

UNITED STATES PATENT AND TRADEMARK OFFICE

BEFORE THE PATENT TRIAL AND APPEAL BOARD

SONY CORPORATION
Petitioner

Patent No. 6,665,003
Issue Date: Dec. 16, 2003
Title: SYSTEM AND METHOD FOR GENERATING AND DISPLAYING
PANORMAIC IMAGES AND MOVIES

CORRECTED SECOND PETITION FOR *INTER PARTES* REVIEW
OF U.S. PATENT NO. 6,665,003

No. IPR2013-00326

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List of Exhibits

Ex. No.	Exhibit Name
Sony-1101	U.S. Patent No. 6,665,003 (“the ’003 Patent”)
Sony-1102	Answering Brief in Opposition to Sony’s Motion to Stay Pending the Outcome of Inter Partes Review of the Patents-In-Suit, <i>HumanEyes Technologies Ltd. v. Sony Electronics Inc. et al.</i> , 1-12-CV-00398, D.I. 34, at 13 (D. Del. May 6, 2013)
Sony-1103	VRSJ Research Report including Yasuhiro Kawakita, Yoshitaka Hamaguchi, Akitoshi Tsukamoto, Toshihiko Miyazaki, <i>Generation of Panoramic Stereo Images from Movie Using Single Video Camera</i> , Kansai Laboratory Research & Development Group, OKI Electric Industry Co., Ltd. (Nov. 27, 1997)
Sony-1104	Certified English Translation of VRSJ Research Report including Yasuhiro Kawakita, Yoshitaka Hamaguchi, Akitoshi Tsukamoto, Toshihiko Miyazaki, <i>Generation of Panoramic Stereo Images from Movie Using Single Video Camera</i> , Kansai Laboratory Research & Development Group, OKI Electric Industry Co., Ltd. (Nov. 27, 1997) (“Kawakita”)
Sony-1105	Hiroshi Ishiguro, Masashi Yamamoto, and Saburo Tsuji, <i>Acquiring Omnidirectional Range Information</i> , SYSTEMS AND COMPUTER IN JAPAN, Vol. 23, No. 4, 47-56 (1992) (“Ishiguro”)
Sony-1106	Japanese Patent Laid-Open No. Hei 8-159762 (June 21, 1996)
Sony-1107	Certified English Translation of Japanese Patent Laid-Open No. Hei 8-159762 (June 21, 1996) (“Asahi”)
Sony-1108	Otto Hofmann, <i>A Digital Three Line Stereo Scanner System</i> , ISPRS INTERNATIONAL ARCHIVES OF PHOTOGRAMMETRY AND REMOTE SENSING, KYOTO, COMMISSION II, 206-13 (1988) (“Hofmann”)
Sony-1109	Prov. App. No. 60/100,721 filed Sep. 17, 1998
Sony-1110	Response to Office Action During Prosecution of ’003 Patent, U.S. Pat. App. 09/396,248 (Sep. 5, 2002)
Sony-1111	Hans C. Ohanian, PHYSICS at 246 (1985)

Ex. No.	Exhibit Name
Sony-1112	Lyndon O. Barton, MECHANISM ANALYSIS, SIMPLIFIED GRAPHICAL AND ANALYTICAL TECHNIQUES, at 11-13 (2nd ed. 1993)
Sony-1113	Expert Declaration of Trevor Darrell
Sony-1114	Curriculum Vitae of Trevor Darrell
Sony-1115	Declaration of Kouichi Matsuda (“Matsuda Declaration”)
Sony-1116	Exhibit 1M to Matsuda Declaration – Email correspondence to Kouichi Matsuda dated November 17, 1997
Sony-1117	Certified English Translation of Exhibit 1M to Matsuda Declaration – Email correspondence to Kouichi Matsuda dated November 17, 1997
Sony-1118	Exhibit 2M to Matsuda Declaration – VRSJ Research Report including Yasuhiro Kawakita, Yoshitaka Hamaguchi, Akitoshi Tsukamoto, Toshihiko Miyazaki, <i>Generation of Panoramic Stereo Images from Movie Using Single Video Camera</i> , Kansai Laboratory Research & Development Group, OKI Electric Industry Co., Ltd. (Nov. 27, 1997)
Sony-1119	Certified English Translation of Exhibit 2M to Matsuda Declaration – VRSJ Research Report including Yasuhiro Kawakita, Yoshitaka Hamaguchi, Akitoshi Tsukamoto, Toshihiko Miyazaki, <i>Generation of Panoramic Stereo Images from Movie Using Single Video Camera</i> , Kansai Laboratory Research & Development Group, OKI Electric Industry Co., Ltd. (Nov. 27, 1997)
Sony-1120	Exhibit 3M to Matsuda Declaration – [CS] SIG cyberspace meeting memo dated October 30, 1997
Sony-1121	Certified English Translation of Exhibit 3M to Matsuda Declaration – [CS] SIG cyberspace meeting memo dated October 30, 1997
Sony-1122	Exhibit 4M to Matsuda Declaration – Minutes of Cyberspace and Virtual City Study Committee Meeting
Sony-1123	Certified English Translation of Exhibit 4M to Matsuda Declaration – Minutes of Cyberspace and Virtual City Study Committee Meeting
Sony-1124	Declaration of Katsuhide Takahashi (“Takahashi Declaration”)
Sony-1125	Exhibit 1T to Takahashi Declaration – Homepage for the Virtual Reality Society of Japan City Study Committee

Ex. No.	Exhibit Name
Sony-1126	Certified English Translation of Exhibit 1T to Takahashi Declaration – Homepage for the Virtual Reality Society of Japan City Study Committee
Sony-1127	Exhibit 2T to Takahashi Declaration – Notice of call for participation for the Virtual Reality Society of Japan 2nd Virtual City (Cyberspace) Study Meeting
Sony-1128	Certified English Translation of Exhibit 2T to Takahashi Declaration – Notice of call for participation for the Virtual Reality Society of Japan 2nd Virtual City (Cyberspace) Study Meeting
Sony-1129	Exhibit 3T to Takahashi Declaration – VRSJ Research Report including Yasuhiro Kawakita, Yoshitaka Hamaguchi, Akitoshi Tsukamoto, Toshihiko Miyazaki, <i>Generation of Panoramic Stereo Images from Movie Using Single Video Camera</i> , Kansai Laboratory Research & Development Group, OKI Electric Industry Co., Ltd. (Nov. 27, 1997)
Sony-1130	Certified English Translation of Exhibit 3T to Takahashi Declaration – VRSJ Research Report including Yasuhiro Kawakita, Yoshitaka Hamaguchi, Akitoshi Tsukamoto, Toshihiko Miyazaki, <i>Generation of Panoramic Stereo Images from Movie Using Single Video Camera</i> , Kansai Laboratory Research & Development Group, OKI Electric Industry Co., Ltd. (Nov. 27, 1997)
Sony-1131	Declaration of Kenichi Okada (“Okada Declaration”)
Sony-1132	Exhibit 1O to Okada Declaration – Homepage for the Virtual Reality Society of Japan City Study Committee
Sony-1133	Certified English Translation of Exhibit 1O to Okada Declaration – Homepage for the Virtual Reality Society of Japan City Study Committee
Sony-1134	Exhibit 2O to Okada Declaration – Notice of call for participation for the Virtual Reality Society of Japan 2nd Virtual City (Cyberspace) Study Meeting
Sony-1135	Certified English Translation of Exhibit 2O to Okada Declaration– Notice of call for participation for the Virtual Reality Society of Japan 2nd Virtual City (Cyberspace) Study Meeting
Sony-1136	Exhibit 3O to Okada Declaration – VRSJ Research Report including Yasuhiro Kawakita, Yoshitaka Hamaguchi, Akitoshi Tsukamoto,

Ex. No.	Exhibit Name
	Toshihiko Miyazaki, <i>Generation of Panoramic Stereo Images from Movie Using Single Video Camera</i> , Kansai Laboratory Research & Development Group, OKI Electric Industry Co., Ltd. (Nov. 27, 1997)
Sony-1137	Certified English Translation of Exhibit 3O to Okada Declaration – VRSJ Research Report including Yasuhiro Kawakita, Yoshitaka Hamaguchi, Akitoshi Tsukamoto, Toshihiko Miyazaki, <i>Generation of Panoramic Stereo Images from Movie Using Single Video Camera</i> , Kansai Laboratory Research & Development Group, OKI Electric Industry Co., Ltd. (Nov. 27, 1997)

I. Mandatory Notices (37 C.F.R. § 42.8)

Real Party-in-Interest: Sony Corporation (“Sony” or “Petitioner”), Sony Electronics Inc., Sony Corporation of America, Sony Mobile Communications AB, and Sony Mobile Communications (USA) Inc.

Related Matters: The following matter would affect or be affected by the decision in this proceeding: *HumanEyes Technologies Ltd. v. Sony Electronics Inc. et al.*, 1-12-cv-00398 (D.Del.); *Sony Corp. v. HumanEyes Technologies Ltd.*, IPR2013-00218 (P.T.A.B.).

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II. Grounds for Standing (37 C.F.R. § 42.104(a))

Petitioner certifies that the patent for which review is sought, U.S. Patent No. 6,665,003 (“the ’003 Patent,” Sony-1101), is available for *inter partes* review and that Petitioner is not estopped from requesting an *inter partes* review challenging the patent claims on the grounds identified in this petition. Although Petitioner was served more than one year ago with a complaint asserting infringement of the ’003 Patent, Petitioner submits that, pursuant to 35 U.S.C. § 315(b), it is not barred from filing this petition because Petitioner timely filed a prior petition (IPR2013-00218) for *inter partes*

review of the '003 Patent and has accompanied the present petition with a request for joinder under 35 U.S.C. § 315(c).

III. Identification of Challenge (37 C.F.R. § 42.104(b)(1)-(3)) and Relief Requested (37 C.F.R. § 42.22(a)(1))

Petitioner challenges claims 4, 5, and 34 of the '003 Patent under 35 U.S.C. §§ 102, 103, and cancellation of those claims is requested.

A. Procedural Background

HumanEyes Technologies Ltd. (“HumanEyes”) has alleged that Sony has infringed the '003 Patent in the civil action in the District of Delaware identified as a related matter in Section I above (the “Delaware action”), which was filed on March 29, 2012. At about the same time that HumanEyes initiated the Delaware action, HumanEyes also filed a Complaint against Sony in the International Trade Commission (“ITC”), in which it asserted that Sony was infringing claims 1, 2, 3, and 22 of the '003 Patent. On March 29, 2013, Sony filed a petition for *inter partes* review requesting cancellation of those asserted claims. *Sony Corp. v. HumanEyes Technologies Ltd.*, IPR2013-00218 (P.T.A.B.).

On April 19, 2013, Sony filed a motion in the Delaware action for a stay pending IPR2013-00218. On May 6, 2013, in response to the stay motion, HumanEyes contended that Sony was infringing additional claims of the '003 Patent that were not asserted in the ITC Complaint nor otherwise previously asserted against Sony, namely claims 4, 5, and 34. *See* Answering Brief in Opposition to Sony’s Motion to Stay

Pending the Outcome of Inter Partes Review of the Patents-In-Suit, *HumanEyes Technologies Ltd. v. Sony Electronics Inc. et al.*, 1-12-CV-00398, D.I. 34, at 13 (D. Del. May 6, 2013) (Sony-1102).

Accordingly, Sony is filing its second petition for *inter partes* review of the '003 Patent, IPR2013-00326, requesting cancellation of the additional claims HumanEyes identified on May 6, 2013. Concurrently, Sony is filing a motion seeking joinder of this petition with IPR2013-000218.

B. Background of the '003 Patent

The '003 Patent states that the invention relates to both the generation and display of stereoscopic panoramic images. '003 Patent 1:19-20. However, the claims of the '003 Patent for which review is sought are directed to “[a] system for generating a stereoscopic panoramic mosaic image pair,” and not to a system for displaying the images. '003 Patent 14:51-52 (claim 1). Other claims that are not the subject of this Petition, for example claim 29, are directed to “[a] system for displaying a stereo panoramic image to a viewer.” '003 Patent 17:14-15 (claim 29). Therefore, the following discussion focuses on the '003 Patent’s description of the generation of a stereoscopic panoramic mosaic image pair.

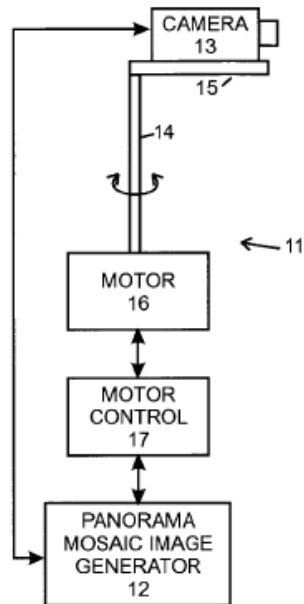
Stereoscopic images comprise two images of a scene recorded from slightly displaced positions, which, when viewed simultaneously, provide a perception of depth. *Id.* 1:36-39. The '003 Patent states that there are preexisting “arrangements for generating . . . stereoscopically *non-panoramic images*.” *Id.* 1:39-41 (emphasis added).

Therefore, the '003 Patent describes generating left and right *panoramic* images to enable a viewer to view the panorama represented thereby stereoscopically. *Id.* 1:46-48, 11:38-42.

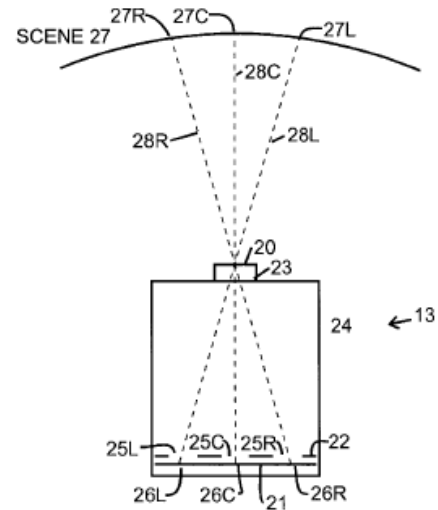
A panoramic image is an image of a scene having a wide field of view, up to a full 360°. *Id.* 1:21-22. Panoramic images can be generated by mosaicing several images together. *Id.* 1:24-28. Thus, left and right panoramic mosaic images are generated, corresponding to the left and right images in the stereoscopic image pair, respectively. *Id.* 1:53-55.

Figures 2 and 3 (reproduced below) of the '003 Patent illustrate a stereoscopic panorama recording and generating system, and Figure 4, (reproduced below) illustrates the generation of left and right panoramic images. *Id.* Figs. 2-4, 10, 6:18-36. Image data are collected using, for example, a camera mounted on the arm of a rotatable support. *Id.* 4:7-14, Fig. 2. The camera, having all but three slits (left, center, and right) of the image recording medium covered, is revolved step-by-step by a motor, with the camera being stopped at each step. *Id.* Fig. 2, 4:14-24 (motor); *id.* Fig. 3, 5:25-30, 6:1-9 (slits). At each step, the light from the scene that passes through the slits is recorded on the image recording medium. *Id.* 4:27-29; 5:25-30; 6:1-6. Then, the right and left image portions recorded at each step are respectively mosaiced together, to form left and right panoramic images. *Id.* 4:29-34, Fig. 4, 6:10-13, 6:30-38. A center panoramic image may also be generated by mosaicing together the

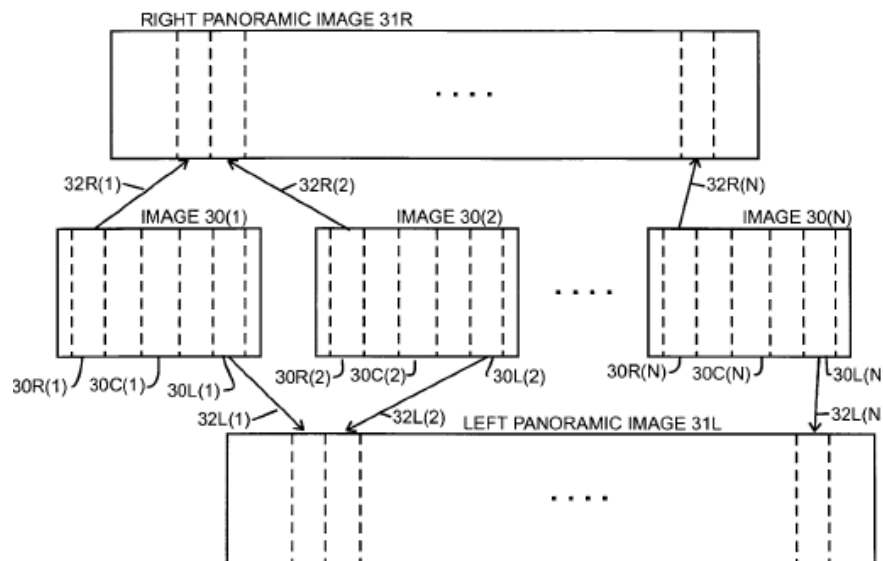
center image portions recorded at each step. *Id.* 7:1-10. The left and right panoramic images may then be used for stereo viewing. *Id.* 6:13-18, 4:29-34.



'003 Patent, Fig. 4



'003 Patent, Fig. 3



'003 Patent, Fig. 4

C. Printed Publications Relied On

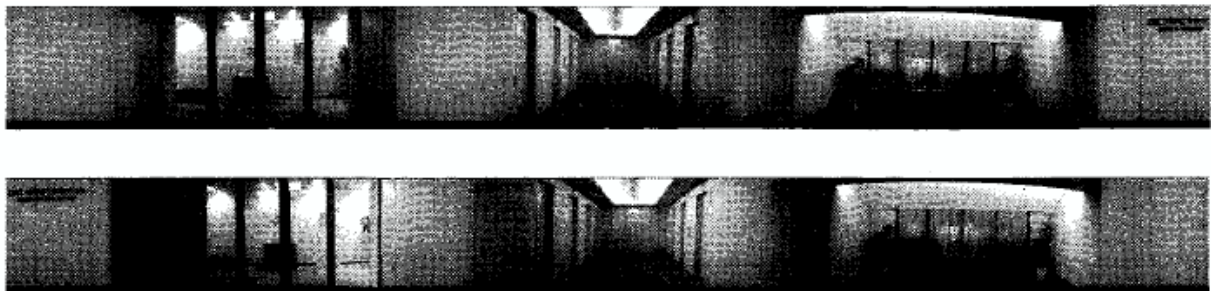
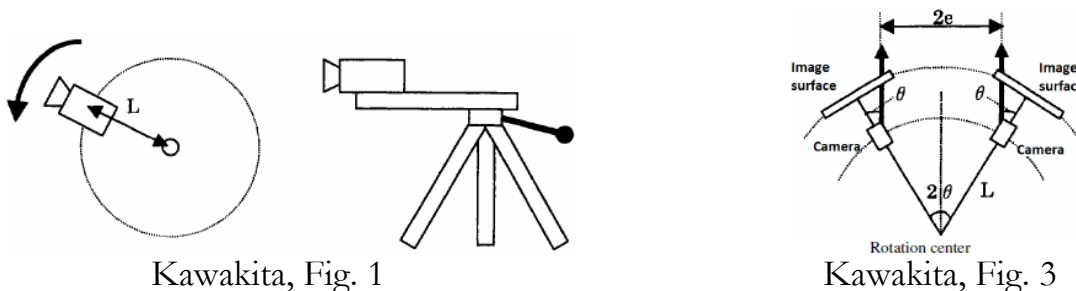
Petitioner relies on the following patents and publications:

- 1. Sony-1103 & Sony-1104: VRSJ Research Report including Yasuhiro Kawakita, Yoshitaka Hamaguchi, Akitoshi Tsukamoto, Toshihiko Miyazaki, *Generation of Panoramic Stereo Images from Movie Using Single Video Camera*, Kansai Laboratory Research & Development Group, OKI Electric Industry Co., Ltd. (Nov. 27, 1997) (“Kawakita”)**

Kawakita was published on Nov. 27, 1997, and as described in Section V, is prior art to the '003 Patent under at least 35 U.S.C. § 102(a). A reference related to Kawakita, JP Pat. Pub. No. 11-164326, was cited, but not discussed, during the prosecution of U.S. Pat. No. 7,477,284, which is in the same family as the '003 Patent.

Kawakita discloses a system that generates a stereoscopic panoramic mosaic image pair using the same technique described in the '003 Patent. Kawakita first describes the preexisting technique for generating a single, non-stereoscopic panorama by capturing images using a rotating camera, excising a vertical slit from the center of each of the images, and sequentially combining the vertical slit images together. Kawakita, Sec. 1. Then Kawakita describes a stereoscopic panoramic image generating system in which, not one, but two vertical slits (which correspond to the “strips” in the '003 Patent claims at issue) are taken from each video frame of a video camera that traverses a circular path about a center of rotation. Each slit image is displaced from the center of the video frame; one to the right and the other to the left, resulting in a series of left and right vertical image slits. The displacement of the

left and right slits within a frame is selected consistent with the displacement of the eyes of a viewer of the scene, just as the displacement of the left and right slits is selected in the camera of the '003 Patent. *Compare* '003 Patent, Fig. 3 (above) *and id.* 5:36-60, *with* Kawakita, Fig. 3 (below) *and id.* Sec. 4 (“In Fig. 3, the left and right camera positions correspond to the left and right eye positions when viewing a panoramic image stereoscopically.”). In Kawakita, the series of left and right vertical slit images are then respectively “composited” (i.e., mosaiced) to create right and left panoramas, respectively. The two panoramas form a stereoscopic panoramic image pair of a scene recorded from slightly displaced positions. *See* Fig. 5 (below). According to Kawakita, “stereoscopic viewing” of the left and right panoramic images was performed for ten researchers, and the results showed that a “sense of depth was faithfully reproduced.” *See* Kawakita, Sec. 7.

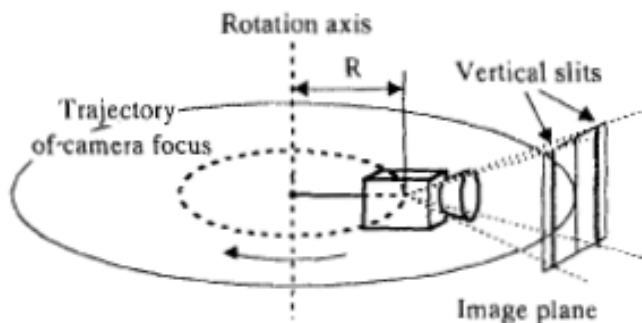


Kawakita, Fig. 5

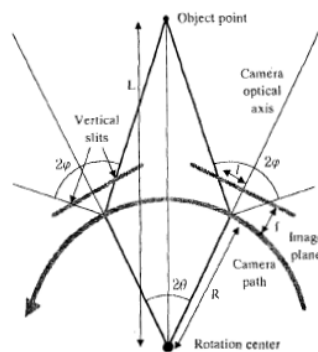
2. Sony-1105: Hiroshi Ishiguro, Masashi Yamamoto, and Saburo Tsuji, *Acquiring Omnidirectional Range Information*, SYSTEMS AND COMPUTER IN JAPAN, Vol. 23, No. 4, 47-56 (1992) (“Ishiguro”)

Ishiguro published in June, 1992, and is prior art to the '003 Patent under 35 U.S.C. § 102(b). A reference related to Ishiguro, Ishiguro, et al., *Correspondence, Omni-Directional Stereo*, IEEE TRANS. ON PATTERN ANA. AND MACH. INTEL., vol. 14, p.257-62 (1992) was cited, but not discussed, during the prosecution of U.S. Pat. No. 7,477,284, which is in the same family as the '003 Patent.

Ishiguro discloses a system for generating a stereoscopic panoramic mosaic image pair for computer vision applications including robotic navigation. The disclosed technique is the same as in the '003 Patent. A single camera traverses a circular path at a distance R away from an axis. Ishiguro, Fig. 4 (below). As in the camera described in the '003 Patent, two vertical slits are set symmetrically from the image center and images are captured through the two slits. *Id.* at 50; 003 Patent, Fig. 3. Figure 4, below, shows an enlargement of the image plane of the camera with the vertical slits illustrated. The resulting two series of slit images (which correspond to the “strips” in the '003 Patent claims at issue) are then mosaiced (i.e., “arrang[ed]”) into a pair of omnidirectional images of a scene recorded from slightly displaced positions for stereo viewing. *See id.* at 48, 50; Fig. 5 (below).



Ishiguro, Fig. 4



Ishiguro, Fig. 6



(a) Omnidirectional view from left slit



(b) Omnidirectional view from right slit

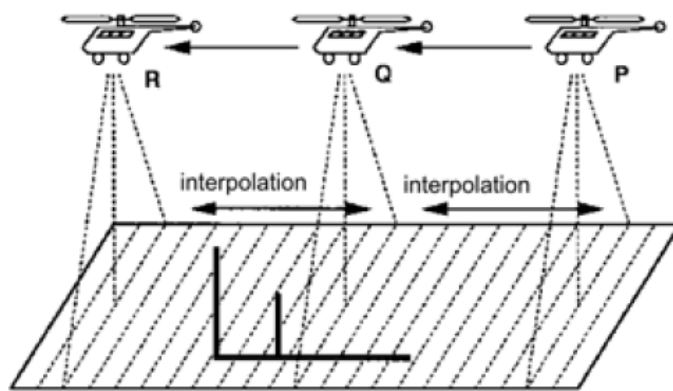
Ishiguro, Fig. 5

3. Sony-1106 & Sony-1107: Japanese Patent Laid-Open No. Hei 8-159762 (June 21, 1996) (“Asahi”)

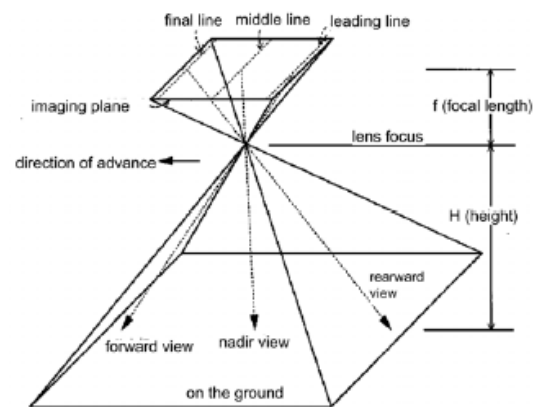
Asahi published on June 21, 1996, and is prior art to the '003 Patent under 35 U.S.C. § 102(b).

Asahi discloses an aerial camera for generating a stereoscopic panoramic mosaic image pair of a ground scene using the same principles described in the '003 Patent. Asahi, Fig. 10 (below). In Asahi, a video camera records images of a ground scene at the standard video frame rate of 30 frames (60 interlaced fields) per second. *Id.* ¶¶ 0001, 0034, Fig. 8 (reproduced below). Three scan lines (which correspond to the “strips” in the '003 Patent claims at issue) from each of the interlaced fields are

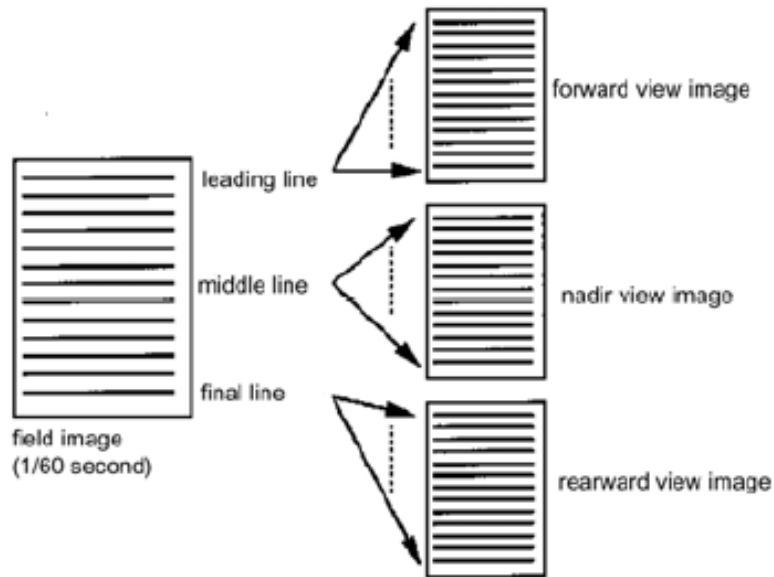
extracted. *Id.* ¶ 0035 (“as shown in FIG. 9, line data for the leading line, the middle line, and the final line of each field are extracted therefrom”), Fig. 8 (below), Fig. 9 (below). The three scan lines are then respectively mosaiced to form three “continuous [i.e., panoramic] mosaic images,” of the ground scene recorded from slightly displaced positions, which allows for “stereoscopic viewing.” *Id.* ¶ 0035, Fig. 9 (reproduced below), ¶ 0008 (“lines of video images are extracted, and continuous mosaic images having different parallax are formed”), ¶ 0035 (“stereoscopic viewing is possible using this forward view image, this nadir view image, and this rearward view image.”), Claim 24 (“A stereo image formation device characterized by comprising: an extraction means that extracts line image data, at two or more different prescribed line positions in screens, in a video captured image; and a combining means that combines line image data from the same line positions.”).



Asahi, Fig. 10 (cropped)



Asahi, Fig. 8



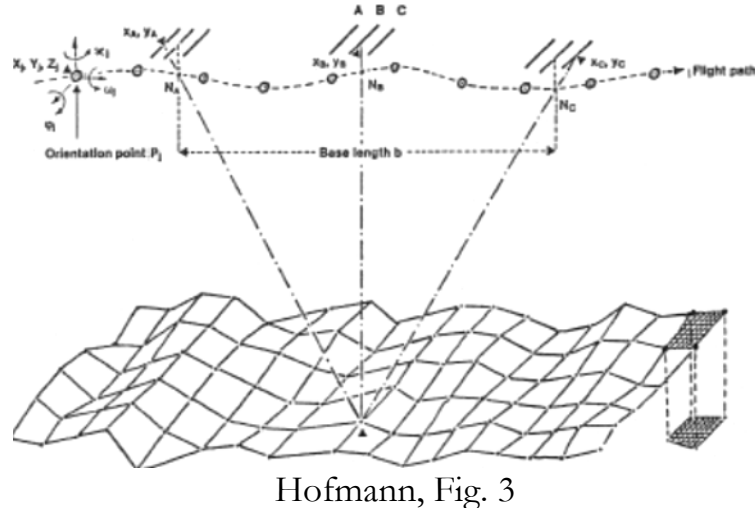
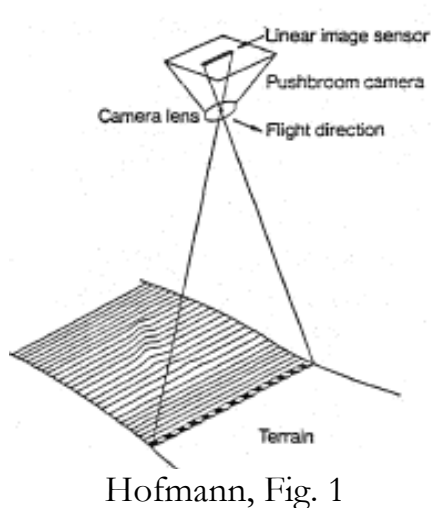
Asahi, Fig. 9

4. Sony-1108: Otto Hofmann, *A Digital Three Line Stereo Scanner System*, ISPRS INTERNATIONAL ARCHIVES OF PHOTOGRAMMETRY AND REMOTE SENSING, KYOTO, COMMISSION II, 206-13 (1988) (“Hofmann”)

Hofmann published in 1988 and is date stamped Jan. 27, 1989 by the Engineering Societies Library in Kansas City, Missouri. Accordingly, Hofmann is prior art to the '003 Patent under 35 U.S.C. § 102(b).

Like Asahi, Hofmann discloses an aerial camera for generating a stereoscopic panoramic mosaic image pair of a ground scene using the same basic principles described in the '003 Patent. Hofmann first describes a 2D camera system using the “well-known push-broom scanner principle” that produces images “line by line,” mosaicing the individual lines (which correspond to the “strips” in the '003 Patent claims at issue) to produce a continuous image. Hofmann at 206; *id.* Fig. 1 (below). Hofmann then discloses using three of such line scanners, displaced laterally from one another, to capture each point of the scene on the ground by each of the three line

scanners. *Id.* Fig. 2; Fig. 3 (below); *id.* at 208 (“Each terrain point . . . is imaged in three different image cycles”). The respective series of lines are then mosaiced together to form up to three images of the ground scene recorded from slightly displaced positions, two of which can then be viewed stereoscopically in conjunction with a “stereo monitor system.” *Id.* Fig. 1; *id.* at 211. In Hofmann, the images of the scene are a top view of a scene below. *Compare id.* Fig. 3 (below), with ’003 Patent Fig. 3.



D. Statutory Grounds for Challenge

Cancellation of claims 4, 5, and 34 is requested on the following grounds:

- A. Kawakita anticipates claims 4, 5, and 34 under 35 U.S.C. § 102(a).
- B. Ishiguro anticipates claims 4, 5, and 34 under 35 U.S.C. § 102(b).
- C. Asahi anticipates claims 4, 5, and 34 under 35 U.S.C. § 102(b).
- D. Hofmann anticipates claims 4, 5, and 34 under 35 U.S.C. § 102(b).

E. Claim Construction

The claim terms should be given their broadest reasonable construction in view of the specification. Generally, the terms should be construed in accordance with their ordinary meaning. Specific terms are discussed below.

1. “stereoscopic . . . image pair” (claims 1, on which claims 4 and 5 depend, and 34)

The term “stereoscopic . . . image pair” should be construed to mean two images of a scene recorded from slightly displaced positions, which, when viewed simultaneously by the respective eyes, provides a perception of depth. This construction is consistent with the definition of the term “stereoscopic images” set forth in the ’003 Patent at column 1:36-39. This proposed construction of the term “stereoscopic . . . image pair” does not require that the image pair actually be viewed stereoscopically. That is, the construction does not introduce into the claims the method step of actually viewing the image pair stereoscopically. Indeed, if the claims were construed to require such a method step, they would be invalid for indefiniteness. *See, e.g., IPXL Holdings v. Amazon.com, Inc.*, 430 F.2d 1377, 1384 (Fed. Cir. 2005); MPEP § 2173.05(p). Under the proposed construction, the image pair need only be capable of providing a perception of depth *when* viewed simultaneously by the respective eyes.

2. “module” (claim 1, on which claims 4 and 5 depend)

The term “module” should be construed to mean any combination of hardware and/or software elements. The specification of the ’003 Patent does not define the term “module.” Nor is the term “module” used in the specification in reference to elements that generate or mosaic image strips, as the term is used in claim 1. The term “module” appears in the specification only in the irrelevant context of “display control module 122” of the “panoramic display system” of Fig. 11. *See* ’003 Patent, 11:42 – 12:8. However, with respect to elements forming the system of the alleged invention, the ’003 Patent states:

It will be appreciated that a system in accordance with the present invention can be constructed in whole or in part from special purpose hardware or a general purpose computer system, or any combination thereof which may be controlled by a suitable program.

’003 Patent, 14:26-30. Furthermore, dependent claims 9, 10, 12, and 16, among others, provide examples of both hardware and software elements that a “module” can include: a camera (claim 9), a plurality of cameras (claim 10), a reflector and a reflector module (claim 12), and a “computer graphics methodology” (claim 16).

3. “image strip” (claims 1, on which claims 4 and 5 depend, and 34)

An “image strip” means an image, or a portion of an image, without any minimum or maximum width. The specification of the ’003 Patent does not define the term “image strip.” Nor is the term “image strip” used in the specification in reference to a

portion of an image that is joined with other image portions to produce a “panoramic mosaic image,” as the term is used in claim 1. The term “image strip” is used in the specification only to refer to the two resultant “left and right panoramic images 31L and 31R” illustrated in Fig. 4:

The panoramic mosaic image generator 12 can generate the left and right panoramic images 31L and 31R as respective image strips, or it may form the images as respective continuous loops by mosaicing together their respective left and right ends.

'003 Patent 6:47-51. However, one of the provisional applications to which the '003 Patent claims priority, Prov. App. No. 60/100,721 filed Sept. 17, 1998 (Sony-1109), contains the following passage in which the term “strip” is used to refer to an image portion that is joined with other image portions to form a resultant panoramic image:

Since images are synthetically generated, they can be generated from any desired number of viewing positions. For highest quality, images can be generated densely enough so that each strip will have a width of one pixel.

Sony-1109 at 8. Here, it is clear that a “strip” may be as narrow as one pixel in width.

4. “strips of a series of images” (claims 1, on which claims 4 and 5 depend, and 34)

The term “strips of a series of images” encompasses strips that are themselves the images. That is, the term embraces strips that are extracted from a larger recorded image, but does not require that the strips be extracted from a larger recorded image. The strips can themselves be what is recorded by the camera. For example, during

prosecution of the '003 Patent, the applicants stated the following regarding this claim term:

Preliminarily, regarding claim 28, Applicants note that the strip generator module is recited as generating image strips from images *as would be* recorded by a camera. . . . In addition, the language is used to make clear that the strip generator module does not have to generate, for each image strip, an entire image--instead, the strip generator module need only generate the respective image strip.

See Sony-1110 at 22 (Sep. 5, 2002) (emphasis in original).

In the system of Figs. 2 and 3 of the '003 Patent, the camera does not record the entire image plane within the field of view of the camera's lens, but rather records image strips within the portions of the image plane that correspond to the uncovered portions of the image recording medium 21. *See, e.g.*, 5:25-30, Fig. 3, and 3:31-41.

Therefore, consistent with the specification, “strips of a series of images” encompasses strips that themselves are the series of images.

5. “strips of the respective images displaced from one another”¹ (claims 1, on which claims 4 and 5 depend, and 34)

The term “strips of the respective images displaced from one another” encompasses image strips that are displaced relative to one another within an image

¹ Petitioner submits that this language is indefinite, but that is not an issue that can be raised in this proceeding.

plane. This construction follows from the same intrinsic evidence that supports the proposed construction of the term “strips of a series of images.” Based on the Applicant’s arguments during prosecution, and consistent with the description of the embodiment of Figs. 2 and 3 of the ’003 Patent, the image “strips” need not be portions of recorded images, but can themselves constitute what is recorded. Therefore “strips of the respective images displaced from one another” need not be strips that are displaced from one another within recorded images, but can be strips that are displaced from one another within an image plane.

6. “panoramic” images (claims 1, on which claims 4 and 5 depend, and 34)

The term “panoramic” images is defined in the ’003 Patent as “images of a scene having a wide field of view.” *See* ’003 Patent, 1:21-22.

7. “translation” (claim 4)

Claim 4 recites that “the series of positions define a translation relative to the scene.” *See* ’003 Patent, 15:7-8. A translation is a change of position in space.

A rigid body can simultaneously have two kinds of motion: it can change its position in space and it can change its orientation in space. Change in position is translational motion; . . . this motion can be conveniently described by the motion of the center of mass. Change in orientation is rotational motion. . . . *See* Hans C. Ohanian, PHYSICS at 246 (1985) (Sony-1111). There are two types of translation:

- a. **Rectilinear translation**, where all points in the body move along parallel straight paths . . .

b. **Curvilinear translation**, where all points in the body move along similar (or parallel) curved paths. . . .

When a body undergoes simultaneous translation and rotation, that body is said to be in combined motion. . . .

See Lyndon O. Barton, MECHANISM ANALYSIS, SIMPLIFIED GRAPHICAL AND ANALYTICAL TECHNIQUES, at 11-13 (2nd ed. 1993) (Sony-1112) (bold text in original).

Accordingly, a camera that is moving in a circle while continuously facing outwardly is undergoing combined motion because its motion includes curvilinear translation (the camera is changing position in space along a curved path) and rotation (the camera changes orientation to continuously face outwardly).

IV. How the Challenged Claims Are Unpatentable (37 C.F.R. § 42.104(b)(4)-(5))

The challenged claims are invalid for the reasons discussed below. An abridged set of claim charts is provided for the Board's convenience in Section VII, *infra*.

A. Kawakita Anticipates Claims 4, 5, and 34

As shown in the Appendix (VII) and described below, Kawakita anticipates claims 4, 5, and 34 of the '003 Patent; thus, claims 4, 5, and 34 are unpatentable under at least 35 U.S.C. § 102(a).

1. Kawakita Discloses Each Limitation of Claims 4 and 5 Incorporated from Claim 1

Kawakita discloses every element of claim 1, and in fact, discloses a system that uses the same technique for generating a stereoscopic panoramic mosaic image pair as the technique described in the '003 Patent.

i. A system for generating a stereoscopic panoramic mosaic image pair comprising:

As the title suggests, the purpose of Kawakita is the “Generation of Panoramic Stereo Images.” The paper presents a system that generates two images of a scene recorded from slightly displaced positions, which, when viewed simultaneously, provide a perception of depth. Left and right (i.e., a pair of) panoramic images are generated by mosaicing segments of images together. Kawakita, Abstract, Sec. 1, Fig. 5. Thus, Kawakita discloses the preamble of claim 1.

ii. A. a strip generator module configured to generate two series of image strips,

Kawakita discloses generating two series of image strips (left and right), which Kawakita refers to as “vertical slit images.” *Id.* Sec. 1, 3, 4, 5. “[T]he respective right eye and left eye slit images are excised from the frame images” captured by the rotating camera. *Id.* Sec. 4, Fig. 3. Accordingly, this element (IV.A.1.ii) is disclosed.

iii. all of said image strips in each series comprising strips of a series of images of a scene as would be recorded by a camera from a respective series of positions relative to a scene,

The vertical slit images (i.e., image strips) in Kawakita are taken from frame images (i.e., a series of images of a scene) recorded by a “camera [that] is rotated counterclockwise smoothly” over a respective series of positions. *Id.* Sec. 2 and 4. Thus, Kawakita discloses this element (IV.A.1.iii) of claim 1.

iv. the image strips of the respective series representing strips of the respective images displaced from one another by at least one selected displacement; and

In Kawakita, the left and right vertical slit images (i.e., image strips) in each frame image (e.g., respective images) are displaced from one another within the frame image by a selected displacement. *Id.* Sec. 4 (“First, we derive the positions at which the left eye and right eye slit images are to be excised.”). The selected displacement is calculated from θ in the equation $L\sin\theta = e$, where L is the radius of rotation of the camera and $2e$ is the distance between a person’s eyes, as depicted in Kawakita, Fig. 3 (above). *Id.* The displacement of the vertical slit for the left eye is at the position $w/2+x$, where w is width of the frame image and x is the position offset. *Id.* Sec. 4, Fig. 4. The displacement of the vertical slit for the right eye is at the position $w/2-x-sm$, where sm is the vertical slit width. *Id.* Sec. 4, Fig. 4. In the ’003 Patent, the displacement between the strips is selected in an essentially identical way. ’003 Patent, Fig. 10 (above), 11:22-26, 5:3-60. Kawakita discloses this element (IV.A.1.iv) of claim 1.

v. B. a mosaic image generator module configured to mosaic the respective series of image strips together thereby to construct two panoramic mosaic images, the panoramic mosaic images comprising the stereoscopic panoramic mosaic image pair providing a stereoscopic image of the scene as recorded over the path.

Kawakita discloses the mosaic image generator module: “[a]ll of the slit images excised from the frame images are continuously composited in sequence.” Kawakita,

Sec. 5; Sec. 6; *see also id.* English Abstract (“this technique cuts and connects vertical slit images”). As disclosed in Kawakita, the compositing (i.e., mosaicing) of the image slits results in two panoramic mosaic images of the scene (the elevator hallway), as depicted in Fig. 5. The two panoramic mosaic images are images of a scene recorded from slightly displaced positions, which, when viewed simultaneously, provide a perception of depth, and, therefore, comprise “a stereoscopic image of the scene as recorded over the path.” *Id.* Sec. 6 (“When the left and right panoramic images obtained using the foregoing procedure are viewed binocular stereoscopically, a stereoscopic view is possible that faithfully reproduces the positional relationships . . .”). Accordingly, Kawakita discloses this element (IV.A.1.v) of claim 1.

2. Kawakita Discloses the Limitation of Claim 4.

Claim 4 adds the limitation that in the system defined by claim 1, “the series of positions define a translation relative to the scene.” As shown in Figures 1 and 3, in Kawakita, each of the images from which the slit images are excised is captured at one of a series of positions along a curved path. Kawakita, Figs. 1, 3. In moving from one position to the next along the curved path, the camera changes its position in space (i.e., undergoes curvilinear translation), and, therefore, the positions along the curved path define a translation relative to the scene.

3. Kawakita Discloses the Limitation of Claim 5.

Claim 5 adds the limitation that in the system defined by claim 1 “the series of positions define a change in angular orientation relative to the scene.” As shown in

Figures 1 and 3, in Kawakita, each of the images from which the slit images are excised is captured at one of a series of positions along a curved path. Kawakita, Figs. 1, 3. The positions of the camera along the path define a change in angular orientation relative to the scene (for example, the two positions of the camera in Kawakita Fig. 3 define a change equal to the angle 2θ). *Id.*

4. Kawakita Discloses Each Limitation of Claim 34

i. A method of generating a stereoscopic panoramic mosaic image pair comprising the steps of:

The argument for this step is the same as discussed for the term above in IV.A.1.i.

ii. A. a strip generation step of generating two series of image strips,

The argument for this step is the same as discussed for the term above in IV.A.1.ii.

iii. all of said image strips in each series comprising strips of a series of images of a scene as would be recorded by a camera from a respective series of positions relative to the scene,

The argument for this term is the same as discussed for the term above in

IV.A.1.iii.

iv. the image strips of the respective series representing strips of the respective images displaced from one another by at least one selected displacement; and

The argument for this term is the same as discussed for the term above in

IV.A.1.iv.

- v. B. a mosaic image generation step of mosaicing the respective series of images strips together thereby to construct two panoramic mosaic images, the panoramic mosaic images comprising the stereoscopic panoramic mosaic image pair providing a stereoscopic image of the scene as recorded over the path.*

The argument for this step is the same as discussed for the term above in IV.A.1.v.

B. Ishiguro Anticipates Claims 4, 5, and 34.

Ishiguro discloses each limitation of each of claims 4, 5, and 34. Thus, claims 4, 5, and 34 are unpatentable under 35 U.S.C. § 102(b).

1. Ishiguro Discloses Each Limitation of Claims 4 and 5 Incorporated from Claim 1.

Ishiguro discloses each limitation of claim 1, and, in fact, discloses a system that uses the same technique for generating a stereoscopic panoramic mosaic image pair “using a single camera” as the technique described in the ’003 Patent. *See* Ishiguro at 47, 51.

i. A system for generating a stereoscopic panoramic mosaic image pair comprising:

Ishiguro discloses a method of generating a pair of “omnidirectional images” from which distance information can be obtained and which “can [also] be used for stereovision.” Ishiguro at 48; *id.* 49, Sec. 2.2 “Omnidirectional stereo method”; *id.* at 50 (“we acquire a pair of omnidirectional images”); *id.* Fig. 5 (“Two omnidirectional views for stereo method”). The pair of omnidirectional images cover a full 360° and are images of a scene recorded from slightly displaced positions. Thus, they are panoramic and stereoscopic. *Id.* at 48, 50, Figs. 4, 5. The pair of omnidirectional

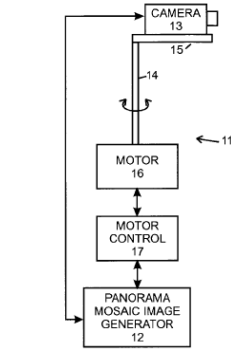
images are mosaics of image strips. *Id.* Thus, Ishiguro discloses the preamble of claim 1.

ii. A. a strip generator module configured to generate two series of image strips

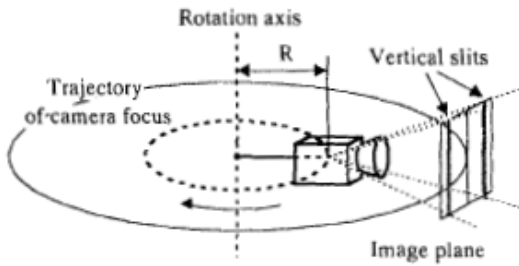
Ishiguro discloses generating two series of images strips from “two vertical slits with a 1-pixel width” that are taken from images of a rotating camera. *Id.* 49-50; Fig. 5. “By arranging the images through the slits, we acquire a pair of omnidirectional images, as shown in Fig. 5.” *Id.* at 50, Fig. 5 (above). Accordingly, Ishiguro discloses this element (IV.A.1.ii) of claim 1.

iii. all of said image strips in each series comprising strips of a series of images of a scene as would be recorded by a camera from a respective series of positions relative to a scene,

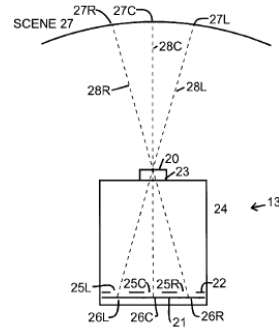
Ishiguro’s technique for recording image strips is substantively identical to that described in the ’003 Patent in connection with the embodiment of Figs. 2 and 3. In the embodiment of Figs. 2 and 3 of the ’003 Patent, the camera 13 includes a “screen 22 [] configured to generally cover portions of the image recording medium 21, except for at least two vertical slits 25L and 25R.” ’003 Patent 5:25-27. In Ishiguro, the images through the vertical slits (i.e., image strips) are taken by a “camera [that] rotates at a distance R from the rotation axis” (i.e., over a respective series of positions). Ishiguro at 50; Fig. 4, 6. Thus, Ishiguro discloses this element (IV.B.1.iii) of claim 1.



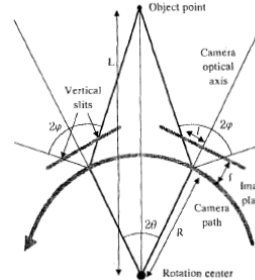
'003 Patent, Fig. 4



Ishiguro, Fig. 4



'003 Patent, Fig. 3



Ishiguro Fig. 6

iv. the image strips of the respective series representing strips of the respective images displaced from one another by at least one selected displacement; and

In Ishiguro, images formed from the left and right slits (i.e., image strips) in each image (e.g., respective images) are displaced from one another within the image plane defined by the field of view of the camera lens, in the same way that the image strips recorded by the camera 13 of Figs. 2 and 3 of the '003 Patent are displaced from one another. Ishiguro at 50 ("We set two vertical slits with a 1-pixel width symmetrically [from] the image center"); *id.* Figs. 5, 6 (above) (depicting displaced slits); '003 Patent 5:25-30. Moreover, Ishiguro's vertical slits are displaced from one another by a selected displacement. The displacement of the slits is defined as one half of the viewing angle of the camera or $\tan^{-1}(1/f)$, where f is the focal length of the camera.

Ishiguro at 50, 53; Fig. 6. Ishiguro also states that the displacement between a left and a right slit focused on the same object “is equivalent to [the] ‘parallax’ [angle] in a conventional stereo method.” *Id.* at 53. The ’003 Patent discloses calculating the parallax angle using the same concepts; choosing “the angle ‘a’” (θ in Ishiguro) such that the distance between the left and right viewing points, or parallax, “approximately corresponds to the distance between human eyes.” *Compare* ’003 Patent, 5:36-60, *with* Ishiguro Fig. 6 *and id.* at 50, 53. Ishiguro discloses this element (IV.B.1.iv) of claim 1.

v. B. a mosaic image generator module configured to mosaic the respective series of image strips together thereby to construct two panoramic mosaic images, the panoramic mosaic images comprising the stereoscopic panoramic mosaic image pair providing a stereoscopic image of the scene as recorded over the path.

Once the slit images (i.e., image strips) in Ishiguro are acquired, two omnidirectional mosaic images (a left and a right) are generated by “arranging” (i.e., mosaicing) the respective series of slits together. *Id.* at 50, Fig. 5 (reproduced above) (“By arranging [(i.e., mosaicing)] the images through the slits, we acquire a pair of omnidirectional images, as shown in Fig. 5.”). The result is a pair of omnidirectional mosaic images that “can be used for stereovision” and which comprise a stereoscopic panoramic mosaic image pair of the scene as recorded over the path. *See id.* at 48; Fig. 5 (depicting the “Omnidirectional view from [the] left slit” and the “right slit”). Accordingly, Ishiguro discloses this element (IV.B.1.v).

2. Ishiguro Discloses the Limitation of Claim 4.

Claim 4 adds the limitation that in the system defined by claim 1, “the series of positions define a translation relative to the scene.” As shown in Figures 4 and 5, in Ishiguro, each of the images from which the slit images are acquired is captured at one of a series of positions along a curved path by a “camera [that] rotates at a distance R from the rotation axis.” *Id.* at 51; *id.* Figs. 4, 5. In moving from one position to the next along the curved path, the camera changes its position in space (i.e., undergoes curvilinear translation), and, therefore, the positions along the curved path define a translation relative to the scene.

3. Ishiguro Discloses the Limitation of Claim 5.

Claim 5 adds the limitation that in the system defined by claim 1, “the series of positions define a change in angular orientation relative to the scene.” As shown in Figures 4 and 5, in Ishiguro, each of the images from which the slit images are acquired is captured at one of a series of positions along a curved path by a “camera [that] rotates at a distance R from the rotation axis.” *Id.* at 51; *id.* Figs. 4, 5. The positions of the camera along the path define a change in angular orientation relative to the scene (for example, the two positions of the camera in Ishiguro Fig. 6 define a change equal to the angle 20).

4. Ishiguro Discloses Each Limitation of Claim 34

i. A method of generating a stereoscopic panoramic mosaic image pair comprising the steps of:

The argument for this step is the same as discussed for the term above in IV.B.1.i.

ii. A. a strip generation step of generating two series of image strips,

The argument for this step is the same as discussed for the term above in IV.B.1.ii.

iii. all of said image strips in each series comprising strips of a series of images of a scene as would be recorded by a camera from a respective series of positions relative to the scene,

The argument for this term is the same as discussed for the term above in

IV.B.1.iii.

iv. the image strips of the respective series representing strips of the respective images displaced from one another by at least one selected displacement; and

The argument for this term is the same as discussed for the term above in

IV.B.1.iv.

v. B. a mosaic image generation step of mosaicing the respective series of images strips together thereby to construct two panoramic mosaic images, the panoramic mosaic images comprising the stereoscopic panoramic mosaic image pair providing a stereoscopic image of the scene as recorded over the path.

The argument for this step is the same as discussed for the term above in IV.B.1.v.

C. Asahi Anticipates Claims 4, 5, and 34.

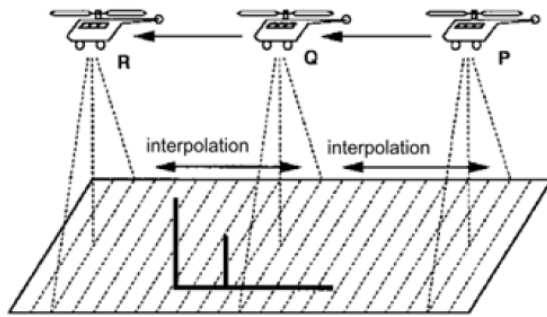
Asahi discloses each limitation claims 4, 5, and 34. Thus, claims 4, 5, and 34 are unpatentable under 35 U.S.C. § 102(b).

1. Asahi Discloses Each Limitation of Claims 4 and 5 Incorporated from Claim 1.

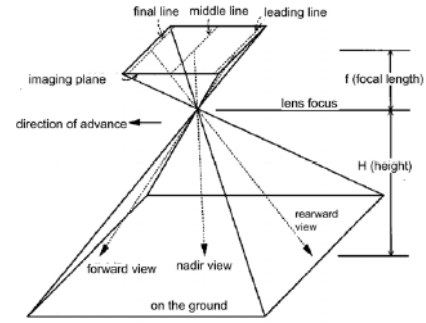
Asahi discloses every element of claim 1, and in fact, discloses an aerial camera system that uses the same technique for generating stereoscopic panoramic mosaic image pairs as the technique described in the '003 Patent. Asahi ¶¶ 0001-02.

i. A system for generating a stereoscopic panoramic mosaic image pair comprising:

Asahi discloses a system that generates at least two “continuous mosaic images” recorded of a ground scene from slightly displaced positions, which, when viewed simultaneously by the respective eyes, provides a perception of depth. *Id.* ¶ 008 (“In the present invention, image data of prescribed lines of video images are extracted, and continuous mosaic images having different parallax are formed.”); *Id.* ¶¶ 0035 (“stereoscopic viewing is possible”); Claim 11 (“a continuous mosaic image generation means that extracts image data of prescribed lines in prescribed screens in consecutive screens of captured images, and generates at least two continuous mosaic images from among a forward view image, a nadir view image, and a rearward view image”); Claim 24. The continuous mosaic images in Asahi are also panoramic as they are “continuous,” generated by stitching lines extracted from interlaced video field images (i.e., strips) together from many individual images captured by aerial camera moving over a ground scene. *Id.* ¶ 008. The field of view of the mosaics is, thus, a wide field of view. *Id.* ¶ 0014, Fig. 10 (below). Accordingly, Asahi discloses this element (IV.C.1.i).



Asahi, Fig. 10 (cropped)



Asahi, Fig. 8

ii. A. a strip generator module configured to generate two series of image strips

Asahi explains that video images of a scene are captured at 30 frames per second, and a single frame is made up of two interlaced fields – an odd field and an even field.

Id. ¶ 0034. Asahi discloses a workstation 76 that “extracts” or generates three lines

from each field – a leading line, a middle line, and a final line. *Id.* ¶ 0035, Fig. 8

(above), Fig. 9 (below), ¶ 0028 (“workstation 76”). Thus, Asahi discloses generating

three series of image strips: (1) the leading lines, (2) the middle lines, and (3) the final

lines. *See id.* ¶ 0034. Accordingly, this element (IV.C.1.ii) is disclosed.

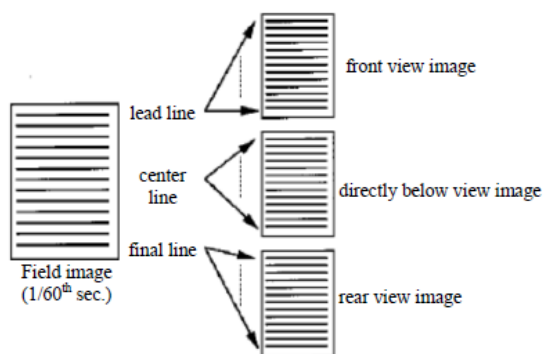
iii. all of said image strips in each series comprising strips of a series of images of a scene as would be recorded by a camera from a respective series of positions relative to a scene

The leading lines, middle lines, and final lines in Asahi are extracted from fields of

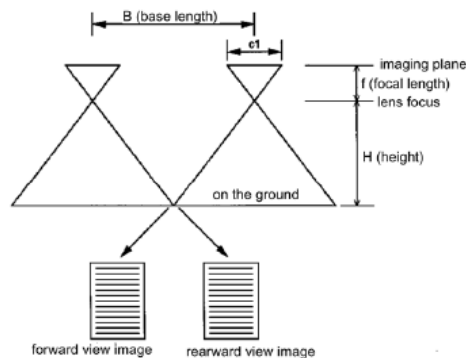
video images recorded by a video camera mounted on a helicopter as it is moved

through the air (“respective series of positions”). *Id.* ¶¶ 0014 (helicopter), 0034-35

(frames and line data), Fig. 12. Accordingly, Asahi discloses this element (IV.C.1.iii).



Asahi, Fig. 9



Asahi, Fig. 19

iv. the image strips of the respective series representing strips of the respective images displaced from one another by at least one selected displacement; and

In Asahi, the lines extracted from each field image recorded by the video camera represent strips of an image that are displaced relative to one another by a fixed amount within the image. *Id.* ¶ 0035 (“as shown in FIG. 9, line data for the leading line, the middle line, and the final line of each field are extracted therefrom.”); *see also* Figs. 8, 9. The displacement between, for example, the leading line and final line extracted from each field image (depicted as *c1* in Fig. 19 above) is selected to ensure that the mosaics that are generated each represent respective views of the ground. *Id.* ¶ 0034, Fig. 19, ¶ 0064 (“FIG. 19 illustrates a relationship between parallax difference and height.”; “ $h = d \times H/B$ ¶ [Where] *h* is a derived height (m), *d* is the parallax difference (m), *B* is the base length (m), and *H* is the imaging height (m).”). Thus, Asahi discloses this element (IV.C.1.iv) of claim 1.

- v. B. a mosaic image generator module configured to mosaic the respective series of image strips together thereby to construct two panoramic mosaic images, the panoramic mosaic images comprising the stereoscopic panoramic mosaic image pair providing a stereoscopic image of the scene as recorded over the path.*

In Asahi, three “continuous” (i.e., panoramic) mosaic images - a forward view image, a nadir view image, and a rearward view image - are generated by workstation 76 by mosaicing the respective series of image strips together. *Id.* ¶ 0034, ¶ 0028 (“the workstation 76 can obtain image data . . . after going through the various processing . . . continuous mosaic image formation”). Specifically, the extracted leading lines are mosaiced together to form the forward view image, the extracted middle lines are mosaiced together to form the nadir view image, and the extracted final lines are mosaiced together to form the rearward view image. *Id.* ¶ 0035; Fig. 17. Two of these three panoramic mosaic images are capable of providing a perception of depth when viewed simultaneously by the respective eyes. *Id.* ¶¶ 0035 (“stereoscopic viewing is possible using this forward view image, this nadir view image, and this rearward view image.”). Figure 18 illustrates a series of four stereoscopic image pairs of a scene (represented by the truncated pyramid in Fig. 17). *Id.* Figs. 17, 18. Each stereoscopic image pair is generated by mosaicing two lines extracted from each field image. *Id.* ¶ 0058, Fig. 18. The four stereoscopic image pairs illustrated in Fig. 18 differ in that they are generated by extracting lines at different displacements within the field images. *Id.* ¶ 0058, Fig. 18. Accordingly, Asahi discloses this element (IV.C.1.v) of claim 1.

2. Asahi Discloses the Limitation of Claim 4.

Claim 4 adds the limitation that in the system defined by claim 1, “the series of positions define a translation relative to the scene.” As depicted in Figure 12, in Asahi, the video images from which the lines are extracted are recorded by a video camera that is mounted in an aircraft flying along a flight path. *Id.* Fig. 12 (above). Video images of a scene are captured at 30 frames per second, and a single frame is made up of two interlaced fields – an odd field and an even field. *Id.* ¶ 0034. Therefore 60 field images per second are captured, each one at a position along the flight path (“the video images captured by the camera 10 are made up of scenes (fields) in which the imaging position is changed every 1/60 second”). *Id.* ¶ 0035. In moving along the flight path, the video camera changes its position in space, and, therefore, the series of positions along the flight path at which the field images are captured define a translation relative to the scene. Accordingly, Asahi discloses the subject matter of claim 4.

3. Asahi Discloses the Limitation of Claim 5.

Claim 5 adds the limitation that in the system defined by claim 1, “the series of positions define a change in angular orientation relative to the scene.” As depicted in Figure 12, in Asahi, the video images from which the lines are extracted are recorded by a video camera that is mounted in an aircraft flying along a flight path. *Id.* Fig. 12 (above). Video images of a scene are captured at 30 frames per second, and a single frame is made up of two interlaced fields – an odd field and an even field. *Id.* ¶ 0034.

Therefore 60 field images per second are captured, each one at a position along the flight path (“the video images captured by the camera 10 are made up of scenes (fields) in which the imaging position is changed every 1/60 second”). *Id.* ¶ 0035.

Although Figure 12 depicts the aircraft flying in a straight line, Asahi acknowledges that as field images are captured once every 1/60 second, the aircraft may fly in irregular patterns as a result of roll, pitch, and yaw of the aircraft, which change the angular orientation of the camera’s path relative to the scene. *Id.* Fig. 12, ¶ 0015.

Although the camera is mounted on a gyroscopic stabilization device that maintains the *optical axis* of the camera pointed down toward the ground, the *path* of the camera changes angular orientation relative to the scene. *Id.* ¶ 0015 (“the optical axis of the camera 10 [stays] pointed in a fixed direction in inertial space against any fluctuations in the angles about the roll, pitch, and yaw axes that arise in the airframe.”); *id.* ¶ 0017 (“Also input to the computer 18 is tri-axial gyroscopic data . . . indicating the tri-axial orientation of the camera 10 (roll angle, pitch angle, and yaw angle)”). Accordingly, Asahi discloses the subject matter of claim 5.

4. Asahi Discloses Each Limitation of Claim 34

i. A method of generating a stereoscopic panoramic mosaic image pair comprising the steps of:

The argument for this step is the same as discussed for the term above in IV.C.1.i.

ii. A. a strip generation step of generating two series of image strips,

The argument for this step is the same as discussed for the term above in IV.C.1.ii.

iii. all of said image strips in each series comprising strips of a series of images of a scene as would be recorded by a camera from a respective series of positions relative to the scene,

The argument for this term is the same as discussed for the term above in

IV.C.1.iii.

iv. the image strips of the respective series representing strips of the respective images displaced from one another by at least one selected displacement; and

The argument for this term is the same as discussed for the term above in

IV.C.1.iv.

v. B. a mosaic image generation step of mosaicing the respective series of images strips together thereby to construct two panoramic mosaic images, the panoramic mosaic images comprising the stereoscopic panoramic mosaic image pair providing a stereoscopic image of the scene as recorded over the path.

The argument for this step is the same as discussed for the term above in IV.C.1.v.

D. Hofmann Anticipates Claims 4, 5, and 34.

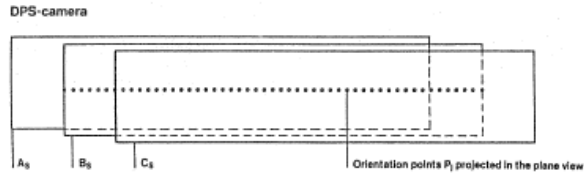
Hofmann discloses each limitation of claims 4, 5, and 34. Thus, claims 4, 5, and 34 are unpatentable under 35 U.S.C. § 102(b).

1. Hofmann Discloses Each Limitation of Claims 4 and 5 Incorporated from Claim 1.

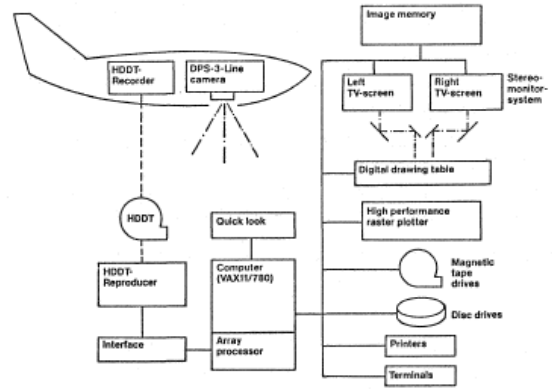
Hofmann discloses every element of claim 1, and in fact, discloses an aerial camera system that uses the same technique for generating a stereoscopic panoramic mosaic image pair as the technique described in the '003 Patent. Hofmann at 206.

i. A system for generating a stereoscopic panoramic mosaic image pair comprising:

Hofmann discloses a “Digital Three Line Stereo Scanner System” which generates a set of three panoramic mosaic images - referred to in Hofmann as “overlapping image strips.” *Id.* at 206, Fig. 4. It should be noted that the “overlapping image strips,” as it is used in Hofmann, are the final, generated stereoscopic panoramic mosaic images, and the term should not be confused with the term “image strips” as it is used in claim 1 of the ’003 Patent. *Id.* at 206. (The scan lines in Hofmann correspond to the “image strips” in claim 1 of the ’003 Patent.) As depicted in Fig. 4 (below) the “overlapping image strips” (i.e., mosaic images) have a wide field of view and are therefore panoramic. *Id.* Fig. 4 (reproduced below); see also Fig. 6. Further, two of the “overlapping image strips” are capable of providing a perception of depth when viewed simultaneously by the respective eyes. Indeed, Hofmann’s system includes a “stereo monitor system.” *Id.* Fig. 8 (reproduced below); *see also id.* Title (“A Digital Three Line Stereo Scanner System”). Accordingly, Hofmann discloses this element (IV.D.1.i).



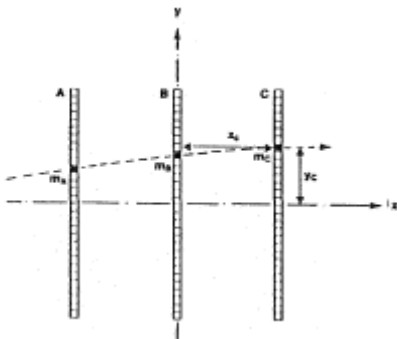
Hofmann, Fig. 4



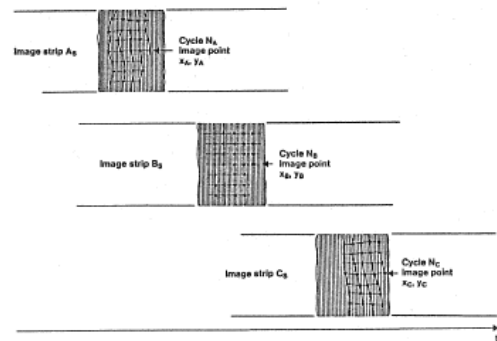
Hofmann, Fig. 8

ii. A. a strip generator module configured to generate two series of image strips

Hofmann discloses using “[t]hree linear sensor arrays” to generate three respective series of linear array images. *Id.* at 208 (“Each terrain point . . . is imaged in three different image cycles”). A single line image from each of the three linear sensor arrays is depicted in Fig. 5 (reproduced below) and the three respective series are depicted in Fig. 6 (reproduced below). The thin vertical line images depicted in Hofmann, Fig. 5 are the individual “image strips.” Accordingly, Hofmann discloses this element (IV.D.1.ii).



Hofmann, Fig. 5



Hofmann, Fig. 6

iii. all of said image strips in each series comprising strips of a series of images of a scene as would be recorded by a camera from a respective series of positions relative to a scene

The linear sensors arrays in Hofmann are sensors of a three line push broom camera. *Id.* at 206, Fig. 2. The camera is mounted in an aircraft, and, as the camera is moved through the air (“respective series of positions”), the camera continuously records three strip images of the scene. *Id.* Fig. 3, 4, 6. Accordingly, Hofmann discloses this element (IV.D.1.iii) of claim 1.

iv. the image strips of the respective series representing strips of the respective images displaced from one another by at least one selected displacement; and

In Hofmann, the line images (i.e., image strips) recorded by the camera using the three linear array scan lines A, B, C, represent strips of an image displaced relative to one another within the image plane defined by the field of view of the camera lens. *Id.* at 206; Fig. 2 (left side). As depicted in Figure 2, the three scan lines A, B, and C are displaced laterally from one another and each captures a single line of the ground scene below through a camera lens. *Id.* Fig 2. The displacement of each of the three line scans are selected to ensure that the mosaics that are generated each represent respective views of the ground scene. *Id.* at 208 (“As the positions of the linear arrays and the pixel intervals are calibrated the image coordinates . . . of any imaged and identified terrain point [] can be determined.”); *see also id.* Fig. 5. Thus, Hofmann discloses this element (IV.D.1.iv) of claim 1.

v. B. a mosaic image generator module configured to mosaic the respective series of image strips together thereby to construct two panoramic mosaic images, the panoramic mosaic images comprising the stereoscopic panoramic mosaic image pair providing a stereoscopic image of the scene as recorded over the path.

In Hofmann, as the three line push broom camera records the respective series of line images (i.e., image strips), three panoramic mosaic images are generated (referred to in Hofmann as “overlapping image strips”). *Id.* at 206 (“thereby producing three overlapping image strips A_s , B_s , C_s (Fig. 4)”). The mosaics are generated “line by line,” i.e., by placing each of the individual lines from the respective series next to one another. *Id.* at 206, 208, Fig. 1 (reproduced above), Fig. 6 (reproduced above). Figure 1 depicts this process using a single line scanner; each line is placed directly adjacent to the next in order to form a mosaic image. When the process is performed on all three lines, as depicted in Figure 6, the result is a set of three panoramic mosaic images. *Id.* Figure 6. Two of the panoramic mosaic images are capable of providing a perception of depth when viewed simultaneously by the respective eyes and, therefore, form a stereoscopic image pair. Indeed, Hofmann’s system includes a “stereo monitor system.” *See id.* Fig. 8 (depicting using a left and right screen for the stereo monitor system), *id.* 211-12 (describing the “stereo monitor system”).

Accordingly, Hofmann discloses this element (IV.D.1.v) of claim 1.

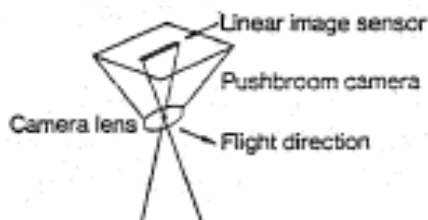
2. Hofmann Discloses the Limitation of Claim 4.

Claim 4 adds the limitation that in the system defined by claim 1, “the series of positions define a translation relative to the scene.” As shown in Figures 1 and 3, in

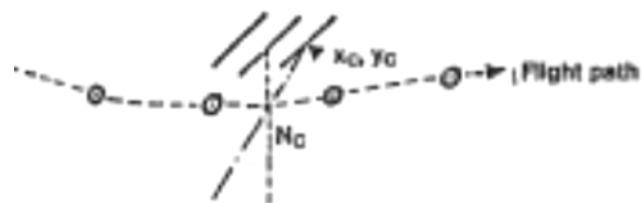
Hofmann, line scans are captured by the three line camera at a series of positions along an aircraft's flight path. *Id.* Fig. 1, Fig. 3 (above, and below in detail). In moving along the flight path, the three line camera changes its position in space, and, therefore, the series of positions along the flight path at which the line images are captured define a translation relative to the scene. Accordingly, Hofmann discloses the subject matter of claim 4.

3. Hofmann Discloses the Limitation of Claim 5.

Claim 5 adds the limitation that in the system defined by claim 1, “the series of positions define a change in angular orientation relative to the scene.” As shown in Figure 3, in Hofmann, line scans are captured by the three line camera at a series of positions along an aircraft's flight path. *See id.* Fig. 3 (above, below in detail). Aircraft do not fly straight and level at all times because of variations in flight conditions, and, therefore, the path of the three line camera undergoes changes to its angular orientation. *See id.* Fig 3. Accordingly, Hofmann discloses the subject matter of claim 5.



Hofmann, Fig. 1 (detail)



Hofmann, Fig. 3 (detail)

4. Hofmann Anticipates Claim 34

- i. A method of generating a stereoscopic panoramic mosaic image pair comprising the steps of:*

The argument for this step is the same as discussed for the term above in IV.D.1.i.

- ii. A. a strip generation step of generating two series of image strips,*

The argument for this step is the same as discussed for the term above in

IV.D.1.ii.

- iii. all of said image strips in each series comprising strips of a series of images of a scene as would be recorded by a camera from a respective series of positions relative to the scene,*

The argument for this term is the same as discussed for the term above in

IV.D.1.iii.

- iv. the image strips of the respective series representing strips of the respective images displaced from one another by at least one selected displacement; and*

The argument for this term is the same as discussed for the term above in

IV.D.1.iv.

- v. B. a mosaic image generation step of mosaicing the respective series of images strips together thereby to construct two panoramic mosaic images, the panoramic mosaic images comprising the stereoscopic panoramic mosaic image pair providing a stereoscopic image of the scene as recorded over the path.*

The argument for this step is the same as discussed for the term above in

IV.D.1.v.

V. Kawakita is Prior Art to the '003 Patent Under At Least 35 U.S.C. § 102(a)

Kawakita is a paper that was published, disseminated and publicly presented on November 27, 1997 at a conference organized by the SIG-CyberSpace (“SIG-CS”) special interest group of the Virtual Reality Society of Japan (“VRS”), before the earliest claimed priority date for the '003 Patent, *i.e.*, September 17, 1998. The Kawakita paper also was made available and disseminated to interested members of the public after the conference. Individuals associated with SIG-CS at the time of the conference – Professor Okada from Keio University (Secretary) and Kouichi Matsuda (operating director) – as well as a conference participant not affiliated with SIG-CS, Katsuhide Takahashi, have each submitted declarations explaining the pertinent facts and dates regarding the publication and distribution of the Kawakita reference.

Under 35 U.S.C. § 102(a), “a printed publication in this or a foreign country, before the invention . . . by the applicant for patent” constitutes prior art. Determining “whether a reference is a ‘printed publication’ . . . involves a case-by-case inquiry into the facts and circumstances surrounding the reference’s disclosure to members of the public.” *In re Klopfenstein*, 380 F.3d 1345, 1350 (Fed. Cir. 2004) (citation omitted). The key inquiry “is whether or not a reference has been made ‘publicly accessible.’” *Id.* at 1348.

A reference is deemed “publicly accessible,” if it shown that it “has been disseminated” or that it was “otherwise made available to the extent that persons interested and ordinarily skilled in the subject matter or art exercising reasonable

diligence, [could] locate it . . .” *Bruckelmyer v. Ground Heaters, Inc.*, 445 F.3d 1374, 1378 (Fed. Cir. 2006) (quoting *In re Wyer*, 655 F.2d 221, 226 (CCPA 1981)). Dissemination of as few as six copies of a reference has been held by the Federal Circuit to constitute a printed publication. *Massachusetts Institute of Technology v. AB Fortia*, 774 F.2d 1104, 1109 (Fed. Cir. 1985) (reference was publicly accessible when disseminated without restriction to six persons at a conference attended by those skilled in the art); *see also Cooper Cameron Corp. v. Kvaerner Oilfield Prods., Inc.*, 291 F.3d 1317, 1323-24 (Fed. Cir. 2002) (dissemination of reports to three members and six participants of a joint venture showed public accessibility).

As set forth in the declarations, Kawakita was included in a printed booklet that was disseminated without any confidentiality restriction to interested individuals at a public SIG-CS conference in November 1997. Sony Exs. 1115 (Matsuda Decl.), ¶¶ 5-6, 9; 1119; 1124 (Takahashi Decl.), ¶¶ 3, 6, 8-11; 1130; 1131 (Okada Decl.), ¶¶ 7, 10-11; 1137. The booklets were piled on the reception desk leading into the conference, and the conference was open to both members and non-members. Sony Exs. 1115, ¶¶ 5, 7-8; 1117; 1119; 1124, ¶¶ 4-6, 9; 1126; 1128; 1131, ¶¶ 7, 9; 1133; 1135. One hundred copies of the booklet were printed and made available at the conference, and approximately thirty were taken. Sony Exs. 1115, ¶¶ 10-12; 1121; 1123; 1124, ¶¶ 8-9; 1131, ¶¶ 10-11. The conference itself was publicly advertised prior to November 27, 1997, including the titles of the papers to be presented, and was directed to, and attended by, those interested in virtual reality and related technologies, including 3D

technology. Sony Exs. 1115, ¶¶ 4-9; 1117; 1124, ¶¶ 4-9; 1126; 1128; 1131, ¶¶ 6-10; 1133; 1135; *see also* Expert Declaration of Trevor Darrell (Sony-1113) ¶ 8.

Accordingly, Kawakita was publicly accessible and qualifies as “printed publication” prior art. *See, e.g., MIT*, 774 F.2d at 1119; *Arcelormittal France v. AK Steel Corp.*, 811 F. Supp. 2d 960, 966 (D. Del. 2011), *rev’d on other grounds*, 700 F.3d 1314 (Fed. Cir. Nov. 30, 2012) (affirming public accessibility based on “testimony that the [reference] was available to the public in book form when [a society] distributed copies of the book to people who attended the conference”); *American Std. Inc. v. Pfizer Inc.*, 722 F. Supp. 86, 129, n. 42 (D. Del. 1989) (finding an oral presentation at a meeting attended by 10-30 people interested in the art to be prior art).

The availability and dissemination of the booklet containing the Kawakita reference continued after the conference. The approximately 70 remaining copies of the booklet were given to Professor Okada for further distribution. Sony Exs. 1115, ¶¶ 10, 12, 13; 1131, ¶¶ 11, 12. Any requests for copies were directed to Professor Okada’s attention, who followed up on payment and delivery of the booklet. Sony Exs. 1115, ¶ 13, 1131, ¶ 12. This further supports that Kawakita was publicly accessible. *See Oki America v. Advanced Micro Devices, Inc.*, No. C 04-013171, 2006 WL 2711555, *5-*6 (N.D. Cal. Sept. 21, 2006) (holding that availability for ordering of a paper supported finding that the paper was a printed publication).

VI. Conclusion

In view of the foregoing, Petitioner requests that *inter partes* review of the '003 Patent be instituted and claims 4, 5, and 34 be cancelled.

Dated: July 10, 2013

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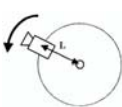
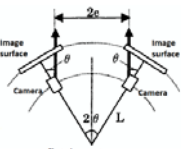
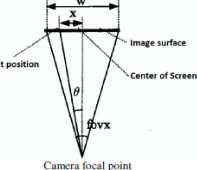

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VII. Appendix: Abridged Claim Charts

U.S. Pat. No. 6,665,003. Claim 1 and claim 34 in <i>italic</i> .	
<p>[1/34]. A [method/system] for generating a stereoscopic panoramic mosaic image pair comprising [the steps of]:</p>	<p><u>Kawakita</u></p> <p>“Generation of Panoramic Stereo Images.” Title.</p> <p>“This paper presents a technique to create panoramic stereo images easily and to display objects normally in the panoramic stereo images.” Abstract (English).</p> <p>“By excising the slit images from the frame images and combining those images, the left and right panoramic images are generated.” Sect. 1.</p> <div style="display: flex; justify-content: space-around; align-items: flex-end;"> <div style="text-align: center;">  <p>Fig. 1</p> </div> <div style="text-align: center;">  <p>Fig. 3</p> </div> <div style="text-align: center;">  <p>Fig. 4</p> </div> <div style="text-align: center;">  <p>Fig. 5</p> </div> </div>
	<p><u>Ishiguro</u></p> <p>“The environmental structure is obtained by a set of two omnidirectional images.” p. 48.</p> <p>Sec. 2.2 “Omnidirectional stereo method” p. 49.</p>

U.S. Pat. No. 6,665,003. Claim 1 and claim 34 in *italic*.

“Feature (3) can be used for stereovision by . . .” p. 48.

“[T]he stereovision using a pair of two omnidirectional images (feature (3) in (A)) is useful for determining both the structure of the wide environment and positions of objects in it.” p. 48.

“By arranging the images through the slits, we acquire a pair of omnidirectional images.” p. 50.

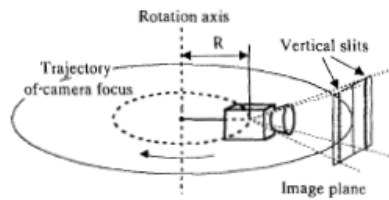


Fig. 4

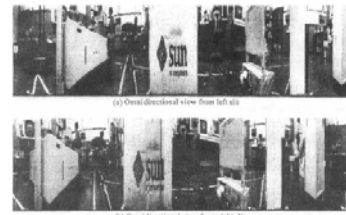


Fig. 5

Asahi

“Another object of the present invention is to propose a stereo image formation device that forms stereo images (two images suitable for stereo matching) from video images.” ¶ 0007.

“In the present invention, image data of prescribed lines of video images are extracted, and continuous mosaic images having different parallax are formed.” ¶ 0008.

“the airborne measurement system shown in FIG. 1 is aboard a helicopter. In this working example, a high-quality camera 10 is mounted on a high-precision anti-vibration stabilizing device (anti-vibration device) 12, and the high-quality image signal output thereof is recorded on videotape by a high-quality video tape recorder 14. Note that, the camera 10 is generally facing downward, and is set so that the image directly below moves in a direction that is perpendicular to the scan lines.” ¶ 0014.

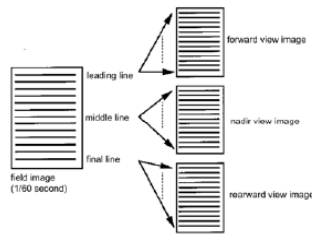
“continuous mosaic image generation means that extracts image data of prescribed lines in prescribed screens in consecutive screens of captured images, and generates at least two continuous mosaic images from among a forward view image, a nadir view image, and a rearward view image[.]” Claim 11.

“A stereo image formation device...” Claim 24.

“as shown in FIG. 9, line data for the leading line, the middle line, and the final line of each field are extracted therefrom. The image formed from the data of the leading line of each field is called the forward view

U.S. Pat. No. 6,665,003. Claim 1 and claim 34 in *italic*.

image, the image formed from the data of the middle line of each field is called the nadir view image, and the image formed from the data of the final line of each field is called the rearward view image. If the travel speed when imaging is constant, and the orientation of the camera is also constant, stereoscopic viewing is possible using this forward view image, this nadir view image, and this rearward view image.” ¶ 0035.



Figs. 9

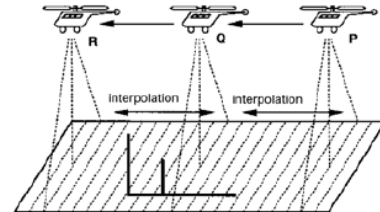


Fig. 10 (cropped)

“A pair consisting of two images that make up a stereoscopic image is called a model” ¶ 0032.

Hofmann

“Digital Three Line Stereo Scanner System” Title.

“the arrangement of three sensor lines A, B, C in the focal plane of a push broom camera . . . scan the terrain according to the push broom principle simultaneously by the synchronized image cycle N from different perspectives (Fig. 3), thereby producing three overlapping image strips As, Bs, Cs (Fig. 4)” p.206.

“The DPS is applicable in a wide range of scales for photogrammetry and remote sensing from aircraft and spacecraft. . . . Digital elevation models (DEM), - Ortho- and stereo-orthophotos[.]” p.212.

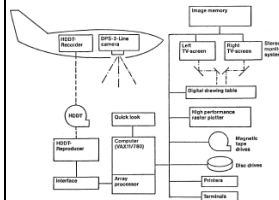


Fig. 8

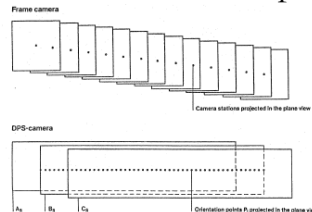


Fig. 4

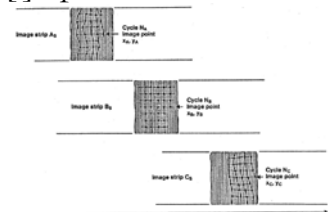


Fig. 6

A. [a strip generator module configured to generate/ *a strip*

Kawakita

“By excising the slit images from the frame images and combining those images, the left and right panoramic images are generated.” Sect. 1.

“Frame images are captured from the recorded video images, and the optical flow between the next frame image and the captured frame image (320x240 (pixels)) (see Fig. 2) is calculated. (b) of the same figure

U.S. Pat. No. 6,665,003. Claim 1 and claim 34 in *italic*.

generation step of generating]
two series of image strips,

presents the result of detecting optical flow with the next frame image using template matching.” Sect. 3.

“Once the optical flow is determined between all the continuous frame images, the size of the flow vector is used to set the slit width, and the respective right eye and left eye slit images are excised from the frame images.” Sect. 4.

“All of the slit images excised from the frame images are continuously composited in sequence. Fig. 5 shows left and right panoramic images created from images taken of an elevator hallway. The upper row is the left eye image, and the lower row is the right eye image.” Sect. 5.

Figs. 3, 5, *supra*.

Ishiguro

“Figure 4 shows the imaging method for the omnidirectional stereo. A camera rotates at a distance R from the rotation axis. We set two vertical slits with a 1-pixel width symmetrically to the image center. By arranging the images through the slits, we acquire a pair of omnidirectional images, as shown in Fig. 5.” p. 50.

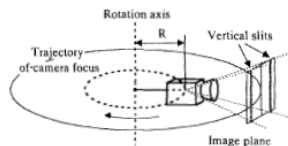


Fig. 4



Fig. 5

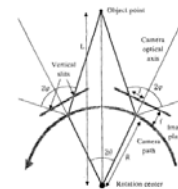


Fig. 6

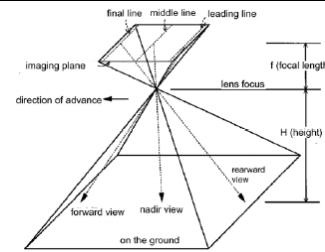
Asahi (*see claim 1, preamble, supra*)

“video images are made up of 30 frames per second, and one frame consists of two fields, an odd field and an even field.” ¶ 0034.

“the workstation 76 controls the VTR 70 and causes it to play back images with the same time code. The reproduced image signals are digitized and stored in the frame buffer 74. In this way, the workstation 76 can obtain image data as well as data on the position and orientation of the camera during imaging, and outputs DEM data after going through the various processing of orientation calculation (S2), continuous mosaic image formation (S3), vertical parallax removal (S4), parallax difference calculation, and DEM creation.” ¶ 0028.

U.S. Pat. No. 6,665,003. Claim 1 and claim 34 in *italic*.

Fig. 8:



Hofmann

“Each terrain point . . . is imaged in three different image cycles.” p. 208.

“the arrangement of three sensor lines A, B, C in the focal plane of a push broom camera . . . scan the terrain according to the push broom principle simultaneously by the synchronized image cycle N from different perspectives (Fig. 3), thereby producing three overlapping image strips As, Bs, Cs (Fig. 4)[.]” p.206.

Fig. 4 (above), 5 (below), Fig. 6 (above).

“The compilation process for the rigorous reconstruction of the strip model now consists of two main procedures . . . The result is a computer stored list of corresponding image coordinates . . .” p.208.

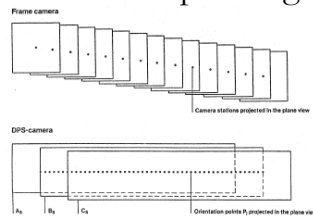


Fig. 4

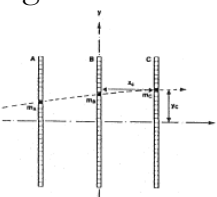


Fig. 5

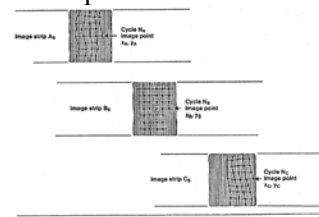


Fig. 6

all of said image strips in each series comprising strips of a series of images of a scene as would be recorded by a camera from a respective series of

Kawakita

“A video camera is attached to a tripod, and the camera is rotated counterclockwise smoothly with the rotating axle of the tripod as the center to record images. . . .” Sect. 2.

“Frame images are captured from the recorded video images, and the optical flow between the next frame image and the captured frame image (320x240 (pixels)) (see Fig. 2) is calculated. (b) of the same figure presents the result of detecting optical flow with the next frame image using template matching.” Sect. 3.

“Once the optical flow is determined between all the continuous frame images, the size of the flow vector is used to set the slit width, and the respective right eye and left eye slit images are excised from the frame images.” Sect. 4.

U.S. Pat. No. 6,665,003. Claim 1 and claim 34 in <i>italic</i> .	
positions relative to the scene,	<p>“All of the slit images excised from the frame images are continuously composited in sequence. Fig. 5 shows left and right panoramic images created from images taken of an elevator hallway. The upper row is the left eye image, and the lower row is the right eye image.” Sect. 5.</p> <p>Fig. 3 (above).</p>
	<p><u>Ishiguro</u></p> <p>“A camera rotates at a distance R from the rotation axis.” p. 50.</p> <p>“A feature point in 3-D space appears in and passes through one slit and then appears in the other as the camera rotates.” p. 50.</p> <p>Fig. 6 (above), 4 (above).</p> <p>“The camera (from Matsushita) has a color CCD with a lens (focal length 16 mm). The camera control system has a dc motor . . .” p. 53.</p>
	<p><u>Asahi</u></p> <p>“the airborne measurement system shown in FIG. 1 is aboard a helicopter. . . the camera 10 is generally facing downward, and is set so that the image directly below moves in a direction that is perpendicular to the scan lines.” ¶ 0014.</p> <p>“the equipment shown in FIG. 1 is put on board the aircraft, the target region is imaged and the flight information is recorded while flying over the target region at as constant an altitude and speed as possible (S1). At this time, the imaging target basically moves perpendicular to the scan lines of the camera 10. The images captured by the camera 10 are recorded on videotape by the VTR 14.” ¶ 0024.</p> <p>“The relationship between the camera imaging plane (CCD plane) and the on-the-ground imaging range is as in FIG. 8. the video images captured by the camera 10 are made up of scenes (fields) in which the imaging position is changed every 1/60 second; in this working example, as shown in FIG. 9, line data for the leading line, the middle line, and the final line of each field are extracted therefrom.” ¶ 0034-35.</p> <p>Fig. 12 (above).</p>
	<p><u>Hofmann</u></p> <p>“The well-known push-broom scanner principle (Fig. 1) solves the problem of the generation of digital imagery, but it produces image strips line by line. Each line has its own set of orientation parameters, but no spatial bundles of rays with central perspectivity exists.” p.206.</p>

U.S. Pat. No. 6,665,003. Claim 1 and claim 34 in *italic*.

Figs. 3 (below), 4 (above), 6 (above).

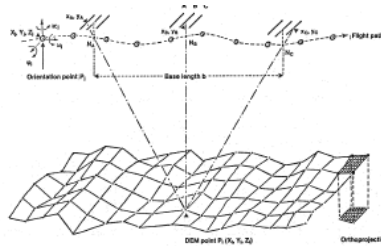


Fig. 2

Fig. 3 Strip model generation with three line camera

the image strips of the respective series representing strips of the respective images displaced from one another by at least one selected displacement ; and

Kawakita

“First, we derive the positions at which the left eye and right eye slit images are to be excised. In Fig. 3, the left and right camera positions correspond to the left and right eye positions when viewing a panoramic image stereoscopically... an image with a width corresponding to the flow vector is excised from a position 104 (pixels) horizontally from the center position of the image, thus generating the slit image.” Sect. 4.

Fig 3 (above).

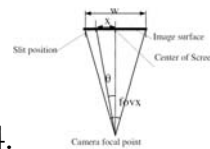


Fig. 4.

Ishiguro

“We set two vertical slits with a 1-pixel width symmetrically to the image center.” p. 50.

“A feature point in 3-D space appears in and passes through one slit and then appears in the other as the camera rotates.” p. 50.

“the two slits were set with the distance of 200 pixels from the image center.” p.54.

“By measuring 2θ of the camera rotating the feature point from one slit to the other, we can estimate the range L of the point from the rotation center...” p. 50.

“in the omnidirectional stereo method (section 2.2) the angle difference produced by the rotation of the camera initially is extracted; and then this is converted into the range information. Note, this angle difference is equivalent to ‘parallax’ in a conventional stereo method..” p. 53.

Figs. 4 (above), 5 (above), 6(above).

Asahi

U.S. Pat. No. 6,665,003. Claim 1 and claim 34 in *italic*.

Compare '003 Patent, claim 1 preamble *with* ¶ 0035.

“as shown in FIG. 9, line data for the leading line, the middle line, and the final line of each field are extracted therefrom.” ¶ 0035.

“video images are made up of 30 frames per second, and one frame consists of two fields, an odd field and an even field. Odd fields and even fields are arranged displaced from each other so that the scan lines do not overlap, and are displayed in alternation every 1/60 second.” ¶ 0034.

“ $h = d \times H / B$ where h is the height (m) to be determined, d is the parallax difference (m), B is the base length (m), and H is the imaging altitude (m). FIG. 19 shows the relationship between parallax difference and height.” ¶ 0064.

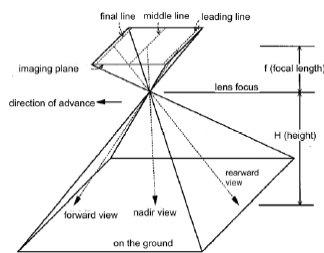


Fig. 8

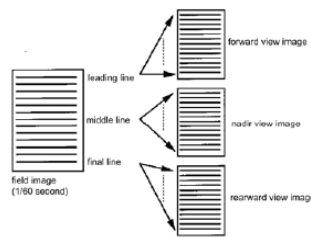


Fig. 9

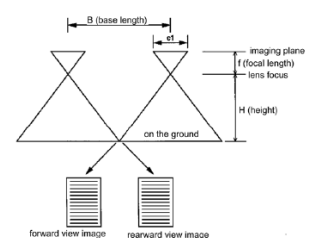


Fig. 19

Hofmann

“the arrangement of three sensor lines A, B, C in the focal plane of a push broom camera . . . [or] three telescopes . . . can be used.” p.206

“the image coordinates . . . of any imaged and identified terrain point [] can be determined.” p. 208.

B. [a mosaic image generator module configured to mosaic/ a mosaic image generation step of mosaicing] the

Kawakita

“All of the slit images excised from the frame images are continuously composited in sequence. Fig. 5 shows left and right panoramic images created from images taken of an elevator hallway. The upper row is the left eye image, and the lower row is the right eye image.” Sect. 5.

Fig. 5 above.

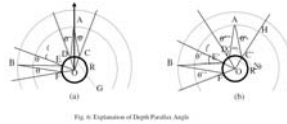
“this technique cuts and connects vertical slit images” Abstract (English).

“When the left and right panoramic images obtained using the foregoing procedure are viewed binocular stereoscopically, a stereoscopic view is

U.S. Pat. No. 6,665,003. Claim 1 and claim 34 in *italic*.

respective series of images strips together thereby to construct two panoramic mosaic images, the panoramic mosaic images comprising the stereoscopic panoramic mosaic image pair providing a stereoscopic image of the scene as recorded over the path.

possible that faithfully reproduces the positional relationships, if the image was captured from a sufficient distance.” Sect. 6.



Ishiguro

“The omnidirectional view is obtained by arranging image data taken through a vertical slit on the image plane while the camera rotates around the vertical axis.” p. 47.

“Feature (3) can be used for stereovision by using two omnidirectional images taken at different locations in an environment.” p. 48.

“By arranging the images through the slits, we acquire a pair of omnidirectional images, as shown in Fig. 5.” p. 50.

“range is obtained from two omnidirectional images . . . along a circular path.” p. 47.

“structure is obtained by a set of two omnidirectional images.” p. 48.

Fig. 4 (above), 5 (above).

Asahi

“In the present invention, image data of prescribed lines of video images are extracted, and continuous mosaic images having different parallax are formed.” ¶ 0008.

“the workstation 76 can obtain image data as well as data on the position and orientation of the camera during imaging, and outputs DEM data after going through the various processing of orientation calculation (S2), continuous mosaic image formation (S3)[.]” ¶ 0028

“... continuous mosaic images are created (S3).” ¶ 0034.

“video images captured by the camera 10 are made up of scenes (fields) in which the imaging position is changed every 1/60 second[.]” ¶ 0035.

“the target region is imaged and the flight information is recorded while flying over the target region at as constant an altitude and speed as possible[.]” ¶ 0024.

“If the travel speed when imaging is constant, and the orientation of the camera is also constant, stereoscopic viewing is possible using this forward view image, this nadir view image, and this rearward view

U.S. Pat. No. 6,665,003. Claim 1 and claim 34 in *italic*.

image.” ¶ 0035.

“Furthermore, this can be used in creating three-dimensional bird’s-eye views and in simulating new route plans in the completed state.” ¶ 0084.

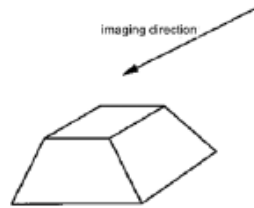


Fig. 17

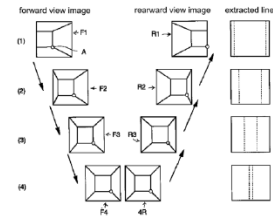


Fig. 18

Hofmann

See above p.206.

“The stereo monitor . . . performs . . . Interpretation, evaluation and measurements for topographic line map production, insertion of legends, coordinates, symbols, etc.” p.211-12.

“Determination of the homologous image points in the three strips belonging to the same terrain point. . .” p.208-09.

“image data of the three line camera. . . are stored. . . on a High Density Digital Tape . . . Beside peripheral computer devices a) an image processing system with an integrated interactive work station and stereo monitor system . . . are important components[.]” p.210-11.

“The DPS is applicable in a wide range of scales for photogrammetry and remote sensing from aircraft and spacecraft. Nearly all evaluations for topographic and thematic map production can be delivered automatically or semiautomatically [including]. . . Ortho- and stereo-orthophotos, . . .” p.212.

Fig. 8 (above).

Fig 1 (below), 4 (above), 6 (above).

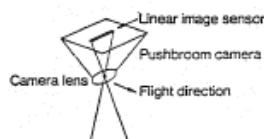


Fig. 1 (detail)

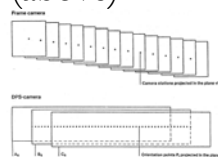


Fig. 4

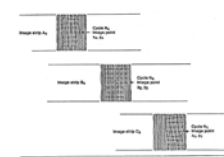


Fig. 6

4. A system as defined in claim 1 in

Kawakita (*see* claim 1, *supra*)

“A video camera is attached to a tripod, and the camera is rotated counterclockwise smoothly with the rotating axle of the tripod as the

<p>which the series of positions define a translation relative to the scene.</p>	<p>center to record images.” Sect. 2.</p> <p>“In the case of a 360-degree panoramic image, a single panoramic image can be generated from images in all direction . . .” Sect. 1.</p> <p>Fig. 1 (above); Fig. 3 (above).</p> <p>Ishiguro (<i>see claim, supra</i>)</p> <p>“A camera rotates at a distance R from the rotation axis.” p. 50.</p> <p>“. . . the camera moves along a circular path.” p. 47.</p> <p>Fig., 4 (above), 5 (above), 6 (above), 8(b), and 10.</p> <div data-bbox="719 632 911 846"> <p>Fig. 8. Conventional binocular stereo vs. omnidirectional stereo.</p> </div> <div data-bbox="927 632 1138 846"> <p>Fig. 10. Imaging model (omnidirectional view).</p> </div> <p>Asahi (<i>see claim 1, supra</i>)</p> <p>“the target region is imaged and the flight information is recorded while flying over the target region at as constant an altitude and speed as possible (S1).” ¶ 0024.</p> <div data-bbox="516 1087 1003 1318"> <p>Fig. 14.</p> </div> <div data-bbox="1230 1087 1393 1318"> <p>Fig. 12.</p> </div> <p>Hofmann (<i>see claim 1, supra</i>)</p> <p>Fig. 3 (above).</p>
<p>5. A system as defined in claim 1 in which the series of positions define a change in angular orientation relative to the scene.</p>	<p>Kawakita (<i>see claim 4, supra</i>)</p> <p>Ishiguro (<i>see claim 4, supra</i>)</p> <p>Asahi (<i>see claim 4, supra</i>)</p> <p>“Also input to the computer 18 is tri-axial gyroscopic data from the anti-vibration stabilizing device 12 indicating the tri-axial orientation of the camera 10 (roll angle, pitch</p>

	<p>angle, and yaw angle)[.]” ¶ 0017.</p> <p>“the optical axis of the camera 10 pointed in a fixed direction in inertial space against any fluctuations in the angles about the roll, pitch, and yaw axes that arise in the airframe.” ¶ 0015.</p> <p><u>Hofmann</u> (<i>see</i> claim 1;claim 2, <i>supra</i>) Figs. 1 (above), 3.</p>
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Dated: July 10, 2013

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