suits every case.. Viewpoint and composition • Move farther from the subject when excessive near–far size differences are unwanted. • Choose a narrower field of view where a very wide image is unnecessary. • Avoid placing important rounded objects or human figures close to the margins of a wide rectilinear image. Camera orientation • Keep the camera image plane parallel to the vertical lines of a building when parallel verticals are required. • Raise or shift the lens or camera rather than tilting the camera upwards. • Use a shift or perspective-control lens where appropriate. Correct viewing position • View a central-perspective image from, or near, its intended centre of projection and viewing distance. • A wide-angle image normally requires a relatively close viewing distance if its angular field is to correspond to the original camera view. Optical and digital lens correction • Use a calibrated lens profile to correct barrel, pincushion, moustache or tangential distortion. • Do not describe such correction as the removal of perspective itself; it corrects departures from the intended projection model. Digital perspective correction • Projective warping can correct converging verticals and other orientation effects, although cropping, resampling and changes of image proportion may result. • 3-D models, photogrammetry, depth maps, RADAR, LiDAR, digital elevation models, point clouds and 3-D Gaussian splatting can aid reconstruction or reprojection, but are unnecessary for ordinary correction.. Alternative wide-field projections • Cylindrical projection can reduce horizontal edge stretching while preserving vertical straightness. • Spherical and fish-eye projections can represent extremely wide fields but curve many straight lines. • Multi-perspective and computationally warped images can distribute distortion selectively across the image. No flat mapping can preserve straightness, uniform angular scale, local shape and an extremely wide field. Correction therefore means choosing the projection best suited to the intended view, measurement, representation or effect.

201. Perspective of Visual Acuity

Status: NEW / REFINED TERM | Dictionary page: 367

Visual acuity refers to the sharpness of a visual image. For any optical imaging instrument, visual acuity refers to the sharpness of the image(s)/view(s) captured by the instrument under a particular set of conditions (ref. Perspective of Visual Acuity (continued) image of physical reality). Instrument performance is measured at a specific field of view, aperture size, focal length, magnification, etc., whilst recording related image qualities (perspective phenomena) such as visual acuity or clarity of image over specific wavelength ranges and for a particular field of view, depth-of-field, etc. It turns out that aspect of perspective phenomena related to image sharpness do vary according to the nature of the optical instrument, its operating mode, and, in particular, the observation scenario, including magnification, lighting level, field of view, aperture, and, if available, the degree of focusing adjustment. A good example is the human eye, whose optical properties have been studied with great interest and found to be highly complex. In particular, the eye has certain optical features such as the ability to focus on a close- up region of object space, whereupon, depending on light level and resultant degree of pupil dilation, only objects located in a narrow region of spatial depth (or depth of field) will appear in focus or sharp with good acuity, whereas objects outside of said region will appear out of focus or blurred. Lower light levels tend to reduce the visual acuity of the eye because (the relatively greater proportion of) light rays that enter at the edge of the pupil are blurred or suffer optical aberrations, and hence the depth-of-field for the region of sharp images is reduced. A camera has a similar relationship between aperture size and reduced depth of field. The eye has many other aspects which affect visual acuity, such as binocular vision, which further reduces the depth-of-field object space region in which objects are sharply perceived. All of these (and other) optical effects are known as the perspective of acuity, a term first used by Leonardo da Vinci.

202. Perspective Phenomena (1, 2, 3)

Status: NEW / REFINED TERM | Dictionary page: 370

Perspective phenomena refer to all of the apparent and generalised changes to object/scene visual features that occur according to a particular type of perspective view, image projection or representation, and its inherent methods/processes.

203. Perspective Phenomena (human perception of)

Status: NEW / REFINED TERM | Dictionary page: 370

An individual perspective category/form demonstrates, and is recognised by, certain perspective phenomena. Perspective phenomena refer to the apparent, generalised changes in the visual features of objects and scenes that occur according to a particular type of perspective and its inherent processes. Hence, certain forms of graphical perspective can facilitate processes such as viewing, matching, and representation of, or illusion/immersion into, 3-D space on a flat or 2-D picture surface and by employing flat images that evoke specific perspective phenomena, or depth/ shape/size/position cues, including • Aspect of View: projection-angle / viewing-angle image warping. • Diminution of Size: remote objects are smaller. • Diminution of Form: remote objects are less distinct. • Degradation of Form: size/shape changes with aspect/distance. • Diminution of Colour/Contrast: Aerial Perspective. • Optical lighting, reflection and shadow effects: gradient of Chiaroscuro, etc. • 'Natural looking' vanishing points, horizon line [See: horizon line (types)]. • ++ other depth / size /shape cues, etc. It is important to note that not all forms of graphical perspective employ/exhibit every single type of perspective phenomenon. Parallel perspective (for example) uses only aspect of form or aspect foreshortening (type 1) but not diminution of size, perspectival foreshortening (type 2 or size/distance law foreshortening), horizon line, or vanishing points.

204. Perspective Phenomena: Form (geometry)

Status: **NEW / REFINED TERM** | Dictionary page: 370

A perspective form (geometrical) refers to the overall (apparently transformed) geometry of a perspective image/ view; including (for example) the number and position of any vanishing points, horizon lines, etc. Example forms include linear, curvilinear, and spherical perspective. Sometimes a perspective type appears to be both a category and form at the same time. But why is this so? The answer is that (for example) linear perspective is a name that applies to both a perspective category (a method/process) and a perspective form (image geometry) simultaneously. This may seem a little confusing, but if we consider that optical perspective is defined as an image- making process, then it becomes clear that we can refer either to the process and/or outcome as required. Our scheme clarifies the multiple and sometimes confusing usage of perspective terms. This is evident with linear perspective which has many variants/doppelgangers; firstly with different (process) categories including the graphical, photographic categories, etc., and secondly different (transformed image) perspective Forms such as one-point, two-point, three-point perspective, etc.

205. Perspective Principle

Status: **NEW / REFINED TERM** | Dictionary page: 372

A perspective principle is a theoretical imaging mechanism, comprised of real or modelled scene/object structures and picture plane/surface geometry, plus one or more <OPTICAL>, <MATHEMATICAL>, <GRAPHICAL>, <COMPUTER> principle(s), interoperable to produce a representation reflecting visual aspect(s) of a spatial reality. Perspective Principles (Operating Principles) According to Kim Veltman, linear perspective introduces, or has the potential to introduce, certain operating principles into a view/image or representation, including the Transparency Principle, the Reversibility Principle, and the Opening and Closing Principles.

206. Perspective Process (Contact)

Status: **NEW / REFINED TERM** | Dictionary page: 374

Visual Perspective Type 1 encompasses visible appearances, views and images used to view, match or represent spatial objects and scenes, or to create illusion or immersion. A contact process is a type of visual perspective process that results from a contact perspective in which the spatial object/scene is surveyed using direct physical contact or material sensing methods.

207. Perspective Process (natural and artificial types)

Status: **NEW / REFINED TERM** | Dictionary page: 374

A perspective process is any process through which a spatial object, scene, image or view in object or target space is viewed, imaged, projected, measured, transformed or represented, producing an image, view or spatial appearance in image or perspective space. Perspective processes may be natural or artificial. Natural processes arise from spatial relations and naturally occurring optical or visual conditions. Artificial processes involve deliberately constructed, calculated, captured, projected, simulated or represented images, using mathematical, graphical, optical, instrument or New Media methods. These are categories or modes of operation, not additional perspective classes. The two basic directional classes are the Viewing or Imaging Class and the Projecting Class.

208. Perspective Process (Optical)

Status: **NEW / REFINED TERM** | Dictionary page: 374

An optical perspective process uses, or purports to use, light or other electromagnetic radiation to form, capture, present or project views and images of spatial objects and scenes. In the Viewing or Imaging Class, light or visual information passes from an object, scene or existing image towards an eye, sensor, image plane or imaging system, where a view or image is formed, captured, presented or perceived. In the Projecting Class, light, images, shadows or beams are projected forwards from a source or system into physical, optical, graphical or simulated space. Such processes may use real, imagined or simulated rays and may involve any wavelength, including gamma rays, X-rays, visible light, microwaves or radio waves. Illusion and immersion are functions, goals or outcomes of these processes, not additional basic classes.

209. Perspective Process

Status: **NEW / REFINED TERM** | Dictionary page: 374

The operation through which principles or methods form, capture, calculate, project, represent, simulate, display or interpret a view, image or spatial relation.

210. Perspective Product

Status: **NEW / REFINED TERM** | Dictionary page: 374

Technical perspective falls under the heading of optical perspective, and is any optical process that forms a detailed visual image, measurement, representation, model, or view, of a 3-D object or scene (ostensibly). These outcomes relate to the products of perspective; or attaining subsumptive data (whole/part), ordinal data (figure/ size/scale/ position) and/or determinative data (state/ activity) from a perspective image and in relation to a spatial reality.

211. Perspective Projection (1,2)

Status: **NEW / REFINED TERM** | Dictionary page: 374

Optical perspective is a process that produces visual images of a spatial reality; and we have two basic classes of perspective image (or perspective directions); namely: • Captured Image — Viewing or Imaging Class: Perspective direction: backward or image-forming direction [see Captured Perspective Image definition below]: Image of spatial reality projected backwards onto picture plane; perspective image made using an eye/camera (for example). • Projected Image — Projecting Class: Perspective direction: projection forwards: Projection of image forwards onto spatial reality: perspective image projected onto cinema screen (for example).

212. Perspective Projection Mode

Status: **NEW / REFINED TERM** | Dictionary page: 375

A perspective projection mode is the specific form of projection produced by a perspective system/method/ process. We have seven basic projection modes: central, parallel, spherical, anamorphic, line-of-sight, and non-standard. Whereby, for the central class, we have linear one-point, linear two-point, linear three-point, linear unlimited-point, cylindrical, and curvilinear. And for the parallel type, we have orthographic (multi-view with first- and third-angle projections) and axonometric (isometric, dimetric, and trimetric) classes, plus oblique (cavalier, cabinet, and military) classes.

213. Perspective Room

Status: **NEW / REFINED TERM** | Dictionary page: 376

A room that employs simulated and/or possibly synthetic perspective images to create perspective views that are in one way or another different in appearance from that of a natural room of the same apparent size/ shape. A modern example is University College London's Virtual Reality CAVE (Cave Automatic Virtual Environment), a high-resolution, head-tracked projection system in the Immersive Displays Lab at the Faculty of Engineering. Within this VR environment, no headset is necessary, and the observer enters a room that projects perspective-corrected images to simulate a false 3-D environment. The facility features a 3-walled rear-projection system with floor projection, enabling collaborative, HMD-free, immersive virtual experiences used for research in computer science, human interaction, and cognitive psychology.

214. Perspective Scale

Status: **NEW / REFINED TERM** | Dictionary page: 377

Projection-scale is a factor that is inherent to a perspective image, being the optical magnification employed. For example, an object of 10m in size (object space units) is mapped to 10cm in image space (image space units), thus with a one percent magnification factor. Accordingly, a graduated scale (or projection/image scale) can be shown on the image to indicate true dimensions (e.g. 1:100 scale). See also: diminution of size perspective.

215. Perspective Scale Resolution

Status: **NEW / REFINED TERM** | Dictionary page: 377

Projection scale resolution is the smallest level of structural detail—or size interval (in object space units)—discernible within a perspective image. Using an increased projection scale, may result in new structural details becoming visible, which relate to the improved projection scale resolution (within limits of the method). See also: diminution of form perspective (Types 1, 2).

216. Perspective Space (B): 1

Status: **NEW / REFINED TERM** | Dictionary page: 378

Synonym for image space: the space in which a resulting image, view, model or representation is formed, located or perceived, whether optical, visual, graphical, mathematical, instrument-generated or digital.

217. Perspective Space (B): 2 Transformation Sense

Status: **NEW / REFINED TERM** | Dictionary page: 378

The transformed spatial appearance produced when a perspective process relates object or target space to image or perspective space. Some properties may be preserved while others are reduced, concealed, compressed or distorted.

218. Perspective Space (Target)

Status: **NEW / REFINED TERM** | Dictionary page: 378

See: Object Space; Target Space. Object or target space is distinct from image or perspective space, although one system's image space may become another system's target space in a chained process.

219. Perspective Structure (1, 2)

Status: **NEW / REFINED TERM** | Dictionary page: 379

1: A perspective image or representation of a spatial object/scene structure. 2: Synonym for a perspective framework in object space (e.g. a metric grid).

220. Perspective System

Status: **NEW / REFINED TERM** | Dictionary page: 379

An organised arrangement of components and processes operating as a unit to view, form, capture, project, measure, represent, simulate, display or interpret spatial information. A system may involve one or more categories and functional classes and may form one stage within a longer image chain.

221. Perspective Target (1)

Status: **NEW / REFINED TERM** | Dictionary page: 380

Refers to a 3-D scene and/or 1-D/2-D/3-D object in a target spatial reality, or a physical, mathematical, artificial, or imaginary scene/object. Facets include absolute spatial size (scene/objects), spatial form (shape) and structure (form within form), and also location, orientation, texture, plus lighting/shadows.

222. Perspective Target (2)

Status: **NEW / REFINED TERM** | Dictionary page: 380

Considered in relation to a perspective process or method, a perspective target refers to either a spatial object/scene in object space; or alternatively refers to the target or object space itself.

223. Perspective Type

Status: **NEW / REFINED TERM** | Dictionary page: 381

A particular method, system, process or subdivision within one or more perspective categories. A type may be defined by its geometry, optical behaviour, viewpoint structure, image surface, instrument, medium, spatial effect or use. Examples include linear, aerial, spherical, reverse, stereoscopic, panoramic, anamorphic and forced perspective.

224. Perspective View (1, 2, 3)

Status: **NEW / REFINED TERM** | Dictionary page: 382

Type 1: Natural perspective view Live or real-time optical view (made by a camera, optical device, or as projected onto the retina within the eye) of a spatial object/scene in object space, and as projected into image/perspective space (i.e. fixed/stationary perspective image). Type 2: Perspective representation The art and science of representing on a plane surface the appearance of spatial objects according to optical and mathematical principles. Often refers to a linear perspective image made (in principle) by standing before a closed window whereby you trace on the glass the outline of an object beyond, whereby, looking through it, you sketch on the glass a true picture or perspective view of that object. The glass when drawn upon is known as the picture plane, and it is normally chosen to be at right angles or perpendicular to the ground plane upon which the artist stands. Whereby perspective is the intersection of the so-called pyramid of sight (or light), by a transparent window. Type 3: Vue d'optique print, drawing, etching, or constructed graphical picture A print, drawing, painting, etching, or graphical perspective construction made for enhancing the sense of depth, producing a sense of a deep, high vantage point, or far distant view, and/or in a panoramic sense, typically with extensive graphical projection perspective or enhanced perspective phenomena such as aerial perspective, and called a vue d'optique or "perspective view". See also: zograscope.

225. Perspective View (primary)

Status: **NEW / REFINED TERM** | Dictionary page: 382

Refers to the natural or primary perspective view (or live / real-time view) created by visual perspective (second type) or by instrument perspective (camera), and whilst directly viewing spatial reality (ref. physical reality). See: projector (actual).

226. Perspective View / Image - Concept of

Status: **NEW / REFINED TERM** | Dictionary page: 383

Perspective View / Image - Concept of. Perspective works because the vast majority of objects have their prototypes as geometric solids - the cube, prism, pyramid, cylinder etc, and all solids are (or can be) bounded by plane surfaces, plus all surfaces are limited by lines, and hence all demonstrations of the theory of perspective, use the outlines of said object forms as the basis of the accurate depiction in a 2-D space of such objects forms in a 3-D space (linear perspective example). See: Perspective View (Types: 1, 2)

227. Perspective, not categorised (1, 2)

Status: **NEW / REFINED TERM** | Dictionary page: 384

1: Natural perspective image: refers to an environmental or visual perspective image/view. Optics/geometry of natural spatial scene, without attempts to detect and categorise operating perspective phenomena (but fails to identify and/or measure the same). 2: Artificial perspective image: refers to creation of an artistic image without using overt/strict or known perspective method or principles. Artistic perspective image that is not easily categorised; for example, cubist and/or futurist artworks or the photomontage work of artist David Hockney.

228. Physical Perspective (A, B)

Status: **NEW / REFINED TERM** | Dictionary page: 388

A: Physical perspective: Fixed or rigid-sized / rigid-shaped objects Patently, physical objects, or non-symmetrical polygons, appear to project different apparent forms/shapes depending upon viewpoint, viewing angle, etc. Indeed, this is what a visual or optical perspective is: an optical projection of a fixed shape and (presumably) fixed-scale spatial structure. Said structure may move in three dimensions, but we assume that translation does not change size, or, if it were to change size in one or more dimensions, its shape would change accordingly. B: Physical perspective: Multi-Size but fixed-shaped objects Physical or multi-size/fixed-shape perspective, however, refers to a physical object or scene, basically a polygon (or group of polygons), that can be expanded or contracted without changing its external shape or geometrical form, which remains identical, only becoming larger or smaller in physical size. One example is a Hoberman sphere. Patently, this capability to change size without changing shape has implications for projected appearance or optical perspective; henceforth, we identify this as a new class of physical perspective.

229. Physical Space

Status: **NEW / REFINED TERM** | Dictionary page: 388

Physical space is a three-dimensional area in the real world that people can occupy and move around in. It has physical dimensions like length, width, and height. In reference to a category of perspective such as linear perspective, normally space is considered to be Euclidean in form, at least locally; however sometimes we can consider the optics/geometry of non-Euclidean spaces as with astronomy in gravitational lensing of light close to distant stars, etc.

230. Pigeon Hole Perspective (1, 2)

Status: **NEW / REFINED TERM** | Dictionary page: 393

A type of two-dimensional (vertical and horizontal vanishing axis) axial, herringbone or vanishing axis scheme of perspective that results in a box-like or compartmentalised 'tiled' view of a scene in which we have a central vanishing point for each box. We have identified two kinds of pigeon-hole perspective: • Pigeon Hole Perspective: a type of multi-view perspective with multiple views/ images scattered across the picture plane or viewing window, whereby each view represents a separate focal perspective with a unique central/primary vanishing point, and views are either unstructured one relative to another, or may follow some optical,

logical or geometric organising principle. • Pigeon Hole Perspective: 2-D arrangement of multiple perspective images/views, whereby all images are combed using a simplified 'herringbone' or axial scheme in two directions.

231. Pixel

Status: **NEW / REFINED TERM** | Dictionary page: 394

1. Sensor Pixel A pixel on a sensor collects photons to convert them into photoelectrons, supporting the measurement of both photon intensity and direction. Each pixel contains sub-pixels for red, green, and blue (RGB) detection, enabling the determination of the light's wavelength or colour. 2. Display Pixel A pixel, derived from "picture element," is the fundamental unit of colour in digital displays, comprising sub-pixels that emit red, green, and blue (RGB) light. Millions of pixels form images and videos, with resolutions like 1920 x 1080 indicating pixel counts in each direction.

232. Plane of Sight (1, 2)

Status: **NEW / REFINED TERM** | Dictionary page: 396

Plane of Sight: Synonym for Sight Line / Plane: Vertical or Horizontal Plane Relates to: Central Axis of Vision: Direction of Vision The horizontal or vertical Plane of Sight, or sight plane, extends from the observer's eye to infinity. In a perspective drawing, the sight plane (or visual ray/line of sight) is not equal to the ground plane, nor is it strictly the same as the "angle of vision (1)"; though it relates to both. It is best understood as a plane centred on the line of sight extending from the viewer to an object. In a 1-point linear perspective projection, the horizontal plane of sight is often dead level (horizontal sight line some distance above ground plane) or dead upright (vertical sight line). Relates to both visual perspective (2nd type) and a linear perspective construction. Note that the plane of sight is sometimes equated to [1] Horizontal Plane of Sight, or [B] the Vertical Plane of Sight or direction of vision. [1] Horizontal Plane of Sight / Sight Line or Plane The horizontal sight line represents the edge of an imaginary horizontal plane which extends from the observer's eye to infinity. It is often dead level. The vertical and horizontal sight lines are always at right angles to each other and can be considered to be at any distance from the observer, and they can then be fixed at a measured distance (for construction purposes). Relates to both visual perspective (2nd type) and a linear perspective construction. [2] Vertical Plane of Sight / Sight Line or Plane A vertical sight line represents the edge of an imaginary vertical plane which extends from the observer's eye to infinity. It is often dead upright. The vertical and horizontal sight lines are always at right angles to each other and can be considered to be at any distance from the observer, and they can then be fixed at a measured distance (for construction purposes). Relates to both visual perspective (2nd type) and a linear perspective construction.

233. Position (Spherical space) [1, 2, 3]

Status: **NEW / REFINED TERM** | Dictionary page: 408

- Position in non-Euclidean Space - Spherical geometry is a non-Euclidean geometry examining 2-D figures on a sphere, where "straight lines" are great circles. It has no parallel lines, as all great circles intersect, and triangle angles sum to > 180 degrees.
- Position in a spherical coordinate system (spherical trigonometry, sphere of vision perspective) - A spherical coordinate system specifies a point in three-dimensional space using a distance and two angles.
- The radial distance r from a point to the origin;
- The polar angle θ between the radial line and polar axis; and
- The azimuthal angle ϕ is the angle of rotation around the polar axis.
- Position on a spherical surface (sphere of rotation perspective) - precise positions on the Earth's surface are essential for navigation, with latitude and longitude coordinates used despite the Earth's imperfect spherical shape.

234. Problem of Scale (1–3)

Status: **NEW / REFINED TERM** | Dictionary page: 411

The expression problem of scale identifies several related but distinct problems. Projective diminution, measurement resolution and the practical scale of a drawing should not be confused. [1] Projective scale and diminution In central projection, the image size of an object depends upon its distance and orientation relative to the centre of projection and image plane. For comparable objects at the same orientation, projected size decreases approximately in inverse proportion to depth. Doubling the distance therefore produces approximately half the image dimension under the same projection conditions. This geometrical relationship is not invalidated by the coastline paradox or by microscopic and telescopic imaging. A perspective image does not normally possess one universal scale throughout its entire represented depth. Different depth planes have different local image-to-object scale ratios. [2] Measurement scale and resolution The measured length or detail of an irregular boundary may depend upon the size of the measuring interval or sampling unit. A coastline measured with shorter intervals generally reveals additional bends and therefore produces a greater measured length. This is a problem of measurement scale, sampling and boundary complexity. It does not mean that the physical coastline changes size whenever it is viewed or measured, nor does it contradict the inverse projective size–distance relationship. Microscopes and telescopes increase angular or optical magnification and may reveal structures that were previously unresolved. The newly visible detail can support finer measurements, but the instrument does not thereby change the physical dimensions of the object. Digital enlargement alone cannot create genuine structural information that was not recorded by the original imaging system. Problem of Scale (1–3) (continued) [3] Drawing and construction scale A full-size or 1:1 plan of an extensive building or landscape is often impractical. Plans and elevations are therefore prepared at a reduced uniform scale, such as 1:50 or 1:100. A perspective construction may then use reduced distance points, measuring points or proportional geometrical procedures to keep the construction within the drawing area. Multi-Scale Perspective Multi-scale perspective is a proposed general framework for connecting views, images and measurements recorded at different magnifications, fields of view and spatial resolutions. Such a framework may relate macroscopic, microscopic, telescopic, nanoscopic or computational views while explicitly recording the scale, resolution and measurement conditions belonging to each image.

235. Problem of Reality

Status: **NEW / REFINED TERM** | Dictionary page: 414

Perspective views/images, are the primary way we humans obtain knowledge of physical reality. We are constantly looking at the world directly using our eyes, or with optical and sensing instruments to observe perspective representations of all kinds. Whereby photographs, drawings, paintings, diagrams, moving TV and cinema images, plus computer/mobile screens, are ever close at hand, enabling the rapid consumption of a nearly unlimited number of perspective views/images. But there are significant problems

related to the correct interpretation of each perspective view/image. How do we make the 'perceptual leap' from what is often a flat or two-dimensional picture taken from a single viewpoint, and then construct an accurate understanding (or model) of a three-dimensional scene/object? Ostensibly, this process is physically impossible. How then is an accurate encoding/decoding, of a perspective image even attainable (on certain occasions)? Questions surrounding the nature of physical reality remain central to the field of perspective. The degree of correspondence with reality, and the inherent limitation(s) in this respect of perspective views/images are much debated and the subject of many articles/books. In a sense, there is no single 'optical reality'; because each perspective image involves unique visual, optical, geometrical, and (often) psychological factors such that particular solutions are required. Hopefully, in at least some cases, we can fruitfully begin analysing/ understanding perspective processes/outcomes using perspective category theory as explained herein (ref. decoding views/images of spatial reality).

236. Problem of Scale

Status: **NEW / REFINED TERM** | Dictionary page: 415

A fundamental tenet of linear perspective is the inverse size-distance law which states that if one doubled the distance, the represented size was one-half. If one trebled the distance, the size was one-third and so on. Indeed, this law is still basic and applied to many problems in science/engineering. In 1967 Benoit Mandelbrot (1924-2010) wrote an interesting article on Fractals that questioned the universal applicability of the size-distance law [52]. Mandelbrot's article concerned the size of the coast of Britain, and implicitly introduced a spanner into this assumption by showing that size was a function of both scale and distance. The measured coastline length depends upon scale or the apparent 'jaggedness' of coastal outline. Accordingly, walking or taking a boat around the coastline will involve travelling vastly different distances in each case! Modern mapping systems like Google Maps do (or should) implicitly consider related 'scaling' effects when calculating route distances /arrival-times for walking, driving, etc. In a sense, we have been vaguely aware of this ever since the 17th century. The shape of an ordinary image is transformed entirely when we change its scale in a telescope or a microscope. What is needed is a new approach to perspective—multi-scale perspective—that takes into account scale as well as distance, whereby any given shape only applies within a given range of scales. This multi-scale capability is vitally important in a world where we travel between scales with greater frequency. True multi-scale views/images/measurements would open the way for better understanding of, and links between, nanoscopic, atomic, microscopic structures and macroscopic happenings.

237. Problem of Time

Status: **NEW / REFINED TERM** | Dictionary page: 416

Perspective encompasses both physical space and time, defined as the continuous progression of existence and events. Time relates to motion, change, and the states of objects, reflecting the interrelated processes occurring across various time scales. We need to capture, record, and manipulate systemised time-flows—in our perspective views (ref. films)—using multi-time perspective. With the aid of 'temporal' focus and lens techniques, a continuum eliminates the gap between macro- and micro- time-flows. Ergo, the viewer could jump straight to any point in space/time, and choose the correct time-flow rate to observe a particular process. Typically today, we see a narrow range of time-flows provided by a single image stream, limited at one end by the camera frame rate—and the other by the overall length of recording time. Needed are ways to overcome this deficiency—and develop 'conjoined' image space(s) with hyperlinked time-flows that can be—indexed, classified, linked, mixed, combined, searched, and explored.

238. Problem of Viewpoint

Status: **NEW / REFINED TERM** | Dictionary page: 416

All perspective methods face a fundamental issue: images of spatial objects from different viewpoints vary significantly in shape due to the specific optics and geometry of each viewpoint. Consequently, each perspective offers unique, albeit partial, information about the 3-D scene or object. To adequately model an object or scene, a multi-view perspective is often necessary, combining views from various vantage points. This can potentially be achieved through networked digital media. However, integrating these viewpoints to accurately reconstruct 3-D geometry presents significant challenges and remains largely unsolved in media systems.

239. Projecting Class / Projection Perspective

Status: **NEW / REFINED TERM** | Dictionary page: 417

A process that projects light, images, shadows, lines or other structured information into or across physical, graphical, optical or simulated space.

240. Projection Perspective / Projecting Class

Status: **NEW / REFINED TERM** | Dictionary page: 417

A process that projects light, images, shadows, lines or other structured information into or across physical, graphical, optical or simulated space.

241. Projection Scale

Status: **NEW / REFINED TERM** | Dictionary page: 418

A special type of scale is the projection scale inherent to a perspective image, or the optical magnification employed. For example, an object of 10m in size (object space units) is mapped to 10cm in image space (image space units), thus with a one percent magnification factor. Accordingly, a graduated scale (or projection/ image scale) can be shown on the image to indicate true dimensions (e.g. 1:100 Scale). Ergo, a perspective image produced according to a particular perspective system will exhibit a specific magnification factor, and associated projection scale (within a defined spatial region).

242. Projection Scale Resolution

Status: **NEW / REFINED TERM** | Dictionary page: 418

An important facet inherent to projection scale is the projection scale resolution; being the smallest level of structural detail—or size interval (in object space units)—discernible within the perspective image/view. Consider that a 'pebble's circumference' can be

viewed (microscopically) at an increased projection scale, and by 'zooming-in' on the outline it will appear more 'jagged' in shape. Ergo, we obtain a higher projection scale resolution, with finer measuring intervals, which can then closely match the tiny pebble crevices previously invisible or missed. As a result, the 'pebble's outer circumference measurement(s) will be longer (in object space units)! In sum, creating or displaying a perspective image using an increased projection scale, results in new structural details becoming visible, which relate to the attendant improved projection scale resolution (within limits of the method). A fundamental principle of perspective is apparent. Measuring size implies measuring also the dimension of shape—wherein perceived object shape is a variable quantity that becomes fixed (or quantified) only at a specific magnification. Thus shape and size are both function(s) of the projection scale and associated projection scale resolution; being key facets of all perspective methods/ systems named the scale/shape/size problem.

243. Proto / Pseudo-Scientific Perspective

Status: **NEW / REFINED TERM** | Dictionary page: 422

Any represented image that exhibits certain natural perspective phenomena such as perspective of diminishing size, aspect of perspective, foreshortening, etc; but which does not have a single unified vanishing point for parallel orthogonal lines and so the space is not unified the modern sense. Several unusual types of proto/pseudo-scientific perspective are known, including: • Proto-Anamorphic Perspective • Proxemic Perspective • Pseudo Development (cotangential) • Pseudo Development (similar exterior) • Pseudo Development (trapezoidal) • Pseudo Perspective - Curviparallel (compensatory) • Pseudo Perspective - Curviparallel (globular) • Pseudo Perspective - Curviparallel (isophoric) • Pseudo Perspective - Curviparallel (sub-globular) • Pseudo Perspective - Rectiparallel (globular) • Pseudo Perspective - Rectiparallel (sinusoidal) • Pseudo Perspective - Rectiparallel (symmetrical) • Pseudo-Conic Perspective • Pseudo-Cylindrical Perspective • Pseudo-Faceted Eye Perspective • Pseudo-metaphorical perspective • Pseudo-Sphere Perspective Several standard types of proto/pseudo-scientific perspective are known, including: • Axial perspective • Herringbone perspective • Fishbone perspective • Axiomatic perspective • Vanishing axis perspective • Ancient Greek perspective • Roman Perspective • Chinese perspective • Japanese perspective • Arabesque perspective

244. Rational Perspective

Status: **NEW / REFINED TERM** | Dictionary page: 431

Refers to what we can call unified perspective (unified visual or image space), whereby we have a single central vanishing point for all sets of orthogonal parallel lines in object space (for example), and further only one vanishing point for any set of parallel lines in object space arranged in any direction whatsoever (apart from lines parallel to picture plane, which in linear perspective theory never meet in a vanishing point). Synonym for central or linear perspective.

245. Ray Imager

Status: **NEW / REFINED TERM** | Dictionary page: 431

A ray imager or imager is a real or modelled device that images (or purports to image) the spatial object or scene present in object space, such as an eye/camera. Within the Viewing or Imaging Class, optical perspective forms or captures an image or view of a spatial reality. Regardless of whether we are talking of natural/visual or artificial perspective, a standard component in this process is the use, or simulation, of an imaging device of one kind or another. For a real-world perspective image (or representation thereof), taken from a specific point of view, then we are dealing with the formation of perspective projections. Whereby, the imager can be one of several different kinds of device, for example, an eye, pinhole camera, lens, lens-based camera, or a graphical drawing technique (e.g. window method) employed by an artist or computer ray-tracing system, etc. Ray Imager (continued) Why do we need a ray imager? And what is the role of the ray imager? Well, we need a ray imager because every luminous point in spatial reality (illuminated by a glowing light source), or point that reflects such light rays, creates a whole ensemble of vast numbers of light rays that proceed from all directions from all points simultaneously - and the result is an undifferentiated mass of diffuse light. We need a ray imager/sorter to organise (or sort) this mass of light rays so that those particular rays that proceed from one object point fall on only one corresponding image point, enabling a sharp image to form. The classic form of ray imager is a camera obscura or pinhole camera, which uses a tiny hole to naturally sort the light rays into a sharp image. The lens of a photographic camera or the human eye serves the same purpose of light ray sorting, but the larger aperture captures more rays from each object point creating a brighter image.

246. Real Perspective (1, 2: View Type)

Status: **NEW / REFINED TERM** | Dictionary page: 432

[1] Real perspective view [process] (Real-time snapshot or moving view/image of a spatial reality) Process of attaining a live and (largely) unprocessed perspective view/image of a real or physically existent spatial scene or object; whereby said view/image is generated in real-time by an eye/camera or other imaging device observing the spatial scene/object such as an optical telescope or microscope. Can be contrasted with a represented perspective view/image. [2] Real perspective view [image outcome] (Real-time snapshot or moving image that has been recorded from, processed, replayed, transmitted, broadcasted, or else generated/reconstructed from a spatial reality) A perspective view/image of a real or physically existent spatial scene or object; whereby said view/image has been directly recorded from spatial reality, and then processed, replayed or else generated/reconstructed before viewing, delivery and/or consumption. Examples of real perspective views are common, for example, photographs, movies, VR systems; and other images directly sourced from physical reality. Can be contrasted with a represented perspective view/image.

247. Reconstructed Perspective(s)

Status: **NEW / REFINED TERM** | Dictionary page: 434

Given only a small number of 2-D perspective image 'snapshots' or one-sided images/views of a 3-D object/ scene; mathematical algorithms, plus computer techniques are employed to reconstruct an original 3-D perspective model that allows the object/scene to be viewed from 'missing' perspectives or aspects not present in the sampled dataset. See also: artificial reality perspective.

248. Represent (function of perspective)

Status: **NEW / REFINED TERM** | Dictionary page: 442

Refers to a basic function of perspective, the representation (or separate embodied copy) of a spatial reality on a 2-D surface or by means of a 3-D model.

249. Reversibility Principle (of Perspective)

Status: **NEW / REFINED TERM** | Dictionary page: 444

The ability to work backwards from a foreshortened square (for example) to reconstruct the original viewpoint which caused it has been termed the reversibility principle of perspective (linear type). This only functions in the case of regular squares (or cubes) positioned at right angles to the picture plane. That linear perspectival drawings tend to feature regular geometrical and idealised architectural shapes is therefore no coincidence. This reversibility principle of linear perspective has been applied to practical problems in photogrammetry, which has also had consequences for many disciplines, including architectural design.

250. Scale / Shape / Size Problem

Status: **NEW / REFINED TERM** | Dictionary page: 450

The inverse size-distance relation is fundamental to central perspective, but applies only to a specified projected dimension under defined viewing and measurement conditions. In an actual image, apparent or measured size is also affected by viewpoint, foreshortening, visible shape, projection geometry, scale, resolution and measurement method. As demonstrated by Mandelbrot's coastline problem, the measured length of an irregular boundary changes with the scale and resolution at which it is viewed or measured. The scale-shape/size problem extends this principle: when scale or resolution changes, different structural details become visible or disappear, altering not only measured length and size but also the apparent outline and shape of the object. A complex form therefore has no single scale-independent measured shape or size; these are conditional outcomes of the scale and resolution of observation.

251. Semi-Systematic Image Space

Status: **NEW / REFINED TERM** | Dictionary page: 456

An image space in which some spatial relationships follow a consistent projection construction while others employ different local viewpoints, axes, scales or convergence systems. A work may, for example, organise one architectural region through central perspective but treat another through axial, parallel, reverse or locally adjusted projection. The term describes partial rather than complete projective unity; it should not be defined merely by the absence of a single central vanishing point, because a valid central-perspective image may contain many vanishing points.

252. Shape Grammars

Status: **NEW / REFINED TERM** | Dictionary page: 459

Refers to a general requirement/capability to understand and systematically model, apparent transformations of spatial object/scene apparent shapes with viewing position, aspect, and projection scale, plus true scale, etc. Due to the shape equivalency problem that is inherent to all perspective systems, natural and artificial methods, etc., humans need to find ways to rapidly, adequately, and accurately interpret the shapes seen in perspective images/views, and thus be able to (for example) map such visual information back to ordinal, determinative, and subsumptive data present in objective reality. Said shape recognition capabilities also extend to artificial systems, including robotic vision systems and AI.

253. Shape Sufficiency Problem of Perspective

Status: **NEW / REFINED TERM** | Dictionary page: 459

A perspective image captures (or represents) physical reality using geometric forms that are valid only at a particular dimensional scale (or viewing/projection scale). For example, while making a perspective drawing of a spatial scene using linear perspective, we assume that within the depicted reality (at the chosen scale), the Shape Sufficiency Problem of Perspective (continued) ground plane, picture/image plane, plus vertical planes, etc., are all sufficiently flat, and any orthogonals exist as sufficiently parallel and sufficiently rectilinear. Ergo, geometrical simplification(s) underpin all artificial perspective methods/systems. Plus even natural perspective processes including visual perspective (2nd type) are based on similar shape sufficiency axioms / assumptions, etc.

254. Simulated Perspective

Status: **NEW / REFINED TERM** | Dictionary page: 463

Perspective produced by deliberately modifying, arranging or constructing physical space, objects or images to create a particular appearance, illusion or spatial effect. Forced perspective is one example.

255. Single Perspective or Single Category Perspective

Status: **NEW / REFINED TERM** | Dictionary page: 463

Single Perspective or Single Category Perspective is when only one category (or perspective system) is involved to produce a perspective view/image; such as when sunlight falls through tree branches and projects shadows onto the ground (natural/environmental perspective). Single perspective is a rare phenomenon, because (as with this example) as soon as someone looks at the shadows we add in visual perspective, and we have an example of composite perspective whereby the image or image chain has passed through more than one perspective system (ref. normal case).

256. Skew Compression Perspective (Oblique Compaction)

Status: **NEW / REFINED TERM** | Dictionary page: 464

A perspective effect in which forms, distances or spatial intervals appear compressed, expanded or laterally skewed because the object, viewing direction or image plane is oblique to the observer or camera. Dimensions receding obliquely from the picture plane appear foreshortened, while angles, spacing and relative proportions may be transformed unevenly across the image. The alternative term oblique compaction emphasises the apparent compression produced along an oblique spatial direction. This effect should be distinguished from distance-based perspective compression, camera tilt and optical lens distortion, although several of these transformations may occur together in a photograph. Oblique perspective alone does not cause straight lines to become curved; such curvature normally results from lens distortion or image processing. Explanation • Oblique compaction: An oblique view can foreshorten or compact distances, shapes and intervals along the receding direction, while other dimensions are affected less strongly. • Perspective compression and extension: Camera position principally determines the apparent spacing and relative sizes of objects at different distances. A closer viewpoint exaggerates near-to-far differences; a more distant viewpoint reduces them. • Wide-angle lenses: Wide-angle lenses are commonly used from closer positions, making nearby objects appear disproportionately large and distant objects comparatively small. • Telephoto lenses: Longer lenses are commonly used from farther positions to retain similar framing, reducing near-to-far size differences and producing an apparent compression of depth. • Skewed or converging lines: Tilting or obliquely positioning the camera can make parallel lines converge. In an ideal rectilinear image, straight lines remain straight; visible curvature usually results from lens distortion or image processing. • Correction: Camera position and orientation should be chosen carefully during photography. Lens profiles may correct barrel or pincushion distortion, while perspective-correction tools may reduce unwanted convergence. • Tilt-shift lenses: Shift movement can control framing while keeping the image plane parallel to vertical architecture, thereby reducing converging verticals. Lens tilt primarily changes the orientation of the plane of focus.

257. Space (Visual) [A, B]

Status: **NEW / REFINED TERM** | Dictionary page: 469

[A] Internal Visual Space (indexical non-global space) Internal visual space refers to an "inner" and possibly represented dimensional space that can be created by the mind as a result of spatial perceptions, or be wholly/partly influenced by memory, experience, and the observer's viewpoint, etc. It is a subjective space which may reflect aspects of the environment constructed by the brain, as distinct from objective physical space; or it may not reflect objective reality in any way whatsoever. It may involve interpreting visual data—such as size, distance, aspect and shape—based on cognitive cues, often functioning as an "internal display" or "controlled hallucination". It can often be a fragmented set of memory views of spatial objects taken from separate viewpoints; whereby the views are not integrated, conjoined, or mapped together. [B] External Visual Space (mapped global space) External visual space refers to a relatively objective (so far as that is possible), three-dimensional, and approximately Euclidean representation of the surrounding physical world that an observer experiences, which is reconstructed by the brain from 2-D light projections on the retina.

258. Space Box (of perspective)

Status: **NEW / REFINED TERM** | Dictionary page: 470

1: Imaginary Box in Physical Space A physical-related (imaginary) box in object space that is defined by the station point, centre of vision, central plane, picture plane, horizontal and ground planes. Relates to both visual perspective (2nd type) and a linear perspective construction. 2: Depicted Box in Orthogonal Space Drawing of a physical box. Synonym: reference cube. See: Space Diagram.

259. Spatial Reality - Realities

Status: **NEW / REFINED TERM** | Dictionary page: 472

Within the Viewing or Imaging Class, optical perspective forms images of spatial reality, which may be divided into four kinds:: • Physical Reality: the so-called physical world or actual reality that comprises the physical universe. • Mathematical Reality: the modelled world or a mathematical abstraction of physical reality. • Artificial Reality: a human-made representation of a physical, mathematical, or imaginary reality; examples include drawings, paintings, photographs, movies, computer models/graphics, and Virtual Reality systems. • Imaginary Reality: a spatial reality in the human mind. An optical reality is (potentially) composed of one or more images of a spatial reality—each typically seen from a single viewpoint, whereby said images can (potentially) be used to infer information about the nature of spatial reality contained 3-D forms. Unfortunately, there is no universal way to unambiguously identify the structure of said 3-D forms (the equivalence problem); and we must resort to contextual factors. One such method is linear perspective, which allows encoding/decoding of an optical reality using known metric grid(s) to map/represent/comprehend a spatial reality.

260. Spatial Reality - Worlds

Status: **NEW / REFINED TERM** | Dictionary page: 472

Optical perspective is concerned with making/presenting/analysing visual images of a three-dimensional space (e.g., the physical world or physical reality). Optical perspective works to view, match, represent, or project/display aspects of a spatial scene, ostensibly limited to: • The Physical World refers to physical reality, or 2-D/3-D Object(s) present in a 3-D space (spatial scene). • The Optical World (includes optical illusions): refers to the changing appearance of objects as conveyed to the camera, instrument, or the eye/detector by emitted or reflected light (ref. using real, modelled, represented, illusive, or even imaginary light-rays). Ergo, a key goal of perspective is to explore the physical world by using the optical world to probe/represent 3-D space accurately or with sufficient realism. • The Visual World (unaided eyesight): refers to the natural products of human vision—or the transformation of the optical world according to the rules/processes of human vision (ref. physiological and psychological optics). We humans also copy aspects of these objective and subjective visual worlds in the form of represented/ modelled world(s). Whereby the classes of 'world' possess fundamental mapping relations—characterised by the phenomena/principles/methods of optical/ technical perspective. However, the precise nature, validity, and operations are by no means straightforward or guaranteed.

261. Spatial Scene

Status: **NEW / REFINED TERM** | Dictionary page: 472

Refers to geometrical plan/design or spatial structure/form of a physical/mathematical/artificial/imaginary 3-D space or a 3-D scene; whereby the same structure/form either exists in three dimensions (is itself a 3-D solid or physical scene) or is a design for three-dimensional space (of one kind or another).

262. Sphere of Revolution Perspective

Status: **NEW / REFINED TERM** | Dictionary page: 474

Capability of a spherical perspective system to produce multiple views of a 3-D object by orbiting or revolving around the 3-D object in question (looking-in/ looking-at perspective). Possible mixing with sphere of vision perspective; see: Spherical View (1, 2, 3).

263. Sphere of Rotation Perspective

Status: **NEW / REFINED TERM** | Dictionary page: 474

Capability of a spherical display to produce spherical views of an object/scene by displaying 2-D/3-D images on the surface of a sphere, and then by rotating said sphere viewing/navigating different regions of the displayed space. System types include an ordinary globe/map of earth, plus interactive globes and/or other types of internal projection spherical displays, all used by looking-in/looking-at 2-D/3-D views on the spherical surface. Note that there are two basic classes of spherical display, fixed image rotating globe, and internally projected digital images which are rotatable/zoomable.

264. Sphere of Vision Perspective

Status: **NEW / REFINED TERM** | Dictionary page: 474

Perspective system producing a complete sphere-of-vision (looking-out/looking-around perspective). Possible mixing with sphere of revolution perspective; see: Spherical View (1, 2, 3).

265. Spherical Display Perspective (1, 2, 3)

Status: **NEW / REFINED TERM** | Dictionary page: 475

Type 1: Flat projection of globe/sphere A projection of a spherical model or globe of Earth (for example) Google Earth, where the spherical display can be rotated and/or zoomed prior to projection onto a flat surface or display screen. Type 2: Spherical-shaped screen (external view - looking at/down) The representation of objects/scenes on the outside surface of a sphere, whereupon the viewer is located outside the display surface, as a type of panoramic curvilinear display that can be rotated, and the views may be zoomed and/or translated also across the external spherical display. Type 3: Spherical-shaped screen (internal view - looking out/up) The representation of objects/scenes on the inside surface of a sphere, whereupon the viewer is located inside the display surface, as a type of panoramic curvilinear display that can be rotated, and the views may be zoomed and/or translated also across the internal spherical display.

266. Spherical View (1, 2, 3)

Status: **NEW / REFINED TERM** | Dictionary page: 476

Spherical Perspective View: Type 1: Unfolding projection class Refers to a spherical perspective image reflected by a metal or mirror ball, or alternatively an image produced by a glass ball; whereby in both cases a miniaturised total-view or panoramic image of a scene is produced that unfolds (or changes viewpoint) as the ball is moved (metal ball) or changes its direction of view (glass ball) resulting in flowing or conjoined spherical perspectives from all directions. This is a type of mixing or a cross between sphere-of-revolution and sphere-of-vision perspective.

267. Synthetic Perspective

Status: **NEW / REFINED TERM** | Dictionary page: 491

Concept of combining or merging different kinds of perspective into a single image (for example natural and artificial perspective); as when you view an anamorphic image in a specially shaped picture plane or mirror (conical or cylindrical shaped picture plane). Also a perspective image, method or system deliberately constructed by combining two or more graphical, optical, instrumental, simulated or digital processes into one integrated result. Examples include forced-perspective scenes photographed through a camera, anamorphic images corrected by mirrors and digitally composited environments. The term has also been used historically for constructed graphical perspective, curved-surface constructions and projection-circle transfer methods. John White applied it as a modern historical interpretation of Leonardo da Vinci's attempts to reconcile planar perspective with wide-angle visual appearance; it should not be treated as an established term used by Leonardo himself.

268. Systemic Image Space

Status: **NEW / REFINED TERM** | Dictionary page: 492

Refers to an image space corresponding closely to an object or target space (3-D spatial scene); whereby said image space accurately and precisely represents the original spatial geometry in a systematic way whereby any object geometry, perspective framework, and/or metric grid structure, etc; is adequately represented in mathematical terms, and as such can be logically perceived and/or reconstructed. Often, Euclidean geometry is assumed for the object space. See: technical perspective.

269. Technical Perspective

Status: **NEW / REFINED TERM** | Dictionary page: 494

A broad descriptive term for systematic methods of viewing, imaging, measuring, calculating, constructing, projecting or representing spatial objects and scenes. It is not a separate principal perspective category.

270. Telescopic Perspective

Status: **NEW / REFINED TERM** | Dictionary page: 496

The perspectival appearance of a magnified, narrow-angle view seen through a telescope or recorded with a long-focus optical system. A telescope enlarges a restricted angular portion of the scene but does not, by itself, alter the central-projection geometry determined by the observer's or camera's position. Within the restricted field, parallel-line convergence may appear weaker because only a small and relatively distant section of the scene is visible. The familiar photographic effect called perspective compression arises principally when a distant camera position is used and the image is magnified or framed with a long-focus lens. It should therefore be distinguished from magnification alone.

271. Tilted Perspective (1, 2, 3)

Status: **NEW / REFINED TERM** | Dictionary page: 500

Three related forms may be distinguished: [1] Tilted ground-plane perspective Perspective in which the ground or supporting plane is inclined relative to the normal horizontal ground plane. Lines lying in that plane converge towards vanishing points on the inclined plane's own vanishing line. The ordinary horizon of the observer does not necessarily tilt with the ground plane. [2] Tilted picture-plane or camera perspective Perspective formed when the camera, observer or picture plane is pitched or rolled relative to the scene. Pitching the camera can make vertical lines converge towards a vanishing point above or below the image; rolling the camera makes the horizon appear inclined within the image frame. [3] Tilted object-plane perspective Perspective of an individual object or plane that is inclined within an otherwise stable scene. Its parallel-line families have vanishing points and a vanishing line determined by the object plane's own spatial orientation; the scene's general horizon need not change.

272. Transformation Optics

Status: **NEW / REFINED TERM** | Dictionary page: 502

A proposed perspective term for an optical arrangement that transforms the expected appearance of an object, scene or image by redirecting, dividing, combining, reflecting, refracting, magnifying, compressing or otherwise modifying the light reaching the observer. The resulting view may differ from ordinary unaided appearance in its apparent direction, position, scale, shape, depth, continuity, transparency or visibility. Mirrors, lenses, prisms, projection systems and combinations of optical elements may therefore create transformed perspective images, including displaced views, hidden objects, false spatial continuities and other forms of trick or illusionistic perspective. Examples include mirror-based invisibility effects, Pepper's ghost, anamorphic correction, diverted viewpoints, virtual mirror space and optical special effects. In this dictionary, the term refers specifically to the transformation of perspective appearance and should be distinguished from the established electromagnetic field also known as transformation optics.

273. Transformation Principle (of Linear Perspective)

Status: **NEW / REFINED TERM** | Dictionary page: 503

The transformation principle of linear perspective refers to the systematic transformation of regular and original geometrical forms and solids (outline shapes in a 3-D object space) into apparent 2-D forms in image space (within a 2-D drawing/representation), being a process that is characteristic of one/two/three-point linear perspective (for example). Notably, the principles of said geometrical transformation, and with associated perspective phenomena, can be codified in the methods of (for example) the

legitimate construction. The resulting image representation closely matches what is seen visually with the eye (over a relatively narrow field of view) or that produced mechanically by a camera obscura or a photographic camera, etc.

274. Translation Perspective (1, 2)

Status: **NEW / REFINED TERM** | Dictionary page: 503

[1] Translation of the observer or camera A change in perspective caused by moving the observer or camera from one station point to another without necessarily rotating it. Viewpoint translation changes the projected positions, relative sizes, occlusions and parallax relationships of objects within the scene. [2] Translation of an object A change in perspective produced when an object moves from one spatial position to another while retaining its orientation. With the observer or camera fixed, the object's projected position, scale, overlap and apparent relationship to surrounding objects may change.

275. Transparent Perspective (1, 2, 3)

Status: **NEW / REFINED TERM** | Dictionary page: 504

1: Transparent scene Any image/view that penetrates the viewpoint obscuring transparent or semi-transparent surfaces in a spatial scene, and thus enables the post-surface contents/structure of the scene to be observed. Also referred to as the transparency principle of perspective (for space between viewer and object). 2: Transparent object Any image/view that penetrates obscuring transparent or semi-transparent surfaces comprising a spatial object, and thus enables the internal contents/structure of the object to be observed. 3: Transparent display/screen Any display/screen that can present opaque objects/scenes on a transparent or semi-transparent surface, and thus enables the external or non-obscured contents/structure of the scene lying behind the surface (in the depth dimension) to be observed (ref. transparent television screen).

276. True / Right / Correct Perspective

Status: **NEW / REFINED TERM** | Dictionary page: 508

True perspective may refer to any type of perspective that approaches a "correct" or realistic perspective view or image, whereby the projection is assumed to reflect the true shape or the most realistic or naturalistic appearance of an object or scene, in either a geometrical or optical sense. Several forms of visual, optical and graphical perspective may therefore be claimed to approach, or most closely match, true perspective. Visual Perspective Type 2 concerns how humans observe physical reality through the retinal and perceptual processes of vision. Human sight nevertheless contains inherent optical, physiological and psychological transformations that affect how spatial forms are perceived. Graphical constructions such as linear perspective attempt to match important aspects of this visual appearance and, under suitable viewing conditions, can closely correspond to what we see. Over a wider field of view, or for objects situated far from the central direction of vision, planar linear-perspective constructions may correspond less closely to natural wide-field visual appearance and may exhibit increasing peripheral transformations. Photographic perspective may also be regarded as "true" in the sense that it faithfully records the projection formed by a particular camera and lens onto a flat film or sensor surface. Different lenses and projection systems nevertheless produce different mappings of the same scene. Wide-field fisheye lenses, for example, produce curvilinear transformations that may be understood as a consequence of mapping a very wide field of view into a finite image rather than simply as an inaccurate representation. Perhaps one of the forms that most closely merits the name true perspective is a direct perspective-window, net or veil construction. The artist observes a spatial object or scene through a transparent plane from a fixed eye position and traces upon that plane the points at which the corresponding visual rays intersect it. The resulting image is therefore a direct geometrical record of the scene's projected appearance from that station point. In this precise sense, it may be regarded as a true perspective image, although its accuracy remains specific to the fixed viewpoint and flat picture plane and does not preserve the object's true physical shape, scale or dimensions throughout the image. The term true perspective should therefore be qualified according to what is claimed to be true: visual appearance, optical projection, geometrical construction, viewpoint correspondence, scale, dimensions or some combination of these.

277. Twisted Perspective (B: 1, 2, 3)

Status: **NEW / REFINED TERM** | Dictionary page: 510

Three types of twisted perspective are known: B 1: Twisted / oblique ground plane: twisting of the ground plane, along and relative to the central axis of vision; resulting in orthogonal lines (planar with the ground plane) appearing twisted / angled along with a tilted horizon line and associated tilted vanishing point positions (everything in image frame relative to picture plane). B 2: Twisted picture plane: twisting of the picture plane, along and relative to the central axis of vision; resulting in orthogonal lines (planar with the ground plane) appearing twisted along with a tilted horizon line and associated tilted vanishing point positions (everything in image frame relative to picture plane). B 3: Twisted object plane: twisting of the object plane, along and relative to the central axis of vision; resulting in orthogonal lines (planar with the ground plane) appearing twisted along with a tilted horizon line and associated tilted vanishing point positions (everything in image frame relative to picture plane).

278. Two Directions of Perspective

Status: **NEW / REFINED TERM** | Dictionary page: 510

In the backward or image-forming direction, light, visual information or spatial data passes from a scene towards an eye, sensor or image plane. In the forward or projecting direction, light, images, shadows, lines or spatial information are projected into physical, graphical, optical or simulated space.

279. Unbalanced Perspective (1, 2)

Status: **NEW / REFINED TERM** | Dictionary page: 512

1: Off-centre primary vanishing point (linear perspective construction) A perspective view in which the principal vanishing point lies away from the centre of the image because the viewing direction, object orientation or framing is asymmetrical. An off-centre vanishing point does not itself make the construction geometrically incorrect, provided that the station point, picture plane and projected directions remain consistent. 2: Warped / Violent Perspective View/Image A perspective image characterised by unusually strong foreshortening, convergence, scale differences or angular transformation. Such effects may result from a very

close viewpoint, an oblique viewing direction, a tilted picture plane or a wide field of view. The term unbalanced describes the resulting visual instability rather than necessarily indicating an optical or geometrical error.

280. Uni-Angular Perspective (1, 2)

Status: **NEW / REFINED TERM** | Dictionary page: 513

1: Fixed-viewpoint perspective A perspective image formed, captured or constructed from one station point or viewpoint. One-point, two-point and three-point linear-perspective constructions may all be uni-angular because the number of vanishing points does not determine the number of viewpoints. 2: Single presented view A perspective image or system presenting an object or scene from one principal viewing direction, as opposed to a multi-view or multi-angular representation that combines or reveals several viewing directions.

281. Universal Perspective (1, 2, 3, 4)

Status: **NEW / REFINED TERM** | Dictionary page: 515

[1] Universal integration of multiple perspective images or views A proposed overarching perspective system for indexing, linking and exploring multiple images and views of spatial reality within a common visual or hypermedia framework. Images may be stationary or moving, two-dimensional or three-dimensional, and may be supplemented by metadata identifying viewpoint, direction, scale, time and other relevant conditions. One purpose is to model how apparent shape changes with viewpoint, aspect and scale. [2] Universal approach to the equivalence or correspondence problem Different three-dimensional objects or scenes can produce the same or very similar two-dimensional projection when viewed under different conditions. A single image therefore does not, in general, determine one unique three-dimensional structure without additional assumptions or information. Context, calibrated geometry, metric grids, known objects, multiple views and other constraints may help resolve this ambiguity, but there is no completely context-free universal solution. [3] Overall scene or ground-plan perspective Perspective concerned with the spatial organisation of the complete object space, ground plan, background framework or overall scene, rather than with one isolated object or particular form. Antonym: Particular Perspective. [4] Conjoined views or universal world model A system in which multiple perspective images or spatial datasets are registered and combined into a navigable world model or common image space. Photogrammetry, panoramic imaging, computer vision and digital mapping provide partial solutions, while the construction of a complete and universally accessible visual model of the world remains an open-ended goal. Single-image recovery is inherently constrained by depth and scale ambiguities, while multiple views and additional geometric assumptions can reduce them.

282. Unlimited Vanishing Point Perspective

Status: **NEW / REFINED TERM** | Dictionary page: 515

A perspective space may contain an unlimited number of potential vanishing points because every distinct spatial direction not parallel to the picture plane has its own vanishing point. Each family of mutually parallel lines sharing that direction converges towards the same point. Parallel directions lying within one plane have vanishing points situated on that plane's vanishing line. Because physical space contains innumerable possible line directions and planes, it consequently contains an unlimited or continuous field of potential vanishing points and vanishing lines. A practical perspective drawing normally displays only those vanishing points required by the objects and directions actually represented. The term unlimited vanishing point perspective therefore describes the full directional potential of perspective space rather than a drawing in which every possible vanishing point is explicitly marked. Different parallel directions generate different vanishing points, while all directions lying in one plane generate points on that plane's vanishing line.

283. Vanishing Line /Horizon Line (Optical)

Status: **NEW / REFINED TERM** | Dictionary page: 521

An apparent line or boundary along which distant forms become optically indistinguishable because of limited resolution, contrast, illumination, atmospheric transmission or image scale. Unlike the geometrical horizon line, an optical vanishing line is not a fixed projective structure: its location varies with the object, observer, instrument and viewing conditions.

284. Vanishing Sphere (Geometrical)

Status: **NEW / REFINED TERM** | Dictionary page: 533

A conceptual spherical field centred upon the eye, camera or station point, used to represent all possible spatial directions. Each direction corresponds to a point on the sphere, while opposite directions correspond to antipodal points. When those directions are projected onto a flat picture plane, they generate finite vanishing points, points at infinity or vanishing lines according to their orientation. The geometrical vanishing sphere is therefore a directional model, not a finite physical distance beyond which objects cease to exist or become geometrically indistinct. Optical vanishing sphere = how far objects remain visible; Geometrical vanishing sphere = where directions appear to converge.

285. Vanishing Sphere (Optical)

Status: **NEW / REFINED TERM** | Dictionary page: 533

A conceptual locus representing the maximum distance at which a specified object or detail remains detectable or resolvable under stated viewing conditions. Its radius depends upon object size, contrast, illumination, atmospheric transmission, observer acuity, optical magnification, sensor resolution and image processing. It need not be a perfect sphere and is not one universal boundary applying equally to every object or viewing direction. Optical vanishing sphere = how far objects remain visible; Geometrical vanishing sphere = where directions appear to converge

286. Vertical Horizon Linear Perspective

Status: **NEW / REFINED TERM** | Dictionary page: 537

A perspective arrangement in which the vanishing line of a particular vertical spatial plane appears vertical in the image. Directions lying within that plane have vanishing points situated upon its vertical vanishing line. This should not be confused with the ordinary horizon line, which is the vanishing line of the horizontal plane through the station point. In three-point perspective, tilting the picture

plane may create a finite vertical vanishing point, but it does not rotate the ordinary horizontal horizon into a vertical horizon. A high-angle view looks downwards and may be called a bird's-eye view; a low-angle view looks upwards and may be called a worm's-eye view.

287. View (correct viewing distance / scale)

Status: **NEW / REFINED TERM** | Dictionary page: 539

Oftentimes it is said that it is a good idea to view a perspective picture/painting from the correct station point position, and in particular that you (the painting viewer) must locate the distance point off to one side of the drawing/painting because this is the same length as the viewing distance to the station point from the picture plane - and then use this distance to stand in-front of the picture. It is claimed that this produces the most realistic view of a scene, closely approximating the original scene the artist saw and drew on the picture plane or perspective window, in which the lines of projection entering the viewer's eye appear identical in both cases. Ergo, both the artist and the painting viewer stand at the same distance from the picture plane. However, this recommendation is only true if the painting was made at a true or one-to-one scale relative to physical reality; whereas if the painting was made at some other (reduced/expanded scale relative to physical reality - or is a reproduction that has itself been reduced in scale) then the correct station point position will change or scale accordingly. Oftentimes, in architectural drawings, even this scaled-down distance point may be several metres long. Luckily, this is not normally required because the viewer of such a drawing can make (at least some) necessary visual accommodations (see Zeeman's paradox) and imagine him/herself at an appropriate distance from the building, thus making scale assumptions about the building in question. In any case, this example shows how important visual perception and visual assumptions are in decoding a perspective image/view.

288. View (function of perspective)

Status: **NEW / REFINED TERM** | Dictionary page: 540

Refers to a basic function of perspective: viewing a live image of physical or spatial reality. Said function may be attained by using ordinary visual perspective (2nd type); or naked eyesight; or alternatively, the eye can be placed at the eyepiece of a camera-viewfinder/telescope, etc. Alternatively, the live image from a camera, microscope, telescope, etc., can be relayed to a computer monitor and displayed as a perspective image in this manner.

289. Viewing or Imaging Perspective

Status: **NEW / REFINED TERM** | Dictionary page: 540

A process through which a spatial object, scene or existing image is directly viewed, or through which a new view or image is formed, captured or presented.

290. Virtual Reality

Status: **NEW / REFINED TERM** | Dictionary page: 545

Virtual reality (VR) is an interactive computer-generated, reconstructed or captured environment presented so that a user can explore or act within it from a changing viewpoint. Contemporary systems commonly use a head-mounted display, stereoscopic imagery and head or body tracking, and may also incorporate spatial sound, hand controllers, haptic feedback or other sensory information. Virtual environments may also be presented through projection rooms, panoramic displays or related immersive systems. The displayed views are generated or updated in real time according to the user's position and direction of view. This produces changing perspective, motion parallax, binocular disparity and other depth information, giving the user the impression of being located within the represented space rather than merely looking at a fixed image. The effectiveness of this immersion depends upon factors including field of view, tracking accuracy, latency, image resolution, interaction and the consistency of the visual, auditory and bodily information. Unlike augmented reality, which adds digital material to a continuing view of the physical environment, immersive VR normally replaces or substantially obscures that direct view. Mixed reality combines and registers physical and virtual elements so that they appear to coexist and may interact within one perceived environment. The boundaries between VR, AR and MR are not always absolute, and some systems combine aspects of all three. From the perspective viewpoint, VR is especially important because it permits the station point, viewing direction, field of view, scale and spatial organisation of the represented world to change interactively. A user may move through a simulation at ordinary human scale, enter an enlarged model of a cell or the human body, examine a building before construction, travel through astronomical data or experience spatial arrangements that could not exist in ordinary physical reality. VR can therefore provide not merely a representation of an existing world, but a navigable and transformable perspective space. Virtual reality may represent real, reconstructed, simulated or imaginary environments. It is used in design, architecture, engineering, scientific visualisation, medicine, education, training, entertainment, communication and remote collaboration. It may reveal relationships that are difficult to recognise in conventional images by allowing information to be approached from multiple positions, directions and scales. VR also raises broader questions about perception and reality. To what extent does a virtual environment represent, replace or extend ordinary experience? Does it draw the observer away from the physical world, or provide new methods of examining and understanding it? Although virtual experiences differ from direct physical experience, they may nevertheless produce a strong sense of presence, embodiment and meaningful interaction. Virtual reality can therefore be understood as both a technology and a major new form of visual, spatial and experiential perspective. Virtual Reality (continued)

291. Visual Acuity

Status: **NEW / REFINED TERM** | Dictionary page: 547

Derived from the Latin *acutus*, meaning acute or sharp, visual acuity is the capacity of an observer or imaging system to resolve fine spatial detail. The acuity or clarity produced by an optical instrument depends upon field of view, aperture, focal length, focus, diffraction, aberrations, wavelength, contrast, sensor resolution and viewing conditions. Visual acuity and depth of field are distinct but related. Depth of field is the range of object distances within which an image meets a chosen standard of acceptable sharpness or resolving detail. Acuity may therefore vary across that depth range. A pinhole camera generally has a very large depth of field because its small aperture reduces defocus, although resolution is limited by diffraction and low light transmission. Other optical imagers, including the eye, have a more restricted range within which objects appear acceptably sharp; outside it, defocus blur

increases. Opening the aperture generally reduces depth of field, while stopping down increases it, although an excessively small aperture may reduce fine-detail resolution through diffraction.

292. Visual Angles Problem

Status: **NEW / REFINED TERM** | Dictionary page: 548

With the eye and head fixed, equal objects positioned farther from the central visual axis may occupy smaller angular or retinal image extents and undergo shape change. This Visual Lateral Distortion combines increased egocentric distance, increasing obliquity relative to the line of sight and the eye's angular or curved-retinal mapping. Distance and obliquity principally produce the diminution; retinal mapping expresses their combined result without the tangent-plane expansion of a flat rectilinear image. This does not contradict mathematically exact rectilinear projection. Equal planar objects parallel to a flat picture plane and at the same perpendicular depth may retain equal measured dimensions in the image. The lateral part of that image is farther from, and more oblique to, the prescribed eye, so correct monocular viewing reconstructs the smaller visual angle. Wide-field rectilinear projection may nevertheless exhibit Graphical Lateral Distortion through increasing marginal scale, especially under ordinary viewing conditions.

293. Visual Perspective (Types 1 and 2)

Status: **NEW / REFINED TERM** | Dictionary page: 552

1: Visual Perspective Type 1 The broad category encompassing direct and represented visual appearances of spatial objects, scenes, views and images. 2: Visual Perspective Type 2 The human visual-system subclass, including retinal and perceptual appearances shaped by viewpoint, monocular and binocular vision, apparent size, shape, position, depth cues and acuity.

294. Visual Ray (1)

Status: **NEW / REFINED TERM** | Dictionary page: 554

Visual Ray (1): Axis of Cone of Vision (See: Visual Pyramid / Cone of Vision) Synonym for Axis of Cone of Vision (principal ray [A]) The axis of the Cone of Vision forms the principal visual ray Type A (N.B. different from principal or central ray of each ray bundle diverging from each object point) and in perspective becomes the line of direction or sight line. It is the central line-of-sight or visual direction of look (principal or central visual ray (or visual line) in visual cone at the apex of the eye). Relates to both visual perspective (2nd type) and a linear perspective construction (process of making). Synonyms: Angle of View (1), Angle of Vision (1), Axis Line, Axis of Cone of Vision, Axis of Pyramid Of Vision, Axis of Vision, Axis of Visual Pyramid, Central Axis, Central Axis of Vision, Central Ray, Central Visual Ray, Centre Line, Centre Line of Vision, Centre of Vision (2), Direct Line of Sight, Direct Line, Direct Line of Vision, Direction of Gaze, Direction of Projection, Direction of Vision, Line of Direction, Line of Projection, Line of Sight, Line of Vision (1), Looking Angle, Observation Angle, Optical Axis, Perspective Axis, Principal Angle, Projection Angle, Sight Line, Viewing Angle (1), Visual Axis, Visual Ray (principal), Visual Axis, Visual Direction, Alignment Line (2).

295. Visual Ray (2)

Status: **NEW / REFINED TERM** | Dictionary page: 554

Visual Ray (2): Main or Chief Ray (See: Main Ray in Ray Bundle (principal ray [B])) Synonym for Main Ray in Ray Bundle (principal ray [B]) From every visible point on the object there emanates a ray of light termed a main or chief ray (the principal ray Type B of the ray bundle diverging from each object point), which (whilst the artist is recording a perspective scene) pierced the glass (notional perspective window) and entered the eye. In optics, a visual ray (principal ray type B) signifies an imaginary ray of light, by which vision is supposed to be conveyed from the object to the eye of the spectator, in perspective. It is a straight line, running from every point on an object to the eye. In terms of natural or artificial perspective processes/methods, notionally from every visible point on the object emanates a ray of light termed a visual ray (or principal ray Type B). The outer boundary of the pyramid-of-sight is defined by certain rays, the 'main rays', 'chief rays' or 'principal rays' (centrally located rays in each ray bundle diverging from each object point), which converge towards a single point in the eye from all of the different object points. Ergo, the beam profile of this pyramid of sight, when used for perspective viewing/drawing, defines the boundary or image outline of objects represented on the picture surface/plane or perspective window. Euclid named such rays the 'visual rays'. These chief/principal rays [B Type] define the visual angles subtended by the objects, whose angles are the main subject of visual perspective. Accordingly, the study of visual angles may be called natural perspective.

296. Visual Space (1: A, B)

Status: **NEW / REFINED TERM** | Dictionary page: 555

The expression visual space has been used in several related but non-identical senses in psychology, optics, art history and perspective theory. It should not automatically be treated as synonymous with the visual field, the visual world, the retinal image or physical object space. [1A] Perceptual or phenomenal visual space The spatial organisation experienced through vision, including apparent direction, position, distance, depth, size, shape and orientation. Visual space is the perceived spatial order produced through the human visual system and may differ from the measurable geometry of physical object space. Visual space is related to the retinal image and visual field but is not identical to either. The retinal image is an optical image formed upon the retina, whereas visual space is the spatial appearance or organisation that is perceived. J.J. Gibson distinguished two aspects of visual experience: • the visual field, a temporary, bounded and field-like appearance associated with a particular fixation and orientation; and • the visual world, the stable, extended and three-dimensional environment perceived around the observer. These are related aspects of visual experience rather than synonyms. [1B] Visual or optical world as the space encountered through sight A broader historical or theoretical usage in which visual space refers to the external environment as visually encountered: the optical, physical or object world towards which vision is directed. Kim H. Veltman and other historians of perspective have used distinctions between visual, optical, geometrical and represented space when comparing natural vision with graphical projection. In this broader sense, visual space may denote the visually encountered world rather than only the momentary perceptual field. In this dictionary, this broader sense may also be contrasted with graphical space: visual space is governed or transformed by optical and perceptual conditions, whereas graphical space is organised according to the selected rules of drawing or projection. This usage should be distinguished from Gibson's specific terms visual field and visual world, and from Gombrich's contrast between the mirror and the map, which

concerns alternative theories of pictorial representation. Usage note: Entries should identify whether visual space means perceptual space, the momentary visual field, the stable visual world or the visually encountered external environment.

297. Why Things Vanish

Status: **NEW / REFINED TERM** | Dictionary page: 559

As distance increases, an object of fixed physical size subtends a progressively smaller visual angle. It becomes indistinguishable when its projected size, visible detail or contrast falls below the resolving limits of the eye or imaging instrument, often assisted by atmospheric attenuation, illumination and background conditions. Families of parallel lines may converge geometrically towards vanishing points, but ordinary objects disappear optically because of reduced angular size and visibility, not because their light rays fail to expand. The retinal image is formed through the combined optical action of the cornea and crystalline lens.

298. Window Principle

Status: **NEW / REFINED TERM** | Dictionary page: 560

Let us consider how an artist produces a perspective drawing/painting of a three-dimensional scene. Normally, it is necessary to fix the viewpoint, viewing angle and field of view in some way; and because there are a large number of possible viewing angles and contrasting scene aspects/points-of-view that can be observed, each from a slightly different viewpoint plus viewing angle, etc. The problem is that the artist's viewing location, plus angle-of-view, can both change whilst the drawing is under construction. To solve this problem, a 'transparent' frame is overlaid onto the spatial scene, named the perspective window or windowpane (which may be only imaginary, and can even be wholly or partially unconscious). This perspective window is normally rectangular in shape, and planar (or flat) in form, and serves the purpose of fixing the artist's head-position (location), plus angle of vision (1) and field of view (monocular eye position), relative to the spatial scene/object in question. Ergo, the artist begins by looking at a scene through an imaginary perspective window (or even a real glass window or semi-transparent veil), and the drawing/painting is made as if coincident with this flat and translucent windowpane. Whereby, for a representation created in such a manner, each painted object in the scene is thus depicted as a flat, scaled-down image of the object on the other side of the window. Ergo, the technique of graphical perspective works by representing the light that passes from a scene through an imaginary rectangle (represented on the picture plane as the plane of the drawing/painting), to the viewer's eyes (ostensibly a single eye). Photography provided a physical demonstration that the window principle of perspective was a function of objective geometry, independent of a painter's subjective interventions. Photographic cameras do not employ an overt perspective window, but the lens, sensor and camera orientation establish the viewpoint, viewing direction and field of view when the exposure is made.

299. World Theory

Status: **NEW / REFINED TERM** | Dictionary page: 561

Optical perspective (typically) seeks to explore the physical world by using the optical world to probe spatial reality accurately or with sufficient realism. Occasionally, artists/scientists create other kinds of optical perspective to explore new aspects of the visual or optical world (for example). The natural products of human vision are named as the visual world (unaided eyesight)—or the transformation of the optical world according to the rules/processes of human vision (ref. physiological and psychological optics). The represented world refers to the depiction of aspects of the physical, optical, or visual world(s). Karl Popper identified 3 'worlds'; that of nature/physical, mental and products of the human mind. According to Kim Veltman, we can usefully transform Popper's 3 Worlds, referred to here as the object(s) of attention, into 6 Worlds as follows: • Metaphysical (In Brain) - [imaginary space] - imaginary spatial / metaphysical reality • Mental (Obviously In Brain) - [imaginary space] - imaginary spatial reality • Physical (Nature) - [physical space] - mathematical, instrument and graphical spatial reality • Man-Made (Media + Machines, etc) - [instrument space] - mathematical and instrument spatial reality • Social (Communication Tools / Languages) - [digital space] - new media spatial reality • Natural Built Environment (Life) - [ecosystem] - global ecosystems reality

300. Wrong Perspective

Status: **NEW / REFINED TERM** | Dictionary page: 562

1. Perspective representation without consistent principles/methods An artificial perspective image that does not reflect specific goals of representation. 2. False natural perspective image/view An artificial perspective image that does not truthfully reflect physical reality. 3. Historical or polemical usage: retinal optics as opposed to geometrical or Euclidean optics A perspective image that reflects human vision instead of the rules of linear perspective. 4. Zero vanishing point perspective Type of natural or artificial perspective depicting a spatial scene, such as a mountain range or a landscape of hills and valleys, the same being a non-linear scene in which there are no parallel lines appearing to meet off in the distance somewhere. Ergo, there are no vanishing points visible. 5. Negative perspective (definition B), or wrong perspective. Artwork of Paul Cezanne and/or negative perspective (B). 6. Non-systematic or internally inconsistent perspective. A perspective image whose spatial relationships fail to follow its stated or intended principles; a curvilinear, parallel, retinally based or otherwise non-central system is not wrong merely because it differs from linear perspective.

301. Zero-Point Perspective (A)

Status: **NEW / REFINED TERM** | Dictionary page: 564

Type of natural, artificial, or graphical perspective depicting a natural scene, such as a mountain range or a landscape of hills and valleys, the same being a non-linear scene in which no parallel lines appear to meet off in the distance somewhere. Accordingly, no finite vanishing points are visibly established by the depicted forms.

302. Zero-Point Perspective (B)

Status: **NEW / REFINED TERM** | Dictionary page: 564

Synonym for the 'view from nowhere' or the 'point of view' of no one in particular. This is a difficult or uncertain definition that is linked to God-like perception. Leibniz said: 'the distinction between the appearance bodies have with respect to us and with respect to God is, in a certain way, like that of a drawing in perspective and a ground plan. For there are different drawings in perspective depending upon the position of the viewer, while a ground plan or geometrical representation (geometric model) is unique. Indeed,

God sees things exactly as they are in accordance with geometrical truth, although he also knows how everything appears to everything else, and so he eminently contains himself in all other appearances.'

303. Zooming (Imaging Perspective Class) - Optical versus Digital

Status: **NEW / REFINED TERM** | Dictionary page: 565

For an optical perspective <IMAGING> system, an optical zoom works by physical lens movement to provide a true magnification of the captured image, preserving image quality, whereas a digital zoom digitally crops and enlarges the centre of a captured image, causing pixelation and detail loss. Notably, optical zoom is superior for clarity, but digital zoom offers compact convenience, often enhanced by software, but still results in lower image quality than optical zoom. Optical Zoom • Physical lens elements shift position to magnify the subject. • Maintains sharpness and detail; quality depends on the lens and sensor. • Avoids the resolution loss inherent in digital cropping, although optical quality may vary with focal length. • Adds bulk, cost and complexity. • Applications: Professional photography, large prints, critical detail. Digital Zoom • Crops the image and digitally stretches the pixels (interpolation) to fill the frame. • Degrades quality, making images look pixelated or blurry as you zoom in. • More compact, cheaper, used in smartphones, offers extreme zoom (often using AI). • Loss of detail, reduced resolution. • Applications: Casual use, framing tighter shots when physical proximity isn't possible.

304. Zooming (Projecting Perspective Class) - Optical versus Digital

Status: **NEW / REFINED TERM** | Dictionary page: 565

In a projection system, optical zoom alters the projected image size by changing the projection lens's focal length, normally without discarding source-image resolution. Digital zoom or scaling crops or resamples the image before projection and may reduce effective resolution. Digital keystone correction is a separate Zooming (Projecting Perspective Class) - Optical versus Digital (continued) geometrical transformation used to compensate for trapezoidal distortion caused by off-centre projection; it can also reduce effective resolution or brightness. Physical projector placement, optical zoom and lens shift generally preserve image quality more effectively than digital correction.

305. Zooming Perspective - Types (1, 2, 3, 4)

Status: **NEW / REFINED TERM** | Dictionary page: 566

A changing-scale image in which the represented subject becomes larger or smaller through focal-length change, digital enlargement, movement of a physical or virtual viewpoint, or alteration of a projected beam. These operations must be distinguished because only movement of the viewpoint changes perspective geometry. 1: Imaging Perspective — optical lens zoom. 2: Imaging Perspective — digital image or display zoom. 3: Imaging Perspective — movement of a physical or virtual viewpoint towards or away from the subject. 4: Projecting Perspective — optical adjustment of the projected image or beam footprint.

Next research stage

This inventory is intended to be used as the controlled concept list for the later source-by-source teaching audit. For that next stage, each of the 305 concepts can be checked against the same 87-source corpus for (1) explicit teaching of the PRC term, (2) teaching of a clear functional equivalent under different terminology, and (3) absence or only partial/related treatment.