UNITED STATES PATENT AND TRADEMARK OFFICE

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BEFORE THE PATENT TRIAL AND APPEAL BOARD

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PANASONIC SYSTEM NETWORKS CO., LTD.
Petitioner

v.

6115187 CANADA INC.
Patent Owner

_____

Case IPR _____
U.S. Patent No. 6,844,990
Issue Date: January 18, 2005

Title: METHOD FOR CAPTURING AND DISPLAYING A VARIABLE RESOLUTION DIGITAL PANORAMIC IMAGE

_____

PETITION FOR *INTER PARTES* REVIEW OF U.S. PATENT NO. 6,844,990 UNDER 35 U.S.C. §§ 311-319 AND 37 C.F.R. § 42.100 ET SEQ.

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EXHIBIT LIST

Exhibit 1001:	U.S. Patent No. 6,844,990 ("the '990 patent") with Certificate of Correction.
Exhibit 1002:	U.S. Patent No. 5,686,957 ("Baker").
Exhibit 1003:	U.S. Patent No. 6,128,145 ("Nagaoka").
Exhibit 1004:	U.S. Patent No. 3,953,111 ("Fisher").
Exhibit 1005:	EP 1386480 B1 ("Artonne et al").
Exhibit 1006:	EP 1386480 B1 Amendment of May 6, 2010 with English translation and verification.
Exhibit 1007:	U.S. Patent No. 6,031,670 ("Inoue").
Exhibit 1008:	European Patent Publication EP 1 028 389 A2 ("Shiota").
Exhibit 1009:	Japanese Patent Publication P2000-242773A ("Matsui").
Exhibit 1010:	English translation of Matsui with verification.
Exhibit 1011:	Japanese Unexamined Patent Application Publication 11-261868 ("Enami").
Exhibit 1012:	English translation of Enami with certification.
Exhibit 1013:	Declaration of Jack Feinberg, Ph.D.
Exhibit 1014:	Declaration of Shishir K. Shah, Ph.D.

On behalf of Panasonic System Networks Co., Ltd. ("Panasonic" or "Petitioner") and in accordance with 35 U.S.C. §§ 311-319 and 37 C.F.R. § 42.100 *et seq*., *inter partes* review is respectfully requested for claims 1-4, 6-7, 10, 11, 15-20, 22-23 and 25 of U.S. Patent No. 6,844,990 ("the '990 patent").

I. MANDATORY NOTICES UNDER 37 C.F.R. § 42.8(a)(1)

A. Real Party-In-Interest Under 37 C.F.R. § 42.8(b)(1)

Panasonic is the real party-in-interest for the instant Petition.

B. Related Matters Under 37 C.F.R. § 42.8(b)(2)

(1) *ImmerVision, Inc. v. Vivotek, Inc. et al.;* USDC NEV 2:13-cv-01117-APG-CWH; filed on June 25, 2013 and dismissed September 27, 2013; and

(2) *6115187 Canada Inc. v. CBC Co. Ltd. et al*.; USDC DEL 1:13-cv-01139-SLR-SRF; filed on June 25, 2013 and dismissed August 5, 2014.

Petitioner is not a party to either litigation.

C. Lead And Back-Up Counsel Under 37 C.F.R. § 42.8(b)(3)

Petitioner's designation of counsel: Lead counsel is Michael J. Fink (Reg. No. 31,827) and back-up counsel is Arnold Turk (Reg. No. 33,094). Per 37 C.F.R. § 42.10(b), a Power of Attorney accompanies this Petition.

D. Service Information Under 37 C.F.R. § 42.8(b)(4)

Papers concerning this matter should be served on the following:

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Petitioner consents to electronic service by email at the above email addresses.

II. PAYMENT OF FEES

Payment of $23,800.00 for the fees set forth in 37 C.F.R. § 42.15(a)(1-4) for this Petition for *Inter Partes* Review accompanies this request by way of credit card payment. The undersigned authorizes payment for any additional fees due in connection with this Petition to be charged to Deposit Account No. 19-0089.

III. REQUIREMENTS FOR *INTER PARTES* REVIEW - 37 C.F.R. § 42.104

A. Grounds For Standing Under 37 C.F.R. § 42.104(a)

Petitioner hereby certifies that the '990 patent is available for *inter partes* review and that the Petitioner is not barred or estopped from requesting *inter partes* review challenging the claims of the '990 patent.

B. Identification Of Challenge Under 37 C.F.R. § 42.104(b)

1. Claims For Which *Inter Partes* Review Is Requested Under 37 C.F.R. § 42.104(b)(1)

Petitioner requests *inter partes* review of claims 1-4, 6-7, 10, 11, 15-20, 22-23 and 25 of the '990 patent ("the challenged claims").

2. The Specific Art And Statutory Ground(s) On Which The Challenge Is Based Under 37 C.F.R. § 42.104(b)(2)

Inter partes review of the '990 patent (Ex. 1001) is requested in view of the following prior art references: (1) U.S. Patent No. 5,686,957 ("Baker", Ex. 1002); (2) U.S. Patent No. 6,128,145 ("Nagaoka", Ex. 1003); (3) U.S. Patent No. 3,953,111 ("Fisher", Ex. 1004); (4) European Patent Publication EP 1 028 389 A2 ("Shiota", Ex. 1008); (5) Japanese Patent Publication P2000-242773A ("Matsui", Ex. 1009 and English translation with verification attached as Ex. 1010); (6) Japanese Unexamined Patent Application Publication 11-261868 ("Enami", Ex. 1011 and English translation with verification attached as Ex. 1012); and (7) U.S. Patent No. 6,031,670 ("Inoue", Ex. 1007). Each of these references is prior art to the '990 Patent under pre-AIA 35 U.S.C. §102(b).

The challenged claims are unpatentable as anticipated under 35 U.S.C. §102(b) and/or obvious under 35 U.S.C. §103(a), and should be cancelled for at least the following reasons:

Ground 1: Claims 1, 2, 4, 6, 17, 18, 20 and 22 are anticipated by Nagaoka.

Ground 2: Claims 1, 2, 4, 6, 17, 18, 20 and 22 are obvious over Nagaoka.

Ground 3: Claims 1, 2, 4, 6, 17, 18, 20 and 22 are anticipated by Baker.

Ground 4: Claims 1, 2, 4, 6, 17, 18, 20 and 22 are obvious over Baker.

Ground 5: Claims 1, 2, 3, 6, 7, 17, 18, 19, 22 and 23 are anticipated by Fisher.

Ground 6: Claims 1, 2, 3, 6, 7, 17, 18, 19, 22 and 23 are obvious over Fisher.

Ground 7: Claims 1, 2, 3, 6, and 7 are obvious over Fisher in view of Baker.

Ground 8: Claim 10 is obvious over Nagaoka in view of Shiota.

Ground 9: Claim 10 is obvious over Nagaoka in view of Matsui.

Ground 10: Claim 11 is obvious over Nagaoka in view of Shiota.

Ground 11: Claims 15 and 16 are obvious over Nagaoka in view of Shiota and in further view of Enami.

Ground 12: Claims 10 and 11 are obvious over Baker in view of Shiota.

Ground 13: Claims 15 and 16 are obvious over Baker in view of Shiota and further in view of Enami.

Ground 14: Claim 25 is obvious over Baker in view of Inoue.

Ground 15: Claim 25 is obvious over Nagaoka in view of Inoue.

The above grounds are not duplicative because each prior art reference provides different teachings. For example, Fisher (Ex. 1004) applies to a different set of claims than Baker (Ex. 1002) and Nagaoka (Ex. 1003), and discloses the use of aspherical lenses. Baker differs from Nagaoka in that Baker depicts the claimed expanded and compressed zones in its figures (*see, e.g.,* Figs. 2b & 3BB) whereas Nagaoka provides graphed data (*see, e.g.,* Figs. 3A & 3B) establishing the presence of the claimed expanded and compressed zones. Baker and Nagaoka further differ in the way that they disclose maximum divergence of at least +/-10%.

3. How The Challenged Claims Are To Be Construed Under 37 C.F.R. § 42.104(b)(3)

A claim subject to *inter partes* review receives the "broadest reasonable construction in light of the specification of the patent in which it appears." 37 C.F.R. § 42.100(b). Petitioner asserts the following constructions:

"Panoramic objective lens" should be construed to mean a very wide-angle lens, *e.g.,* a "fisheye" lens, capable of projecting a panoramic image. Ex. 1001, 1:18-19; Feinberg Dec. (Ex. 1013) ¶ 30.

"Object point" should be construed as a point of the image being viewed by the lens. Feinberg Dec. (Ex. 1013) ¶ 31.

"Image point" should be construed as a point of light projected by the lens onto an image plane, said light coming from the corresponding object point of a viewed object. Feinberg Dec. (Ex. 1013) ¶ 32.

"Field angle of an object point" should be construed as the angle of an incident light ray passing through the object point considered and through the center of the panorama photographed, relative to the optical axis of the objective lens. Ex. 1001, 2:18-22; Feinberg Dec. (Ex. 1013) ¶ 33.

"Maximum divergence" (DIVmax) of a non-linear distribution function from a linear distribution function is defined as: *DIV*max %=[[*dr*(Pd)-*dr*(Pd1)]/[*dr*(Pd1)]]*100. Ex. 1001, 8:57; Feinberg Dec. (Ex. 1013) ¶ 34.

"Substantially," as recited in claims 1 and 17, should be construed as an amount of compression or expansion obtained using a lens with a non-linear "distribution function having a maximum divergence of at least ±10% compared to a linear distribution function." Ex. 1001, 4:11-21; Feinberg Dec. (Ex. 1013) ¶ 35.

"Optical means for projecting" should be construed, in accordance with 35 U.S.C. § 112 ¶6, as one or more optical elements such as lenses. Feinberg Dec. (Ex. 1013) ¶ 36. The '990 patent does not limit the optical means to a specific number of optical elements, to specific shaped optical elements, to specific types of optical elements or to a specific arrangement of optical elements. The optical means are one or more optical elements that project a panorama onto an image plane of the objective lens. Ex. 1001, 5:30-31; Feinberg Dec. (Ex. 1013) ¶ 36. The '990 patent discloses "two examples of embodiments of non-linear panoramic objective lenses according to the present invention will be described, the first being a direct-type objective lens and the second of indirect type, that is using mirrors." Ex. 1001, 14:46-53. The structures corresponding to the optical means are shown in Figs. 16 and 18. The '990 patent broadly discloses optical elements, *e.g.,* lenses and/or mirrors, which perform the function of projecting a panorama onto an image plane of the objective lens. Ex. 1001, Feinberg Dec. (Ex. 1013) ¶ 36.

"Apodizer" should be construed to mean an optical system which provides a non-linear distribution of image points relative to the field angle of the object points. Ex. 1001, 16:1-4; Feinberg Dec. (Ex. 1013) ¶¶ 37-38.

"Aspherical lens" is a lens element with a non-spherical surface. Feinberg Dec. (Ex. 1013) ¶ 39.

All other terms should be afforded their ordinary and customary meanings.

4. How The Construed Claims Are Unpatentable Under 37 C.F.R. § 42.104(b)(4)

Explanations of how claims 1-4, 6-7, 10, 11, 15-20, 22-23 and 25 are unpatentable under the grounds identified above are provided in Section VI.

5. Supporting Evidence Under 37 C.F.R. § 42.104(b)(5)

The exhibit numbers of the supporting evidence relied upon to support the challenge and the relevance of the evidence to the challenge raised, including identification of specific portions of the evidence that support the challenge, are provided in Section VI. The Exhibit List is set forth on page vii. Pursuant to 37 C.F.R. § 42.63(a), this Petition is supported by the expert declarations of Jack Feinberg, Ph. D ("Feinberg Dec.")(Ex. 1013) and Shishir K. Shah, Ph. D ("Shah Dec.")(Ex. 1014), attesting to, among other issues, the invalidity of the challenged claims of the '990 Patent and supporting bases for the proposed grounds of unpatentability.

6. One Of Ordinary Skill In The Art At The Time Of Invention

A person of ordinary skill in the relevant art ("POSA") would have been aware of panoramic objective lenses, fish-eye lenses and other wide-angle lenses, and of such lenses having non-linear distribution functions. A POSA would also have understood the desirability of, and how to, correct an image obtained from a panoramic objective lens having a non-linear distribution function. A POSA in the subject matter claimed and disclosed in the '990 patent at the time of the invention would have had at least a bachelor's degree in Physics and/or Electrical Engineering and at least five years' experience working with lenses or related optical systems. Feinberg Dec. (Ex. 1013) ¶¶11-19; Shah Dec.(Ex. 1014) ¶¶20-26.

IV. SUMMARY OF THE '990 PATENT

A. Description Of The Alleged Invention Of The '990 Patent

The '990 patent discloses panoramic objective lenses having an image point distribution function that is *not linear* relative to the field angle of object points. The disclosed lenses have a maximum divergence of at least +/-10% compared to a linear distribution function, such that the image obtained has at least one substantially expanded zone and at least one substantially compressed zone. Ex. 1001, 4:11-21, Feinberg Dec. (Ex. 1013) ¶¶ 20-23. The '990 patent discloses capturing the image points and "correcting the non-linearity of the initial image, performed by means of a reciprocal function of the non-linear distribution function

of the objective lens or by means of the non-linear distribution function." '990 patent, 4:51-55 (Ex 1001); Feinberg Dec. (Ex. 1013) ¶¶ 24-26.

B. Summary Of The Prosecution Of The '990 Patent

During prosecution of the '990 patent, Fisher, and family members of Baker and Nagaoka, were cited to the examiner by the applicant. The Examiner failed to appreciate the teachings of such cited prior art, and issued a first-action allowance on Sept. 14, 2004. The Examiner's reasons for allowance (pp. 2-3) were:

> The prior art fails to teach a combination of all the claimed features as presented, for example, in independent claims 1 and 17, which include a panoramic objective lens having an image point distribution function that is not linear relative to the field angle of object points of the panorama, the distribution function having a maximum divergence of at least +/-10% compared to a linear distribution function, such that the panoramic image obtained has at least one substantially expanded zone and at least on[e] substantially compressed zone.

As shown herein, each of Baker, Nagaoka and Fisher disclose the above recited features and more.

C. Related European Patent No. 1386480 B1

During the prosecution of the European patent corresponding to the '990 patent (EP 1386480 B1)(Ex. 1005), the Applicants were required to limit the scope of the independent claims. Claim 1 of EP 1386480 B1 was originally filed with language substantially identical to claim 1 of the '990 patent. The European patent

examiner rejected the independent claims by applying Fisher and a European family member of Baker. In response, Applicants amended the independent claims to recite that the zones in the center and at the edge of the image are compressed and that an intermediate zone between the center and the edge is substantially expanded [by the panoramic objective lens](Ex. 1006, pp.21, 23). The narrowed European independent claims (claims 1 and 14) generally correspond to dependent claims 5 and 21 of the '990 patent, which are not challenged in this Petition.

V. THERE IS A REASONABLE LIKELIHOOD THAT AT LEAST ONE CLAIM OF THE '990 PATENT IS UNPATENTABLE

A. Identification Of The References As Prior Art

All of the following references are prior art under pre-AIA 35 U.S.C. §102(b) because each published more than one year prior to the earliest possible effective date of the '990 patent, *i.e.,* May 10, 2002.

U.S. Patent No. 5,686,957 ("Baker", Ex. 1002) issued November 11, 1997.

U.S. Patent No. 6,128,145 ("Nagaoka", Ex. 1003) issued October 3, 2000.

U.S. Patent No. 3,953,111 ("Fisher", Ex. 1004) issued April 27, 1976.

European Patent Publication EP 1 028 389 A2 ("Shiota", Ex. 1008) published August 16, 2000.

Japanese Patent Publication P2000-242773A ("Matsui", Ex. 1009 and English translation with verification, Ex. 1010) published September 8, 2000.

Japanese Unexamined Patent Application Publication 11-261868 ("Enami", Ex. 1011 and English translation with certification, Ex. 1012) published September 24, 1999.

U.S. Patent No. 6,031,670 ("Inoue", Ex. 1007) issued February 29, 2000.

B. Summary Of Invalidity Arguments

Nagaoka, Baker and Fisher render the claims directed to the panoramic objective lens and method for capturing an image using such lens, *i.e.,* claims 1-4, 6-7, 17-20, and 22-23, unpatentable under 35 U.S.C. §§102(b) and/or 103(a).

Similar to the '990 patent, Nagaoka, Baker and Fisher disclose panoramic objective lenses having an image point distribution function that is not linear relative to the field angle of object points. Nagaoka, Baker and Fisher disclose lenses having a maximum divergence of at least +/-10% compared to a linear distribution function, and the panoramic images obtained have at least one substantially expanded zone and at least one substantially compressed zone. Nagaoka and Baker disclose obtained images having a substantially expanded peripheral zone. Fisher discloses an obtained image having a substantially expanded center zone. Fisher also discloses using aspherical lenses. Nagaoka and Baker also disclose the desirability of correcting the images obtained.

Shiota, Matsui and Enami disclose correcting a non-linear image obtained from a panoramic objective lens, and in combination with Nagaoka and/or Baker,

render the claims directed to correcting the images, *i.e.,* claims 10, 11, 15 and 16, unpatentable under 35 U.S.C. §103(a). Shiota discloses correction performed by a non-linear distribution function. Matsui discloses correction performed by either a reciprocal function of the non-linear distribution function or by the non-linear distribution function. Shiota additionally discloses the claimed mapping function. Enami discloses the claimed color allocation and mapping functions.

Inoue discloses making lenses from PMMA and, in combination with either Nagaoka or Baker, renders claim 25 unpatentable under 35 U.S.C. §103(a).

VI. DETAILED EXPLANATION UNDER 37 C.F.R. § 42.104(b)

In accordance with 37 C.F.R. § 42.104(b) an explanation of each proposed ground of unpatentability is provided.

A. Ground 1: Claims 1, 2, 4, 6, 17, 18, 20 And 22 Are Anticipated By Nagaoka.

Nagaoka discloses each element recited in claims 1, 2, 4, 6, 17, 18, 20 and 22.

1. Claims 1 And 17

a. 1. "A method for capturing a digital panoramic image" or *17. "A panoramic objective lens comprising:"*

Nagaoka discloses a panoramic objective lens and a method for capturing a digital panoramic image: "…an image processing system utilizing an image pick-up device comprising a fisheye lens..." Ex. 1003 3:63-65, Feinberg Dec. (Ex. 1013) ¶¶ 30, 103. Nagaoka further discloses a panoramic objective lens: "an image of half of the sphere is picked up by the fisheye lens." Ex. 1003 1:23-31, Feinberg

Dec. (Ex. 1013) ¶ 103. Digital image data can be stored, *e.g.,* on a flashcard. Ex. 1003 9:18-21; Feinberg Dec. (Ex. 1013) ¶ 71.

b. 1. "by projecting a panorama onto an image sensor by means of a panoramic objective lens," or *17. "optical means for projecting a panorama into an image plane of the objective lens,"*

Nagaoka discloses that the panorama is projected onto a CCD image sensor by a panoramic objective lens. Ex. 1003 4:66-5:2 and Fig. 2; Feinberg Dec. (Ex. 1013) ¶ 104.

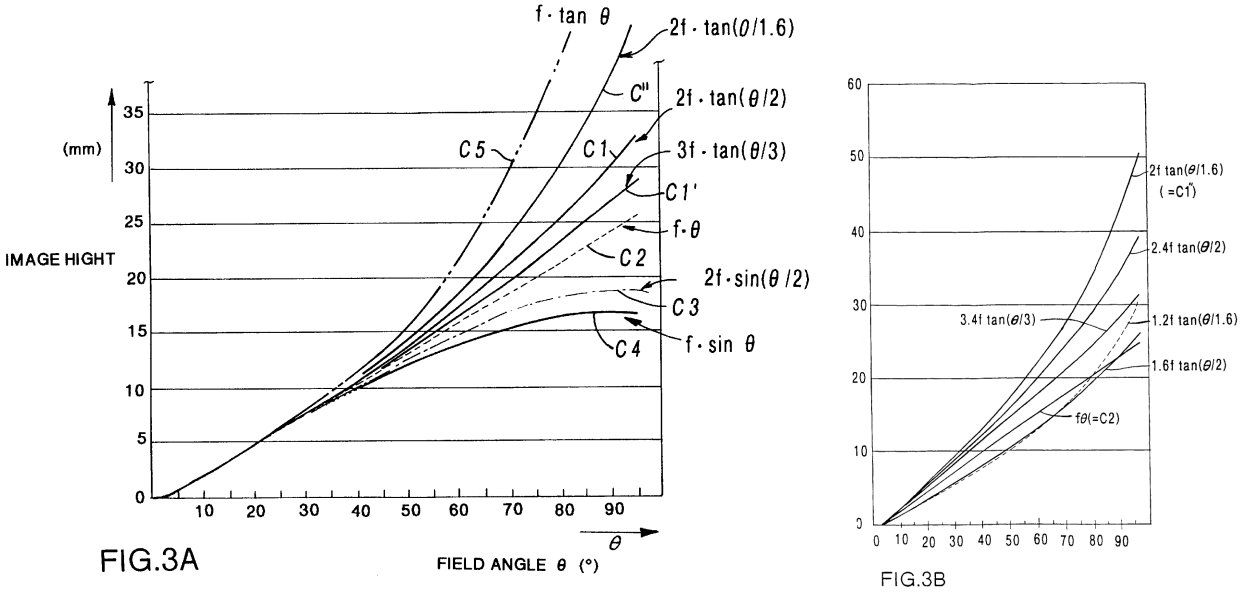
c. 1. "the panoramic objective lens having an image point distribution function that is not linear relative to the field angle of object points of the panorama," or *17. "the optical means having an image point distribution function that is not linear relative to the field angle of object points of the panorama,"*

Nagaoka discloses several panoramic (fisheye) lenses each having an image point distribution function that is not linear relative to the field angle of object points of the panorama. Feinberg Dec. (Ex. 1013) ¶¶ 87, 105. As depicted in Nagaoka Figs. 3A and 3B, examples of such non-linear lenses have the functions $h=1.2f\cdot\tan(\theta/1.6)$, $h=1.6f\cdot\tan(\theta/2)$, and $h=2f\cdot\tan(\theta/2)$. Ex. 1003 Figs. 3A and 3B. Feinberg Dec. (Ex. 1013) ¶¶ 105-106.

d. "the distribution function having a maximum divergence of at least ±10% compared to a linear distribution function"

Nagaoka (Ex. 1003) Figs. 3A and 3B below show the distribution functions for lenses with the functions $h=1.2f\cdot\tan(\theta/1.6)$, $h=1.6f\cdot\tan(\theta/2)$, and $h=2f\cdot\tan(\theta/2)$.

Each of these lenses has a maximum divergence of at least ±10% compared to the linear distribution function. Feinberg Dec. (Ex. 1013) ¶ 88.



To confirm what is shown in Nagaoka Figs. 3A and 3B, Dr. Feinberg computed the actual maximum divergence for each of these lenses using a focal length of f=1: A lens having the function h=1.2f·tan(θ/1.6) has a maximum divergence of at least 18%; a lens having the function h=1.6f·tan(θ/2) has a maximum divergence of at least 16%; and, a lens having the function h=2f·tan(θ/2) has a maximum divergence of at least 24%. Feinberg Dec. (Ex. 1013) ¶¶ 88, 92-94, 107, 108.

A POSA would have known how to fit an image projected by a lens onto an image sensor and how to set the focal length f of a lens so that the size of the projected image approximately matches the size of the image sensor. It was well within the knowledge of a POSA to select the focal length of a lens having a non-

linear distribution function so that the size of the projected image was approximately the same size as the projected image of a lens having the linear distribution function $h=f\cdot\theta$. Feinberg Dec. (Ex. 1013) ¶¶ 97-98.

A POSA would have understood that, by selecting the focal length of a lens having the nonlinear distribution function $h=2f\cdot\tan(\theta/2)$ to make its image size match that of a linear lens, the values of the gradients of that nonlinear lens would change. A lens having the nonlinear distribution function $h=2f\cdot\tan(\theta/2)$ with a focal length $f=0.79$ will produce a fisheye image of approximately the same size as a lens having the linear distribution function $h=f\cdot\theta$ with a focal length $f=1$. Feinberg Dec. (Ex. 1013) ¶¶ 99-100. A lens having the function $h=2f\cdot\tan(\theta/2)$ has a maximum divergence of at least 17% when the focal length is $f=0.79$. Feinberg Dec. (Ex. 1013) ¶¶ 94, 107, 108.

e. 1. "such that the panoramic image obtained has at least one substantially expanded zone and at least one substantially compressed zone" or *17. "such that a panoramic image obtained by means of the objective lens comprises at least one substantially expanded zone and at least one substantially compressed zone."*

The lenses having the functions $h=1.2f\cdot\tan(\theta/1.6)$ and $h=1.6f\cdot\tan(\theta/2)$, and $h=2f\cdot\tan(\theta/2)$(using $f=0.79$), all project a substantially expanded zone and a substantially compressed zone compared to the linear function $h=f\cdot\theta$. Feinberg Dec. (Ex. 1013) ¶¶ 89-91, 95-101, 109.

2. Claims 2 And 18

a. *2. "The method according to claim 1, wherein the objective lens has a non-linear distribution function that is symmetrical relative to the optical axis of the objective lens,"* or *18. "The panoramic objective lens according to claim 17, having a non-linear distribution function that is symmetrical relative to the optical axis of the objective lens,"*

Nagaoka Fig. 2 shows a lens having a non-linear distribution function that is symmetrical relative to the optical axis of the objective lens. In the lenses having functions $h=1.2f\cdot\tan(\theta/1.6)$, $h=1.6f\cdot\tan(\theta/2)$, and $h=2f\cdot\tan(\theta/2)$, the non-linear distribution function is symmetrical relative to the optical axis. Fig. 4A also shows that the non-linear distribution function $h=2f\cdot\tan(\theta/2)$ is symmetrical relative to the optical axis. Ex. 1003, Feinberg Dec. (Ex. 1013) ¶ 111.

b. *2. "the position of an image point relative to the center of the image varying according to the field angle of the corresponding object point."* or *18. "the position of an image point relative to the center of an image obtained varying according to the field angle of the corresponding object point."*

As shown in Nagaoka Fig. 2, the position of an image point relative to the center of the image varies according to the field angle of the corresponding object point. Ex. 1003 Fig. 2. Also, in lenses having the functions $h=1.2f\cdot\tan(\theta/1.6)$, $h=1.6f\cdot\tan(\theta/2)$, and $h=2f\cdot\tan(\theta/2)$, the position of an image point relative to the center of the image varies according to the field angle of the corresponding object point. Feinberg Dec. (Ex. 1013) ¶ 111.

3. Claims 4 And 20: *4. "The method according to claim 1, wherein the objective lens expands the edges of the image and compresses the center of the image"* or *20. "The panoramic objective lens according to claim 17, wherein the lens expands the edges of an image and compresses the center of the image"*

As established by Dr. Feinberg, Nagaoka discloses lenses having the functions $h=1.2f\cdot\tan(\theta/1.6)$ and $h=1.6f\cdot\tan(\theta/2)$, and $h=2f\cdot\tan(\theta/2)$(using $f=0.79$), which expand the edges of the image and compress the center of the image. Feinberg Dec. (Ex. 1013) ¶ 112.

4. Claims 6 And 22: *6. "The method according to claim 1, wherein the objective lens comprises a set of lenses forming an apodizer"* or *22. "The panoramic objective lens according to claim 17, further comprising a set of lenses forming an apodizer."*

An "apodizer" is an optical system which provides a non-linear distribution of image points relative to the field angle of the object points. As shown in Nagaoka Fig. 2, the lens system controls the angular distribution of the panoramic objective lens to obtain a non-linear distribution function. Feinberg Dec. (Ex. 1013) ¶ 113.

In view of the above, these claims should be cancelled under 35 U.S.C. §102(b) because Nagaoka discloses every element recited in claims 1, 2, 4, 6, 17, 18, 20 and 22 of the '990 patent. Feinberg Dec. (Ex. 1013) ¶¶ 70-113.

B. Ground 2: Claims 1, 2, 4, 6, 17, 18, 20 And 22 Are Obvious Under 35 U.S.C. §103(a) Over Nagaoka.

In the event that the Board finds any element of claims 1, 2, 4, 6, 17, 18, 20 and/or 22 not expressly or inherently present in Nagaoka, for example, that using a focal length of 0.79 for that embodiment of a lens having the function $h=2f\bullet\tan(\theta/2)$ to determine the maximum divergence is not inherent, such claims should nonetheless be cancelled as unpatentable under 35 U.S.C. §103(a). Feinberg Dec. (Ex. 1013) ¶ 114. Where the claimed and prior art products are identical or substantially identical in structure or composition, or are produced by identical or substantially identical processes, a prima facie case of either anticipation or obviousness has been established. *In re Best*, 562 F.2d 1252, 1255 (CCPA 1977). Claim charts for independent claims 1 and 17 are set forth below.

Claim 1 '990 Patent	NAGAOKA, U.S. Patent No. 6,128,145
1a. A method for capturing a digital panoramic image,	"An image processing system utilizing an image pick-up device comprising a fisheye lens." Ex. 1003, 3:63-65; "an image of half of the sphere is picked up by the fisheye lens." Ex. 1003 1:23-31, 9:18-21. Digital image data can be stored, *e.g.,* on a flashcard. Ex. 1003 9:18-21. Feinberg Dec. (Ex. 1013) ¶¶71, 103.
1b. by projecting a panorama onto an image sensor by means of a panoramic objective lens,	The panorama is projected onto a CCD image sensor by a panoramic objective lens. Ex. 1003, 4:66-5:2 and Fig. 2; Feinberg Dec. (Ex. 1013) ¶104.
1c. the panoramic objective lens having an image point distribution function	Nagaoka discloses several lenses having an image point distribution function that is not linear relative to the field angle of object points of the panorama. Specifically, the lenses having the functions

that is not linear relative to the field angle of object points of the panorama,	h=1.2f·tan(θ/1.6), h=1.6f·tan(θ/2), and h=2f·tan(θ/2) are non-linear. Ex. 1002, Figs. 3A and 3B; Feinberg Dec. (Ex. 1013) ¶¶105-106, 77-78.
1d. the distribution function having a maximum divergence of at least ±10% compared to a linear distribution function,	The graphs in Nagaoka Figs. 3A and 3B show lenses with a non-linear distribution function having a maximum divergence of at least ±10% compared to a linear distribution function. Feinberg Dec. (Ex. 1013) ¶88. Lenses with the distribution functions h=1.2f·tan(θ/1.6), h=1.6f·tan(θ/2), and h=2f·tan(θ/2) each have a maximum divergence of at least ±10% compared to the linear distribution function. Feinberg Dec. (Ex. 1013) ¶¶81-84, 88, 92-94, 107, 108.
1e. such that the panoramic image obtained has at least one substantially expanded zone and at least one substantially compressed zone.	Lenses having the functions h=1.2f·tan(θ/1.6) and h=1.6f·tan(θ/2), and h=2f·tan(θ/2)(*using f=0.79*), have a substantially expanded zone and a substantially compressed zone. Feinberg Dec. (Ex. 1013) ¶¶89-91, 95-101, 109, 115.
Claim 17 '990 Patent	**NAGAOKA, U.S. Patent No. 6,128,145**
17a. A panoramic objective lens comprising:	"a fisheye lens which can pick up an image of all the directions of the field of view around the optical axis at a field angle of at least 90° in each direction with respect to the optical axis." Ex. 1003, 1:17-21. "an image of half of the sphere is picked up by the fisheye lens." Ex. 1003 1:23-31. Feinberg Dec. (Ex. 1013) ¶¶71, 103.
17b. optical means for projecting a panorama into an image plane of the objective lens,	Nagaoka discloses that the panorama is projected onto a CCD image sensor by a panoramic objective lens. Ex. 1003, 4:66-5:2 and Fig. 2; Feinberg Dec. (Ex. 1013) ¶104.
17c. the optical means having an image point distribution function that is not linear relative to the field angle of object points of the panorama,	Nagaoka discloses several lenses having an image point distribution function that is not linear relative to the field angle of object points of the panorama. Specifically, the lenses having the functions h=1.2f·tan(θ/1.6), h=1.6f·tan(θ/2), and h=2f·tan(θ/2) are non-linear. Ex. 1003 Figs. 3A and 3B; Feinberg Dec. (Ex. 1013) ¶¶105-106, 77-78..

17d. the distribution function having a maximum divergence of at least ±10% compared to a linear distribution function,	The graphs in Nagaoka Figs. 3A and 3B show lenses with a non-linear distribution function having a maximum divergence of at least ±10% compared to a linear distribution function. Feinberg Dec. (Ex. 1013) ¶88. Lenses with the distribution functions $h=1.2f\cdot\tan(\theta/1.6)$, $h=1.6f\cdot\tan(\theta/2)$, and $h=2f\cdot\tan(\theta/2)$ each have a maximum divergence of at least ±10% compared to the linear distribution function. Feinberg Dec. (Ex. 1013) ¶¶81-84, 88, 92-94, 107, 108.
17e. such that a panoramic image obtained by means of the objective lens comprises at least one substantially expanded zone and at least one substantially compressed zone.	Lenses having the functions $h=1.2f\cdot\tan(\theta/1.6)$ and $h=1.6f\cdot\tan(\theta/2)$, and $h=2f\cdot\tan(\theta/2)$(*using f=0.79*), have a substantially expanded zone and a substantially compressed zone. Feinberg Dec. (Ex. 1013) ¶¶89-91, 95-101, 109, 114.

As discussed above, there are believed to be no differences between Nagaoka and the claims at issue. Feinberg Dec. (Ex. 1013) ¶¶ 102, 110, 155. Nagaoka shows at least three embodiments satisfying the recited claim elements.

Further, as is evident from the Feinberg Declaration, a POSA would have known how to fit an image projected by a lens onto an image sensor, and that to determine the maximum divergence of a lens having the function $h=2f\cdot\tan(\theta/2)$, the image projected by a lens first had to be fit onto an image sensor. A POSA would have known how to determine the proper focal length and would have determined that a lens having the non-linear distribution function $h=2f\cdot\tan(\theta/2)$ with a focal length f=0.79 will produce a fisheye image of approximately the same size as a lens having the linear distribution function $h=f\cdot\theta$ with a focal length f=1.

Feinberg Dec. (Ex. 1013) ¶¶ 97-101. Accordingly, a POSA would have been able to readily determine that this non-linear lens has a maximum divergence of at least ±10% compared to a linear distribution function, and that the projected panoramic image has at least one substantially expanded zone and at least one substantially compressed zone. Thus, should the Board find that using a focal length of 0.79 for a lens having the function $h=2f\cdot\tan(\theta/2)$ to determine the maximum divergence is not inherent, such knowledge would nevertheless have been obvious to a POSA.

Similarly, even if the Board finds that Nagaoka does not expressly disclose expanding the edges of the image and compressing the center of the image, a POSA would nevertheless have known that each of the prior art lenses having respective functions $h=1.2f\cdot\tan(\theta/1.6)$, $h=1.6f\cdot\tan(\theta/2)$, and $h=2f\cdot\tan(\theta/2)$, expand the edges of the image and compress the center of the image. Feinberg Dec. (Ex. 1013) ¶¶ 90, 91, 101, 107-109, 112, 114-115.

Claims 1, 2, 4, 6, 17, 18, 20 and 22 should thus be cancelled under 35 U.S.C. §103(a) as obvious in view of Nagaoka.

C. Ground 3: Claims 1, 2, 4, 6, 17, 18, 20 And 22 Are Anticipated By Baker.

Baker discloses each element recited in claims 1, 2, 4, 6, 17, 18, 20 and 22.

1. Claims 1 And 17

a. *1. "A method for capturing a digital panoramic image"* or *17. "A panoramic objective lens comprising:"*

Baker discloses "the visual imaging system can use a single camera to capture the relevant visual information within a panoramic field of view existing along the horizon," Ex. 1002 6:29-32, and that the "captured scene can be stored onto an assortment of media, e.g., photographic film 16, electronic storage 18, or other conventional storage means." Ex. 1002 8:62-65; 2:35-39; 10:55-57; 14:32-36; Feinberg Dec. (Ex. 1013) ¶¶ 50-52.

b. 1. "by projecting a panorama onto an image sensor by means of a panoramic objective lens," or *17. "optical means for projecting a panorama into an image plane of the objective lens,"*

Baker discloses projecting a panorama onto an image sensor by means of a panoramic objective lens, and that a "CCD" may be used for digital storage. Ex. 1002 13:16; Feinberg Dec. (Ex. 1013) ¶¶ 53-57.

c. 1. "the panoramic objective lens having an image point distribution function that is not linear relative to the field angle of object points of the panorama," or *17. "the optical means having an image point distribution function that is not linear relative to the field angle of object points of the panorama,"*

Baker Fig. 2A depicts a lens having a typical *linear* distribution function of image points, and Baker Fig. 3BA depicts a lens having a *non-linear* distribution function of image points, relative to the field angle of the object points of the panorama. Ex. 1002, 12:23-25; Feinberg Dec. (Ex. 1013) ¶¶ 41-46.

Baker discloses the "fundamental principle behind the enhanced peripheral content lens is the selective magnification of the periphery and the focusing of

more of that content on the imaging plane." Ex. 1002 10:38-41; Fig. 3BA. Baker further discloses a non-linear "lens, indicated generally at 14, designed to capture and enhance the peripheral content of a hemispheric scene." Ex. 1002 8:60-62. "To maximize data collection and resolution for analysis and/or display of the relevant visual information located in this portion of the hemispheric scene, it is desirable to maximize the dedication of the available image detection area to this peripheral field portion." Ex. 1002 8:32-36; Feinberg Dec. (Ex. 1013) ¶¶ 56-58.

d. "the distribution function having a maximum divergence of at least ±10% compared to a linear distribution function"

Baker discloses a panoramic objective lens with a distribution function having a maximum divergence of at least ±10% compared to a linear distribution function. "[I]f an ordinary fisheye lens focuses the lowest 15 degrees up from the horizon on ten percent of the imager at the imaging plane and the peripheral-enhancing lens focuses that same 15 degrees on fifty percent of the imager, there is a five-fold increase in resolution using the same imaging device. Depending on the application and exact formulation of the lens equations, there will be at least a five times increase in resolving power by this lens/imager combination." Ex. 1002 6:48-56. A POSA would understand that a lens that provides a five-fold increase in resolution for the lowest 15 degrees up from the horizon will always have a maximum divergence of at least ±10% compared to a linear distribution function. Feinberg Dec. (Ex. 1013) ¶¶ 59-61.

e. 1. "such that the panoramic image obtained has at least one substantially expanded zone and at least one substantially compressed zone" or *17. "such that a panoramic image obtained by means of the objective lens comprises at least one substantially expanded zone and at least one substantially compressed zone."*

Baker discloses "The lens uniquely achieves this by filling the greater available area of an imager device with the peripheral areas rather than the central areas of the captured scene." Ex. 1002, 10:57-60. "[T]he lens constructed according to the present invention has a fairly significant portion of the imaging surface dedicated to the peripheral field, and consequently less of the surface dedicated to the central field." Ex. 1002, 12:29-32.

The panoramic image obtained from the *linear* objective lens is shown in Baker Fig. 2B below, and the panoramic image obtained from the *non-linear* objective lens is shown in Baker Fig 3BB below (Ex. 1002):

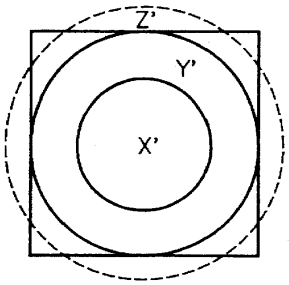


Fig. 2B

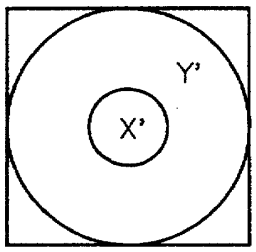


Fig. 3BB

Comparing the image in Fig. 2B (linear image) to the image in Fig. 3BB (non-linear image) shows how zone X' has been substantially compressed and zone Y' has been substantially expanded. Thus, the panoramic image obtained from the non-linear objective lens (Fig. 3BB) depicts a substantially expanded

zone Y' and a substantially compressed zone X' compared to the panoramic image obtained from the linear objective lens (Fig. 2B). Ex. 1002 12:29-32; Feinberg Dec. (Ex. 1013) ¶¶ 42-48, 62, 66, 67.

2. Claims 2 And 18

a. *2. "The method according to claim 1, wherein the objective lens has a non-linear distribution function that is symmetrical relative to the optical axis of the objective lens,"* or *18. "The panoramic objective lens according to claim 17, having a non-linear distribution function that is symmetrical relative to the optical axis of the objective lens,"*

Baker Fig. 3BA depicts a lens having a non-linear distribution function that is symmetrical relative to the optical axis of the objective lens. Feinberg Dec. (Ex. 1013) ¶ 64.

b. *2. "the position of an image point relative to the center of the image varying according to the field angle of the corresponding object point."* or *18."the position of an image point relative to the center of an image obtained varying according to the field angle of the corresponding object point."*

Baker Figs. 3BA and 3BB show that the position of an image point relative to the center of the image varies according to the field angle of the corresponding object point. Feinberg Dec. (Ex. 1013) ¶ 65.

3. Claims 4 And 20: *4. "The method according to claim 1, wherein the objective lens expands the edges of the image and compresses the center of the image"* or *20. "The panoramic objective lens according to claim 17, wherein the lens expands the edges of an image and compresses the center of the image"*

Compare Baker Figs. 2B and 3BB. "The lens uniquely achieves this by filling the greater available area of an imager device with the peripheral areas rather than the central areas of the captured scene." Ex. 1002 10:57-60. "The lens constructed according to the present invention has a fairly significant portion of the imaging surface dedicated to the peripheral field, and consequently less of the surface dedicated to the central field." Ex. 1002 12:29-32. Feinberg Dec. (Ex. 1013) ¶¶ 66-67.

4. Claims 6 And 22: *6. "The method according to claim 1, wherein the objective lens comprises a set of lenses forming an apodizer"* or *22. "The panoramic objective lens according to claim 17, further comprising a set of lenses forming an apodizer."*

An "apodizer" is an optical system which provides a non-linear distribution of image points relative to the field angle of the object points. The hemispherical lens elements at bottom of Fig. 3BA comprise an apodizer, as they control the angular distribution of the panoramic objective lens to obtain the desired non-linearity. Figs. 3BA and 3BB. Feinberg Dec. (Ex. 1013) ¶ 68.

In view of the above, claims 1, 2, 4, 6, 17, 18, 20 and 22 of the '990 patent should be cancelled under 35 U.S.C. §102(b) because Baker anticipates each of these claims. Feinberg Dec. (Ex. 1013) ¶¶ 40-69.

D. Ground 4: Claims 1, 2, 4, 6, 17, 18, 20 And 22 Are Obvious Under 35 U.S.C. §103(a) Over Baker.

In the event that the Board finds any element of claims 1, 2, 4, 6, 17, 18, 20 and/or 22 not expressly or inherently present in Baker, *e.g.,* a non-linear lens with a maximum divergence of at least ±10% compared to a linear distribution function, such claims should nonetheless be cancelled as unpatentable over Baker under 35 U.S.C. §103(a). Feinberg Dec. (Ex. 1013) ¶ 69. Claim charts for independent claims 1 and 17 are set forth below.

Claim 1 '990 patent	**Baker, U.S. Patent No. 5,686,957**
1a. A method for capturing a digital panoramic image,	Baker discloses "the visual imaging system can use a single camera to capture the relevant visual information within a panoramic field of view existing along the horizon," Ex. 1002 6:29-32, and that the "captured scene can be stored onto an assortment of media, e.g., … electronic storage 18…" Ex. 1002 8:62-65; 2:35-39; 10:55-57; 14:32-36; Feinberg Dec. (Ex. 1013) ¶¶49-52.
1b. by projecting a panorama onto an image sensor by means of a panoramic objective lens,	Baker discloses "the visual imaging system … includes a still image or moving picture camera 10, having a lens, …, designed to capture and enhance the peripheral content of a hemispheric scene." Ex. 1002 8:58-62. A "CCD" may be used for digital storage. Ex. 1002 13:16; Feinberg Dec. (Ex. 1013) ¶¶50-57.
1c. the panoramic objective lens having an image point distribution function that is not linear relative to the field angle of object points of the panorama,	Baker Fig. 3BA depicts a lens having a non-linear distribution function of image points, relative to the field angle of the object points of the panorama. Ex. 1002, 12:23-25; Feinberg Dec. (Ex. 1013) ¶¶41-46. Baker discloses the "fundamental principle behind the enhanced peripheral content lens is the selective magnification of the periphery and the focusing of more of that content on the imaging plane." Ex. 1002 10:38-41; Fig. 3BA. Baker further discloses a non-

	linear "lens, indicated generally at 14, designed to capture and enhance the peripheral content of a hemispheric scene." Ex. 1002 8:60-62. Ex. 1002 8:32-36; Feinberg Dec. (Ex. 1013) ¶¶56-58.
1d. the distribution function having a maximum divergence of at least ±10% compared to a linear distribution function,	"[I]f an ordinary fisheye lens focuses the lowest 15 degrees up from the horizon on ten percent of the imager at the imaging plane and the peripheral-enhancing lens focuses that same 15 degrees on fifty percent of the imager, there is a five-fold increase in resolution using the same imaging device. Depending on the application and exact formulation of the lens equations, there will be at least a five times increase in resolving power by this lens/imager combination." Ex. 1002 6:48-56. A POSA would understand that a lens that provides a five-fold increase in resolution for the lowest 15 degrees up from the horizon inherently has a maximum divergence of at least ±10% compared to a linear distribution function. Feinberg Dec. (Ex. 1013) ¶¶59-61.
1e. such that the panoramic image obtained has at least one substantially expanded zone and at least one substantially compressed zone.	"[T]he lens constructed according to the present invention has a fairly significant portion of the imaging surface dedicated to the peripheral field, and consequently less of the surface dedicated to the central field." Ex. 1002, 12:29-32. The panoramic image obtained from the non-linear objective lens (Fig. 3BB) depicts a substantially expanded zone Y' and a substantially compressed zone X' compared to the panoramic image obtained from the linear objective lens (Fig. 2B). Feinberg Dec. (Ex. 1013) ¶¶42-48, 62, 66, 67.
Claim 17 '990 Patent	**Baker, U.S. Patent No. 5,686,957**
17a. A panoramic objective lens comprising:	Baker Fig. 3BA. "[T]he visual imaging system can use a single camera to capture the relevant visual information within a panoramic field of view existing along the horizon." Ex. 1002, 6:29-32. Feinberg Dec. (Ex. 1013) ¶¶49-52.
17b. optical means for projecting a panorama	"the visual imaging system of the parent [sic] invention includes a still image or moving picture

into an image plane of the objective lens,	camera 10, having a lens, indicated generally at 14, designed to capture and enhance the peripheral content of a hemispheric scene" Ex. 1002, 6:29-32, 8:58-62; a "CCD" may be used for digital storage. Ex. 1002, 13:16; Feinberg Dec. (Ex. 1013) ¶¶50-57.
17c. the optical means having an image point distribution function that is not linear relative to the field angle of object points of the panorama,	Baker Fig. 3BA depicts a lens having a non-linear distribution function of image points, relative to the field angle of the object points of the panorama. Ex. 1002, 12:23-25; Feinberg Dec. (Ex. 1013) ¶¶41-46. Baker discloses the "fundamental principle behind the enhanced peripheral content lens is the selective magnification of the periphery and the focusing of more of that content on the imaging plane." Ex. 1002 10:38-41; Fig. 3BA. Baker further discloses a non-linear "lens, indicated generally at 14, designed to capture and enhance the peripheral content of a hemispheric scene." Ex. 1002 8:60-62. Ex. 1002 8:32-36; Feinberg Dec. (Ex. 1013) ¶¶56-58.
17d. the distribution function having a maximum divergence of at least ±10% compared to a linear distribution function,	"[I]f an ordinary fisheye lens focuses the lowest 15 degrees up from the horizon on ten percent of the imager at the imaging plane and the peripheral-enhancing lens focuses that same 15 degrees on fifty percent of the imager, there is a five-fold increase in resolution using the same imaging device. Depending on the application and exact formulation of the lens equations, there will be at least a five times increase in resolving power by this lens/imager combination." Ex. 1002 6:48-56. A POSA would understand that a lens that provides a five-fold increase in resolution for the lowest 15 degrees up from the horizon inherently has a maximum divergence of at least ±10% compared to a linear distribution function. Feinberg Dec. (Ex. 1013) ¶¶59-61.
17e. such that a panoramic image obtained by means of the objective lens comprises at least one	"[T]he lens constructed according to the present invention has a fairly significant portion of the imaging surface dedicated to the peripheral field, and consequently less of the surface dedicated to the

substantially expanded zone and at least one substantially compressed zone.	central field." Ex. 1002, 12:29-32. The panoramic image obtained from the non-linear objective lens (Fig. 3BB) depicts a substantially expanded zone Y' and a substantially compressed zone X' compared to the panoramic image obtained from the linear objective lens (Fig. 2B). Feinberg Dec. (Ex. 1013) ¶¶42-48, 62, 66, 67.

As discussed above, there are believed to be no differences between the prior art and the claims at issue. Feinberg Dec. (Ex. 1013) ¶¶ 49, 63, 153. However, should the Board find, *e.g.,* that Baker does not expressly or inherently disclose a non-linear lens having a maximum divergence of at least ±10% compared to a linear distribution function, it would nevertheless have been obvious to a POSA that Baker discloses a panoramic objective lens (*see* Fig 3BA) and that such lens would have a non-linear distribution function with a maximum divergence of at least ±10% compared to a linear distribution function. Specifically, Baker states "if an ordinary fisheye lens focuses the lowest 15 degrees up from the horizon on ten percent of the imager at the imaging plane and the peripheral-enhancing lens focuses that same 15 degrees on fifty percent of the imager, there is a five-fold increase in resolution using the same imaging device. Depending on the application and exact formulation of the lens equations, there will be at least a five times increase in resolving power by this lens/imager combination." Ex. 1002 6:48-56; Feinberg Dec. (Ex. 1013) ¶¶ 57-61. A POSA would understand that such a lens, which provides a five-fold increase in resolution for the lowest 15 degrees

up from the horizon, will always have a maximum divergence of at least ±10% compared to a linear distribution function. Feinberg Dec. (Ex. 1013) ¶ 60.

Claims 1, 2, 4, 6, 17, 18, 20 and 22 should thus be cancelled under 35 U.S.C. §103(a) as obvious in view of Baker.

E. Ground 5: Claims 1, 2, 3, 6, 7, 17, 18, 19, 22 And 23 Are Anticipated By Fisher

Fisher discloses each element recited in claims 1-3, 6-7, 17-19, 22 and 23.

1. Claims 1 And 17

a. 1. "A method for capturing a digital panoramic image" or *17. "A panoramic objective lens comprising:"*

Fisher Fig. 6 depicts a non-linear panoramic objective lens. Ex. 1004, 5:44-45. Feinberg Dec. (Ex. 1013) ¶¶ 123, 133. Additionally, "[t]he distorted image formed by the non-linear lens exists in an image plane p located beyond the third lens grouping C. The vidicon of the television camera should be at this plane p." Ex. 1004 6:51-54; Abstract; 4:35-45. Feinberg Dec. (Ex. 1013) ¶¶ 119-120. A vidicon is a camera tube in which a charge-density pattern is formed by photoconduction and stored on a photoconductor surface that is scanned by an electron beam, usually of low-velocity electrons. Feinberg Dec. (Ex. 1013) ¶ 121. "Digital", recited only in the preamble of claim 1 (not claim 17), does not breathe life or meaning into claim 1, and thus should not be considered a claim element.

b. 1. "by projecting a panorama onto an image sensor by means of a panoramic objective lens," or *17. "optical means for projecting a panorama into an image plane of the objective lens,"*

Fisher discloses projecting a panorama onto an image sensor by means of a panoramic objective lens. Ex. 1004, 3:48-49, Fig. 3; Feinberg Dec. (Ex. 1013) ¶ 134. Fisher also discloses "The image cast by the lens falls on the vidicon of a television camera where it is scanned and transmitted to a projector." Ex. 1004 Abstract and 4:35-45. Feinberg Dec. (Ex. 1013) ¶¶ 119-121.

c. *1. "the panoramic objective lens having an image point distribution function that is not linear relative to the field angle of object points of the panorama,"* or *17. "the optical means having an image point distribution function that is not linear relative to the field angle of object points of the panorama,"*

Fisher discloses "The present invention relates in general to lenses and more particularly to a lens having non-linear distortion characteristics." Ex. 1004 1:9-11. "One of the principal objects of the present invention is to provide a lens having non-linear distortion characteristics." Ex. 1004 2:6-8; Feinberg Dec. (Ex. 1013) ¶¶ 126, 135-137.

d. *"the distribution function having a maximum divergence of at least ±10% compared to a linear distribution function"*

Fisher Fig. 3 shows a "NON-LINEAR LENS" where the image height is equal to a variable function of the field angle. Fig. 3 shows "the distortion characteristics of the lens of the present invention in terms of normalized image height and field of view and comparing such distortion characteristics with the distortion characteristics of a linear fisheye lens and a conventional camera lens."

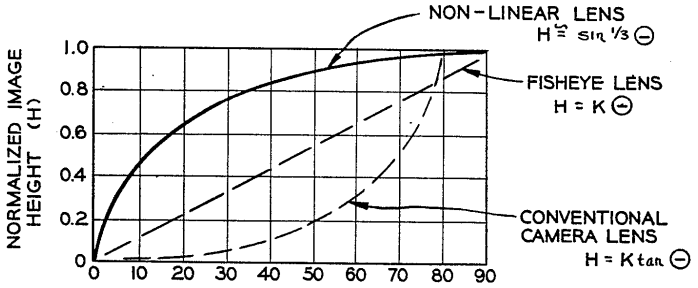


FIG. 3

Ex 1004, 2:38-43; Feinberg Dec. (Ex. 1013) ¶ 125. The relationship is approximated by the formula $H=\sin^{1/3}\theta$. Ex 1004, 3:1-4; Feinberg Dec. (Ex. 1013) ¶ 126. As shown in Fig. 3, Fisher discloses a non-linear lens having a distribution function whose maximum divergence is much greater than 10% compared to a linear distribution function (fisheye lens). Feinberg Dec. (Ex. 1013) ¶ 127.

> *e. 1. "such that the panoramic image obtained has at least one substantially expanded zone and at least one substantially compressed zone"* or *17. "such that a panoramic image obtained by means of the objective lens comprises at least one substantially expanded zone and at least one substantially compressed zone."*

Fisher discloses: "The present invention is embodied in a lens which distorts a field of view such that objects in the vicinity of the optical axis occupy a disproportionately large area of the image cast by the lens and objects in the peripheral region of the field of view occupy a disproportionately small area of the image." Ex. 1004 2:19-24; Feinberg Dec. (Ex. 1013) ¶ 140. "[O]bjects centered along the optical axis of the non-linear lens L cast a much larger image than objects located near the periphery of the field of view with the size diminishing as

the angle from the optical axis increases. The result of the distortion is that objects along the optical axis occupy a disproportionately large share of the image cast by the lens when compared with other objects closer to the periphery of the field of view for the lens." Ex. 1004 3:4-12; Feinberg Dec. (Ex. 1013) ¶¶128-131, 138-140.

Fisher Fig. 4 further shows how equal increments on the image plane correspond to unequal increments in the field of view. Ex 1004 2:44-47, Feinberg Dec. (Ex. 1013) ¶¶ 128-129.

2. Claims 2 And 18

a. *2. "The method according to claim 1, wherein the objective lens has a non-linear distribution function that is symmetrical relative to the optical axis of the objective lens,"* or *18. "The panoramic objective lens according to claim 17, having a non-linear distribution function that is symmetrical relative to the optical axis of the objective lens,"*

As shown in Fig. 6, the non-linear distribution function is symmetrical relative to the optical axis. Ex. 1004 Fig. 6; Feinberg Dec. (Ex. 1013) ¶ 142.

b. *2. "the position of an image point relative to the center of the image varying according to the field angle of the corresponding object point." or 18. "the position of an image point relative to the center of an image obtained varying according to the field angle of the corresponding object point."*

Fisher Fig. 4 shows that the position of an image point varies according to the field angle of a corresponding object point. Feinberg Dec. (Ex. 1013) ¶ 142.

3. Claims 3 And 19: *3. "The method according to claim 1, wherein the objective lens expands the center of the image and compresses the edges of the image."* or *19. "The panoramic objective lens according to claim 17, wherein the lens expands the center of an image and compresses the edges of the image."*

Fisher discloses that the "present invention is embodied in a lens which distorts a field of view such that objects in the vicinity of the optical axis occupy a disproportionately large area of the image cast by the lens and objects in the peripheral region of the field of view occupy a disproportionately small area of the image." Ex. 1004 2:19-24; Feinberg Dec. (Ex. 1013) ¶¶ 140, 143.

4. Claims 6 And 22: *6. "The method according to claim 1, wherein the objective lens comprises a set of lenses forming an apodizer"* or *22. "The panoramic objective lens according to claim 17, further comprising a set of lenses forming an apodizer."*

An "apodizer" is an optical system which provides a non-linear distribution of image points relative to the field angle of the object points. As shown in Figs. 4 and 6, the lens system in Fisher controls the angular distribution of the objective lens to obtain non-linearity. Feinberg Dec. (Ex. 1013) ¶ 144.

5. Claims 7 And 23: *7. "The method according to claim 6, wherein the set of lenses forming an apodizer comprises at least one aspherical lens."* or *23. "The panoramic objective lens according to claim 17, further comprising a set of lenses forming an apodizer."*

Aspherical lenses were well known in the prior art. Feinberg Dec. (Ex. 1013) ¶ 146. Fisher discloses that the lens surfaces R_1 and R_3 shown in Fisher Fig. 6 are non-spherical (aspherical): "The first lens grouping A (FIG. 6) consists of

three lens elements a, b, and c with no air gaps between adjacent elements. The outside lens element a has a non-spherical surface R_1 exposed outwardly and a spherical surface R_2 presented inwardly against a matching surface R_2 on the intermediate element b. The opposite surface R_3 of the intermediate element b is non-spherical and abuts a matching surface R_3 on the inside element c." Ex. 1004, 5:61–6:1; Feinberg Dec. (Ex. 1013) ¶¶ 122-124. At least lens elements "a" and "c" are aspherical (*i.e.*, R_1, R_3). Ex. 1004, Fig. 6, Feinberg Dec. (Ex. 1013) ¶ 145.

Accordingly, claims 1, 2, 3, 6, 7, 17, 18, 19, 22 and 23 of the '990 patent should be cancelled because Fisher anticipates each of these claims. Feinberg Dec. (Ex. 1013) ¶¶ 116-146.

F. Ground 6: Claims 1, 2, 3, 6, 7, 17, 18, 19, 22 And 23 Are Obvious Under 35 U.S.C. §103(a) Over Fisher

In the event that the Board finds any element of claims 1, 2, 3, 6, 7, 17, 18, 19, 22 and 23 not expressly or inherently present in Fisher, such claims should nonetheless be cancelled as unpatentable under 35 U.S.C. §103(a) because all of the elements recited in such claims would have been obvious to a POSA in view of Fisher. Feinberg Dec. (Ex. 1013) ¶ 148. Claim charts for independent claims 1 and 17 are set forth below.

Claim 1 '990 Patent	FISHER, U.S. Patent No. 3,953,111
1a. A method for capturing a digital panoramic image,	"The image cast by the lens falls on the vidicon of a television camera where it is scanned and transmitted to a projector." Ex. 1004 Abstract and 4:35-45; Feinberg Dec. (Ex. 1013) ¶¶119-121, 133.

1b. by projecting a panorama onto an image sensor by means of a panoramic objective lens,	The camera is fitted with a non-linear panoramic objective lens. *See* Ex. 1004, 3:48-49, and projects a panorama onto an image sensor by means of a panoramic objective lens. Feinberg Dec. (Ex. 1013) ¶134. The lens of the present invention provides non-linear image distortion characteristics over an extremely wide field of view which approaches 160°. Ex. 1004, 2:56-59. Feinberg Dec. (Ex. 1013) ¶¶119-123, 134.
1c. the panoramic objective lens having an image point distribution function that is not linear relative to the field angle of object points of the panorama,	The present invention relates in general to lenses and more particularly to a lens having non-linear distortion characteristics. Ex. 1004, 1:9-11. One of the principal objects of the present invention is to provide a lens having non-linear distortion characteristics. Ex. 1004, 2:6-8; Feinberg Dec. (Ex. 1013) ¶¶126, 135-137.
1d. the distribution function having a maximum divergence of at least ±10% compared to a linear distribution function,	Fisher Fig. 3 discloses a non-linear lens having a distribution function whose maximum divergence is much greater than 10% compared to a linear distribution function (fisheye lens). Feinberg Dec. (Ex. 1013) ¶¶125-127.
1e. such that the panoramic image obtained has at least one substantially expanded zone and at least one substantially compressed zone.	The present invention is embodied in a lens which distorts a field of view such that objects in the vicinity of the optical axis occupy a disproportionately large area of the image cast by the lens and objects in the peripheral region of the field of view occupy a disproportionately small area of the image. Ex. 1004, 2:19-24. Objects centered along the optical axis of the non-linear lens L cast a much larger image than objects located near the periphery of the field of view with the size diminishing as the angle from the optical axis increases. The result of the distortion is that objects along the optical axis occupy a disproportionately large share of the image cast by the lens when compared with other objects closer to the periphery of the field of view for the lens. Ex. 1004, 3:4-12, Fig. 4; Feinberg Dec. (Ex. 1013) ¶¶128-131, 138-140.

Claim 17 '990 Patent	**FISHER, U.S. Patent No. 3,953,111**
17a. A panoramic objective lens comprising:	The lens of the present invention provides non-linear image distortion characteristics over an extremely wide field of view which approaches 160°. Ex. 1004, 2:56-59. Feinberg Dec. (Ex. 1013) ¶¶119, 133.
17b. optical means for projecting a panorama into an image plane of the objective lens,	The camera is fitted with a non-linear panoramic objective lens. *See* Ex. 1004, 3:48-49, and projects a panorama onto an image sensor by means of a panoramic objective lens. Feinberg Dec. (Ex. 1013) ¶134. The lens of the present invention provides non-linear image distortion characteristics over an extremely wide field of view which approaches 160°. Ex. 1004, 2:56-59. Feinberg Dec. (Ex. 1013) ¶¶119-121, 134.
17c. the optical means having an image point distribution function that is not linear relative to the field angle of object points of the panorama,	The present invention relates in general to lenses and more particularly to a lens having non-linear distortion characteristics. Ex. 1004, 1:9-11. One of the principal objects of the present invention is to provide a lens having non-linear distortion characteristics. Ex. 1004, 2:6-8; Feinberg Dec. (Ex. 1013) ¶¶126, 135-137.
17d. the distribution function having a maximum divergence of at least ±10% compared to a linear distribution function,	Fisher Fig. 3 discloses a non-linear lens having a distribution function whose maximum divergence is much greater than 10% compared to a linear distribution function (fisheye lens). Feinberg Dec. (Ex. 1013) ¶¶125-127.
17e. such that a panoramic image obtained by means of the objective lens comprises at least one substantially expanded zone and at least one substantially compressed zone.	A lens which distorts a field of view such that objects in the vicinity of the optical axis occupy a disproportionately large area of the image cast by the lens and objects in the peripheral region of the field of view occupy a disproportionately small area of the image. Ex. 1004, 2:19-24. Objects centered along the optical axis of the non-linear lens L cast a much larger image than objects located near the periphery of the field of view with the size diminishing as the angle from the optical axis increases. The result of the distortion is that objects along the optical axis occupy

	a disproportionately large share of the image cast by the lens when compared with other objects closer to the periphery of the field of view for the lens. Ex. 1004, 3:4-12, Fig. 4; Feinberg Dec. (Ex. 1013) ¶¶128-131, 138-140.

As discussed above, there are believed to be no differences between the prior art and the claims at issue. Feinberg Dec. (Ex. 1013) ¶¶ 132, 141, 157. However, if the Board finds that the vidicon disclosed in Fisher does not capture a "digital" panoramic image, as recited in the preamble of independent claim 1, and deems this preamble recitation to be a claim element, such would nevertheless have been obvious to a POSA at the time of invention. At the time of the alleged invention, a POSA would have known that the electronic images of Fisher could be stored digitally. Feinberg Dec. (Ex. 1013) ¶ 157.

Thus, claims 1, 2, 3, 6, 7, 17, 18, 19, 22 and 23 should be cancelled under 35 U.S.C. §103(a) as obvious in view of Fisher.

G. Ground 7: Claims 1, 2, 3, 6 And 7Are Obvious Under 35 U.S.C. §103(a) Over Fisher In View Of Baker

In the event that the Board finds that the vidicon disclosed in Fisher does not capture a "digital" panoramic image as recited in the preamble of claim 1, and deems this preamble recitation to be a claim element, claims 1, 2, 3, 6 and 7 should nonetheless be cancelled as unpatentable under 35 U.S.C. §103(a) because Baker discloses capturing a digital panoramic image (Ex. 1002 8:62-65; 2:35-39; 10:55-57; 14:32-36; Feinberg Dec. (Ex. 1013) ¶¶ 50-52), and because it would have been

obvious to a POSA to digitally capture the image projected by Fisher as disclosed by Baker. Feinberg Dec. (Ex. 1013) ¶ 160. A POSA would have understood as of the time of filing of the '990 patent that it would have been obvious to use the advanced digital capture circuitry from Baker with the optics disclosed in Fisher.

Thus, claims 1, 2, 3, 6 and 7 should also be cancelled under 35 U.S.C. §103(a) as further obvious over Fisher in view of Baker.

H. Ground 8: Claim 10 Is Obvious Under 35 U.S.C. §103(a) Over Nagaoka In View Of Shiota

Dependent claim 10 recites: "the method for displaying comprising: "correcting the non-linearity of the initial image, performed by means of a reciprocal function of the non-linear distribution function of the objective lens or by means of the non-linear distribution function."

As set forth in Sections A & B, Nagaoka (Ex. 1003) discloses all the elements of claim 1, from which claim 10 depends. Ex. 1003; Feinberg Dec. (Ex. 1013) ¶¶ 70-115. One of the lenses specifically described in Nagaoka has the non-linear distribution function $h=2f\cdot\tan(\theta/2)$. Ex. 1003; 5:13-18, Fig 3A; Feinberg Dec. (Ex. 1013) ¶ 105. Nagaoka further discloses that the obtained image is "converted into a plane image by the image data processing unit 3," Ex. 1001 8:2-3, but does not disclose the specific correction applied by the image data processing unit. A POSA would have recognized that the images obtained using the non-linear lenses in Nagaoka need to be corrected. Shah Dec. (Ex. 1014) ¶ 94.

Shiota (Ex. 1008) discloses correcting the non-linearity of an initial image performed by using a non-linear distribution function. Ex.1008 [0030-0032]; Shah Dec. (Ex. 1014) ¶¶ 45-62, 95. "An image is transformed as follows. The projecting position on the image pickup face (p, q coordinates) of a point (u, v coordinates) on a plane image is obtained by arithmetic operation." Ex. 1008 [0024]; Shah Dec. (Ex. 1014) ¶ 96. In one embodiment, the non-linear distribution function **h**=2f·tan(θ/2) is used to compute the coefficient $\mathbf{k_2}$. $\mathbf{k_2=h/r}$, where h is the lens function and r is the distance from the origin. Ex. 1008 [0037-0042]; Shah Dec. (Ex. 1014) ¶ 97. The coefficient k_2 is used to obtain the image points that will be displayed. Ex. 1008 [0031-0035]; Shah Dec. (Ex. 1014) ¶ 97. As the coefficient k_2 used to correct the image is computed using the non-linear distribution function h, Shiota discloses "correcting the non-linearity of the initial image, performed … by means of the non-linear distribution function." Shah Dec. (Ex. 1014) ¶ 98.

It would have been obvious to a POSA to correct the non-linearity of an initial image obtained when using a lens disclosed in Nagaoka with the correction method disclosed in the commonly assigned Shiota patent publication. Nagaoka (Fig. 3A) discloses obtaining an image using a lens having a non-linear distribution function h=2f·tan(θ/2) and Shiota discloses a specific method of correcting the non-linearity of the image in which the same non-linear distribution function h=2f·tan(θ/2) is used. Ex. 1008 [0037]. In other words, it would have been obvious

to correct an image obtained using a lens having a distribution function $h=2f\cdot\tan(\theta/2)$ with a correction method which uses the same distribution function $h=2f\cdot\tan(\theta/2)$. Shah Dec. (Ex. 1014) ¶¶ 99-100. A claim chart for claim 10 is set forth below.

Claim 10 '990 Patent	Nagaoka in view of Shiota
A method for displaying an initial panoramic image obtained in accordance with the method according to claim 1, the method for displaying comprising: correcting the non-linearity of the initial image, performed by means of a reciprocal function of the non-linear distribution function of the objective lens or by means of the non-linear distribution function.	Nagaoka (Ex. 1003) discloses all the elements of claim 1. *See* Sections A & B (Grounds 1 & 2) above; Feinberg Dec. (Ex. 1013) ¶¶70-115. A POSA would also have understood the desirability of, and how to, correct an image obtained from a panoramic objective lens having a non-linear distribution function. Shah Dec. (Ex. 1014) ¶25. A POSA would further have recognized that the images obtained using the non-linear lenses in Nagaoka need to be corrected. Shah Dec. (Ex. 1014) ¶94. Commonly assigned Shiota (Ex. 1008) discloses correcting the non-linearity of the initial image obtained by a panoramic objective lens by means of the non-linear distribution function. Ex. 1008 [0030-0035, 0037-0042]; Shah Dec. (Ex. 1014) ¶¶94-102, 44-62.

Accordingly, Claim 10 should be cancelled under 35 U.S.C. §103(a) as obvious over Nagaoka in view of Shiota. Shah Dec. (Ex. 1014) ¶¶ 101-102.

I. Ground 9: Claim 10 Is Obvious Under 35 U.S.C. §103(a) Over Nagaoka In View Of Matsui

As set forth in Sections A & B, Nagaoka (Ex. 1003) discloses all the elements of claim 1 of the '990 patent, from which claim 10 depends. Ex. 1003; Feinberg Dec. (Ex. 1013) ¶¶ 70-115. One of the lenses specifically described in

Nagaoka has the non-linear distribution function $h=2f\cdot\tan(\theta/2)$. Ex. 1003, Fig. 3A; Feinberg Dec. (Ex. 1013) ¶ 105. Nagaoka discloses that the obtained image is "converted into a plane image by the image data processing unit 3," (Ex. 1003, 8:2-3), but does not disclose the specific correction applied by the image data processing unit. A POSA would have recognized that the images obtained using the non-linear lenses in Nagaoka need to be corrected. Shah Dec. (Ex. 1014) ¶ 103.

The commonly assigned Matsui patent publication discloses correcting the non-linearity of an initial image, performed by a reciprocal function of the non-linear distribution function of the objective lens or by the non-linear distribution function. Ex. 1010 [0025, 0030-0031]; Shah Dec. (Ex. 1014) ¶¶ 104, 110.

With respect to correcting the non-linearity of the initial image by the non-linear distribution function, Matsui discloses a data image conversion device, in which image data obtained with a fish-eye lens is corrected to remove distortion so that it may be displayed. Ex. 1010 [0001]; Shah Dec. (Ex. 1014) ¶ 105. Matsui discloses that this correction can be performed using the non-linear lens distribution function $h = 2f\cdot\tan(\theta/2) = 2f\cdot\{\sin\theta/(1 + \cos\theta)\}$. Ex. 1010 [0025]; Shah Dec. (Ex. 1014) ¶ 106. Matsui further discloses the calculation of pixel positions on the circular surface from the pixel positions actually captured by the CCD utilizing the non-linear distribution function $h = 2f\cdot\tan(\theta/2)$. Ex. 1010 [0025]; Shah Dec. (Ex. 1014) ¶ 107. A data converter 2, that calculates the circular surface S

pixel position corresponding to each pixel on the post-conversion cylindrical surface C, then converts the pixel data of the pixel positions as respective pixel data on the cylindrical surface C. "As a result, as shown in Fig. 4, the pixel data on the circular surface S is converted as respective pixel data on the cylindrical surface C." Ex. 1010 [0026]; Shah Dec. (Ex. 1014) ¶ 108. "The data converter 2 converts P1 shown in Fig. 3 into P2 shown in Fig. 2." Ex. 1010 [0023]; Shah Dec. (Ex. 1014) ¶ 109.

Matsui also discloses correcting the non-linearity of the initial image using the reciprocal of the non-linear lens distribution function. Ex. 1010 [0030-0031]; Shah Dec. (Ex. 1014) ¶ 110. Specifically, Matsui discloses that rather than using the lens distribution function $h = g(\theta)$, an inverse function $\theta = \mathrm{Tan}^{-1}(R / z)$ can be used to relate points on the cylindrical surface to the points in the circular image. In this case, the points in the circular image can be directly referenced by indexing ψ and z of the cylindrical coordinates according to the relationship $(f \bullet G(\mathrm{Tan}^{-1}(R / z))) \bullet \cos\psi, f \bullet G(\mathrm{Tan}^{-1}(R / z)) \bullet \sin\psi)$. Ex. 1010 [0030-0031]; Shah Dec. (Ex. 1014) ¶111.

It would have thus been obvious to a POSA to correct the non-linearity of an initial image obtained, using a lens disclosed in Nagaoka, with the correction method disclosed in Matsui. Shah Dec. (Ex. 1014) ¶ 112. Matsui discloses correcting the non-linearity of an initial image using either a reciprocal function of

the non-linear distribution function of the objective lens or the non-linear distribution function. Ex. 1010 [0025, 0030-0031]; Shah Dec. (Ex. 1014) ¶¶ 104, 110.

It would further have been obvious to a POSA to correct an image obtained using a lens having a non-linear distribution function $h=2f\cdot\tan(\theta/2)$ as disclosed in Nagaoka with a correction method where the same non-linear distribution function $h=2f\cdot\tan(\theta/2)$ is used in the correction method, as disclosed in Matsui. In other words, it would have been obvious to correct an image obtained using a lens having a distribution function $h=2f\cdot\tan(\theta/2)$ with a correction method which uses the same distribution function. Shah Dec. (Ex. 1014) ¶ 113. A claim chart for claim 10 is set forth below.

Claim 10 '990 Patent	**Nagaoka in view of Matsui**
A method for displaying an initial panoramic image obtained in accordance with the method according to claim 1, the method for displaying comprising: correcting the non-linearity of the initial image, performed by means of a reciprocal function of the non-linear distribution function of the objective lens or by	Nagaoka (Ex. 1003) discloses all the elements of claim 1. *See* Sections A & B (Grounds 1 & 2) above; Feinberg Dec. (Ex. 1013) ¶¶70-115. A POSA would also have understood the desirability of, and how to, correct an image obtained from a panoramic objective lens having a non-linear distribution function. Shah Dec. (Ex. 1014) ¶25. A POSA would further have recognized that the images obtained using the non-linear lenses in Nagaoka need to be corrected. Shah Dec. (Ex. 1014) ¶103. Matsui (Ex. 1010) discloses correcting the non-linearity of the initial image by either means of a reciprocal function of the non-linear distribution function of the objective lens and by means of the non-linear distribution function. Ex. 1010 [0009],

means of the non-linear distribution function.	[0030-31]; Shah Dec. (Ex. 1014) ¶¶63-80, 103-115.

Accordingly, Claim 10 should be cancelled as obvious under 35 U.S.C. §103(a) over Nagaoka in view of Matsui. Shah Dec. (Ex. 1014) ¶¶ 114-115.

J. Ground 10: Claim 11 Is Obvious Under 35 U.S.C. §103(a) Over Nagaoka In View Of Shiota

Claim 11 recites: "wherein the step of correcting comprises a step of transforming the initial image into a corrected digital image comprising a number of image points higher than the number of pixels that the image sensor comprises."

As established in section H, claim 10 is unpatentable as obvious under 35 U.S.C. §103(a) over Nagaoka in view of Shiota.

Shiota discloses a stereoscopic projection having a relationship $h=2f\cdot\tan(\theta/2)$ which produces an image having an expanded portion. Ex.1008 [0037]; Shah Dec. (Ex. 1014) ¶ 116. Shiota further discloses that the position of a pixel on the fish-eye image will not necessarily map to a pixel on the plane image and hence nearby pixels would be used for interpolation. Ex.1008 [0049]; Shah Dec. (Ex. 1014) ¶ 117. Because Shiota has an expanded portion, a POSA would have known that the number of image points in a corrected digital image would be larger than the number of points in the initial image. Considering a region in the initial image that is to be expanded, each initial image point will represent the projection of multiple spatial points according to the lens system. Hence, during the expansion process,

the image points will be mapped to one or more points in the corrected digital image. Shiota discloses this step of transforming the initial image into a corrected digital image where the number of image points is higher than the number of pixels of the image sensor. Shah Dec. (Ex. 1014) ¶ 118.

As discussed in Section H, it would have been obvious to a POSA to correct the non-linearity of an initial image obtained using the Nagaoka lens, which has a non-linear distribution function $h=2f\cdot\tan(\theta/2)$, with the correction method disclosed in Shiota, which uses the same non-linear distribution function $h=2f\cdot\tan(\theta/2)$ to correct the initial image. When Nagaoka and Shiota are so combined, the initial image is necessarily transformed into a corrected digital image comprising a number of image points higher than the number of pixels of the image sensor. Shah Dec. (Ex. 1014) ¶¶ 119, 120.

Accordingly, claim 11 should be cancelled as obvious under 35 U.S.C. §103(a) over Nagaoka in view of Shiota. Shah Dec. (Ex. 1014) ¶¶ 121-122.

K. Ground 11: Claims 15 And 16 Are Obvious Under 35 U.S.C. §103(a) Over Nagaoka In View Of Shiota And Further In View Of Enami

1. Claim 15

As set forth in Section H, the combination of Nagaoka and Shiota renders obvious the correction method recited in claim 10. Enami discloses an image correction method which incorporates the color allocation recited in claim 15. It would have been obvious to a POSA to allocate the colors of the image obtained

using Nagaoka and corrected using Shiota with the color allocation disclosed in Enami as it would ensure that the mapped coordinates are assigned the appropriate color value and provide a more accurate corrected image. Shah Dec. (Ex. 1014) ¶¶ 123-124.

a. "The method according to claim 10, further comprising: determining the color of image points of a display window, by projecting the image points of the display window onto the initial image by means of the non-linear distribution function and"

Enami discloses determining the color of image points of a display window, by projecting the image points of the display window onto the initial image by means of the non-linear distribution function. Ex. 1012 [0058, 0084-0085]; Shah Dec. (Ex. 1014) ¶¶ 128, 138. Enami discloses allocating to each image point of the display window the color of an image point that is the closest on the initial image. Ex. 1012 [0072-0074]; Shah Dec. (Ex. 1014) ¶ 129. Enami discloses a coordinate of a point of the fisheye lens image img corresponding to a coordinate of each point arranged on a raster in the image frame frm is specified, and a color information signal of the point having the coordinate is made to correspond to a color information signal of a point having a coordinate of the display frame frm, and thus it is possible to perform a correction process of transforming the fisheye lens image img to an original image. Ex.1012 [0058]; Shah Dec. (Ex. 1014) ¶ 130.

b. "allocating to each image point of the display window the color of an image point that is the closest on the initial image."

Enami discloses allocating to each image point of the display window the color of an image point that is the closest on the initial image. Ex. 1012 [0072-0074]; Shah Dec. (Ex. 1014) ¶129. Enami specifically discloses finding the closest coordinate point on the fisheye lens image, as a first step, by converting mapped coordinate points to integers by omitting the decimal points, and utilizing the color values at the corresponding integer coordinate points. Shah Dec. (Ex. 1014) ¶ 129.

Similarly, rounding up to obtain the closest point or the integer coordinate is also disclosed. Shah Dec. (Ex. 1014) ¶ 129. Finally, the use of both integer coordinates is disclosed as part of linear interpolation. A POSA would have well understood that the use of closest point constitutes a form of interpolation and multiple approaches can be utilized in determining the closest point. Shah Dec. (Ex. 1014) ¶ 129.

Enami additionally discloses "the point (x", y") on the coordinates of the fisheye lens image obtained through the above-described operation is indicated by (u, v). In order to smoothly interpolate this coordinate point (u, v), the following interpolation process is performed. Color information signal components of three colors of a picture signal are indicated by Y, U, and V, those components of the point (u, v) are indicated by Yu, v, Uu, v, and Vu, v, values which become an integer by omitting decimal points of the coordinate components u and v of the

point (u,v) are indicated by u0 and v0, and a value of the color information signal Y in a point having the coordinate (u0, v0) is indicated by Yu0v0. Similarly, the same content is indicated by Uu0v0 and Vu0v0 for the color information signals U and V. In addition, values obtained by rounding up decimal points of the coordinate components u and v are respectively indicated by u1 and v1, and values of the color information signals Y, U and V having a coordinate corresponding thereto are respectively indicated by Yu1v1, Uu1v1, and Vu1v1. Further, decimal parts of the coordinate components u and v are respectively indicated by du and dv." Ex. 1012 [0072]; Shah Dec. (Ex. 1014) ¶ 131.

Accordingly, Enami discloses allocating to each image point of the display window the color of an image point that is the closest on the initial image.

After correcting the non-linearity of the initial image using Shiota, it would have been obvious to a POSA to allocate the colors of the image with the color allocation disclosed in Enami as it would ensure that the mapped coordinates are assigned the appropriate color value and provide a more accurate corrected image. Shah Dec. (Ex. 1014) ¶¶ 141, 149. A claim chart for claim 15 is set forth below.

Claim 15 '990 Patent	**Prior Art**
15a. The method according to claim 10, further comprising: determining the color of image points of a display window, by	Nagaoka (Ex. 1003) discloses all the elements of claim 1, (s*ee* Sections A & B), and Shiota discloses all the elements of claim 10 (s*ee* Section G). Enami discloses a coordinate of a point of the fisheye lens image img corresponding to a coordinate of each

projecting the image points of the display window onto the initial image by means of the non-linear distribution function, and	point arranged on a raster in the image frame frm is specified, and a color information signal of the point having the coordinate is made to correspond to a color information signal of a point having a coordinate of the display frame frm, and thus it is possible to perform a correction process of transforming the fisheye lens image img to an original image. Ex. 1012 [0058]; Shah Dec. (Ex. 1014) ¶¶123-130.
15b. allocating to each image point of the display window the color of an image point that is the closest on the initial image.	Enami discloses: "Here, the point (x", y") on the coordinates of the fisheye lens image obtained through the above-described operation is indicated by (u, v). In order to smoothly interpolate this coordinate point (u, v), the following interpolation process is performed. Color information signal components of three colors of a picture signal are indicated by Y, U, and V, those components of the point (u, v) are indicated by Yu, v, Uu, v, and Vu, v, values which become an integer by omitting decimal points of the coordinate components u and v of the point (u, v) are indicated by u0 and v0, and a value of the color information signal Y in a point having the coordinate (u0, v0) is indicated by Yu0v0. Similarly, the same content is indicated by Uu0v0 and Vu0v0 for the color information signals U and V. In addition, values obtained by rounding up decimal points of the coordinate components u and v are respectively indicated by u1 and v1, and values of the color information signals Y, U and V having a coordinate corresponding thereto are respectively indicated by Yu1v1, Uu1v1, and Vu1v1. Further, decimal parts of the coordinate components u and v are respectively indicated by du and dv." Ex. 1012 [0072]; Shah Dec. (Ex. 1014) ¶131.

As such, claim 15 should be cancelled as obvious under 35 U.S.C. §103(a) over Nagaoka in view of Shiota, and in further view of Enami. Shah Dec. (Ex. 1014) ¶¶ 140-141, 150-151, 154.

2. Claim 16

It would have been obvious to a POSA to use the projection of the image points of the display window onto the initial image also disclosed in Shiota and Enami to ensure that what is in the display window is an image that has uniform resolution across all of its points, and thus provide a more accurate corrected image. Shah Dec. (Ex. 1014) ¶ 150.

a. *"The method according to claim 15, wherein the projection of the image points of the display window onto the initial image comprises: projecting the image points of the display window onto a sphere or a sphere portion,"*

Enami discloses mapping from a three-dimensional coordinate point (x, y, z) to a point P (x", y") of the fisheye lens image on the two-dimensional coordinates which is first performed by transforming the point (x, y, z) into a point (r, θ, ϕ) expressed in polar coordinates. This transform can be performed using a polar coordinate transform expression of Equation (5). Ex. 1012 [0065-0066]; Shah Dec. (Ex. 1014) ¶¶ 132-133.

Shiota discloses "transforming a fisheye image obtained using a fisheye lens (2) into a plane image for display comprising: a first coordinate calculating unit (35) for obtaining first projection coordinates derived by projecting coordinates on the plane image onto a fisheye face as an imaginary object face." Ex. 1008 Abstract; Shah Dec. (Ex. 1014) ¶¶ 143-144.

b. *"determining the angle in relation to the center of the sphere or the sphere portion of each projected image point, and,"*

Enami discloses determining the angle in relation to the center of the sphere or the sphere portion of each projected image point. Ex. 1012 [0080-0083]; Shah Dec. (Ex. 1014) ¶ 134. Enami specifically discloses that a transform can be performed using a polar coordinate transform expression of Equation (5). Ex. 1012 [0067]; Shah Dec. (Ex. 1014) ¶ 135.

Shiota discloses "Necessary parameters are, as shown in Figs. 1 and 2, (X0, Y0, Z0) indicative of the center (origin) of a plane image and change amounts ∂ux, ∂vx, ∂uy, ∂vy, ∂uz, ∂vz in the respective axes of the (X, Y, Z) coordinates when a point is moved in the respective directions on the (u, v) coordinate system by an amount of one pixel (corresponding to one pixel on the monitor screen). Ex. 1008 [0025]. "The parameters can be easily obtained from the information of the angle information (ψ, θ, α) of the view point and the magnification of the image." Ex. 1008 [0026]. Since point P' "is on the surface of the hemisphere of radius of 1, the zenithal angle (θ_1) is unconditionally determined …" Ex. 1008 [0034]; Shah Dec. (Ex. 1014) ¶ 145.

c. *"projecting onto the initial image each image point projected onto the sphere or the sphere portion,*

Enami discloses projecting onto the initial image each image point projected onto the sphere or the sphere portion. Ex. 1012 [0070-0071]; Shah Dec. (Ex.

1014) ¶ 136. Enami discloses a fisheye lens of an equal area mapping formula is expressed by an expression of Equation (3-2), and this equation is assigned to Equation (2) so as to obtain an expression of Equation (6). The expression of Equation (5) is simplified to the expression of Equation (7) using the relations $x^2 + y^2 + z^2 = x'^2 + y'^2 + z'^2 = r^2$, and basic trigonometric geometry. Ex. 1012 [0068, 0070]; Shah Dec. (Ex. 1014) ¶ 137.

Shiota discloses "First, the coordinates of a point P' (first projection coordinates) on the hemispherical face as an imaginary object face, which is a projection of a point P on a plane image (the u, v coordinates) are obtained." Ex. 1008 [0028]; Shah Dec. (Ex. 1014) ¶ 146.

d. *"the projection being performed by means of the non-linear distribution function considering the field angle that each point to be projected has in relation to the center of the sphere or the sphere portion."*

Enami discloses the projection being performed by means of the non-linear distribution function considering the field angle that each point to be projected has in relation to the center of the sphere or the sphere portion. Ex. 1012 [0084-0085]; Shah Dec. (Ex. 1014) ¶ 138. A fisheye lens of an equal area mapping formula is expressed by an expression of Equation (3-2), and this equation is assigned to Equation (2) so as to obtain an expression of Equation (6). Ex, 1012 [0068]; Shah Dec. (Ex. 1014) ¶ 139.

Shiota discloses as a second step of the calculation, "a procedure of obtaining second projection coordinates w(p1, q1,) on a fisheye image face from the first projection coordinates (X2, Y2, Z2) determined (refer to FIG. 1 with respect to w) will be explained." Ex. 1008 [0033]; Shah Dec. (Ex. 1014) ¶ 147. An example of a specific function of $F(\theta_1)$ according to the projecting method is the stereographic projection, which has the non-linear distribution function: $2f \bullet \tan(\theta/2)$. Ex. 1008 [0037]; Shah Dec. (Ex. 1014) ¶ 148.

Enami and Shiota establish that it would have been obvious to a POSA to further correct an image obtained from a lens described in Nagaoka with the corrections disclosed in Shiota and Enami as it would provide a more accurate corrected image and ensure that what is in the display window is an image that has uniform resolution across all of its points. Shah Dec. (Ex. 1014) ¶ 150. A claim chart for claim 16 is set forth below.

Claim 16 '990 Patent	**Prior Art**
16a. The method according to claim 15, wherein the projection of the image points of the display window onto the initial image comprises: projecting the image points of the display window onto a sphere or a sphere portion,	Enami discloses mapping from a three-dimensional coordinate point (x,y,z) to a point P (x",y") of the fisheye lens image on the two-dimensional coordinates which is first performed by transforming the point (x,y,z) into a point (r,θ,ϕ) expressed in polar coordinates. This transform can be performed using a polar coordinate transform expression of Equation (5). Ex. 1012 [0066]; Shah Dec. (Ex. 1014) ¶¶132-133. Shiota discloses "transforming a fisheye image obtained using a fisheye lens (2) into a plane image

	for display comprising: a first coordinate calculating unit (35) for obtaining first projection coordinates derived by projecting coordinates on the plane image onto a fisheye face as an imaginary object face." Ex. 1008 Abstract; Shah Dec. (Ex. 1014) ¶¶142-144.
16b. determining the angle in relation to the center of the sphere or the sphere portion of each projected image point, and	Enami discloses this transform can be performed using a polar coordinate transform expression of Equation (5). Ex. 1012 [0067]; Shah Dec. (Ex. 1014) ¶¶134-135. Shiota discloses "Necessary parameters are, as shown in Figs. 1 and 2, (X0, Y0, Z0) indicative of the center (origin) of a plane image and change amounts ∂ux, ∂vx, ∂uy, ∂vy, ∂uz, ∂vz in the respective axes of the (X, Y, Z) coordinates when a point is moved in the respective directions on the (u, v) coordinate system by an amount of one pixel (corresponding to one pixel on the monitor screen). Ex. 1008 [0025]. "The parameters can be easily obtained from the information of the angle information (ψ, θ, α) of the view point and the magnification of the image." Ex. 1008 [0026]. Since point P' "is on the surface of the hemisphere of radius of 1, the zenithal angle (θ1) is unconditionally determined…" Ex. 1008 [0034]; Shah Dec. (Ex. 1014) ¶145.
16c. projecting onto the initial image each image point projected onto the sphere or the sphere portion,	Enami discloses a fisheye lens of an equal area mapping formula which is expressed by Equation (3-2), and this equation is assigned to Equation (2) so as to obtain an expression of Equation (6). The expression of Equation (5) is simplified as in an expression of Equation (7) using a relation of $x^2 + y^2 + z^2 = x'^2 + y'^2 + z'^2 = r^2$, Equation (5), and further a basic expression of a trigonometric function. Ex. 1012 [0068, 0070]; Shah Dec. (Ex. 1014) ¶¶136-137. Shiota discloses "First, the coordinates of a point P' (first projection coordinates) on the hemispherical face as an imaginary object face, which is a projection of a point P on a plane image (the u, v coordinates) are obtained." Ex. 1008 [0028]; Shah Dec. (Ex. 1014) ¶146

16d. the projection being performed by means of the non-linear distribution function considering the field angle that each point to be projected has in relation to the center of the sphere or the sphere portion.	Enami discloses that the projection is performed by means of the non-linear distribution function considering the field angle that each point to be projected has in relation to the center of the sphere or the sphere portion. The field angle is defined according to the horizontal and vertical extents in the image area while the center is defined to be the image center position. Shah Dec. (Ex. 1014) ¶138. Further, a fisheye lens of an equal area mapping formula is expressed by an expression of Equation (3-2), and this equation is assigned to Equation (2) so as to obtain an expression of Equation (6). Ex, 1012, ¶0068; Shah Dec. (Ex. 1014) ¶139. Shiota discloses as a second step of the calculation, "a procedure of obtaining second projection coordinates w(p1, q1,) on a fisheye image face from the first projection coordinates (X2, Y2, Z2) determined (refer to FIG. 1 with respect to w) will be explained." Ex. 1008 [0033]. An example of a specific function of $F(\theta_1)$ according to the projecting method is the stereographic projection, which has the non-linear distribution function: $2f \bullet \tan(\theta/2)$. Ex. 1008 [0037]; Shah Dec. (Ex. 1014) ¶¶147-148.

Therefore, claim 16 should be cancelled as obvious over Nagaoka in view of Shiota and in further view of Enami. Shah Dec. (Ex. 1014) ¶¶ 141, 150, 152-154.

L. Grounds 12 And 13: Claims 10 And 11 Are Obvious Over Baker In View Of Shiota And Claims 15 And 16 Are Obvious Over Baker In View Of Shiota And Further In View Of Enami

Baker (like Nagaoka) discloses all the elements of claim 1. *See* Sections C and D. Thus, for the same reasons that Nagaoka in view of Shiota render claims 10 and 11 unpatentable (*see* Sections H & J), and Nagaoka in view of Shiota and in further view of Enami render claims 15 and 16 unpatentable (*see* Section K), Baker

can be substituted for Nagaoka in each of these combinations thereby rendering claims 10, 11, 15 and 16 unpatentable. Accordingly, these claims should be cancelled as obvious under 35 U.S.C. §103(a) for this additional reason. Shah Dec. (Ex. 1014) ¶ 155.

M. Ground 14: Claim 25 Is Obvious Under 35 U.S.C. §103(a) Over Baker In View Of Inoue

Claim 25 recites: "The panoramic objective lens according to claim 22, comprising polymethracylate lenses." Inoue discloses making wide angle lenses from PMMA. Ex. 1007, 2:42-44; Feinberg Dec. (Ex. 1013) ¶ 150. The '990 patent (Ex. 1001, 16:34-36) discloses that PMMA and polymethacylate are either the same or equivalent for use in wide angle lenses. Thus, it would have been obvious to a POSA that the lenses disclosed in Baker (Ex. 1002) could be made from PMMA or polymethacylate as disclosed in Inoue (Ex. 1013). Feinberg Dec. (Ex. 1013) ¶¶ 150, 161. Accordingly, Claim 25 should be cancelled as obvious under 35 U.S.C. §103(a) over Baker in view of Inoue.

N. Ground 15: Claim 25 Is Obvious Under 35 U.S.C. §103(a) Over Nagaoka In View Of Inoue

For the same reasons set forth in Section M above, it would have been obvious to a POSA that the lenses disclosed in Nagaoka could be made from PMMA or polymethacylate. Feinberg Dec. (Ex. 1013) ¶¶ 150, 161. Accordingly,

claim 25 should be cancelled as obvious under 35 U.S.C. §103(a) over Nagaoka in view of Inoue. Feinberg Dec. (Ex. 1013) ¶¶ 150, 161.

VII. CONCLUSION

For the reasons described above, there is a reasonable likelihood that Petitioner will prevail as to each of claims 1-4, 6-7, 10, 11, 15-20, 22-23 and 25 of the '990 patent and a reasonable likelihood that at least one of the claims challenged in the petition is unpatentable. 37 C.F.R. § 42.108(c). Accordingly, *inter partes* review of claims 1-4, 6-7, 10, 11, 15-20, 22-23 and 25 of the '990 patent is respectfully requested.

Dated: September 3, 2014

Respectfully submitted,

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CERTIFICATE OF SERVICE

I hereby certify that the attached Petition For *Inter Partes* Review Of U.S. Patent No. 6,844,990 Under 35 U.S.C. §§ 311-319 And 37 C.F.R. § 42.100 et seq. and supporting materials were served as of the below date by Federal Express on the Patent Owner at the correspondence address indicated for U.S. Patent No. 6,844,990:

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Additionally, I hereby certify that the attached Petition For *Inter Partes* Review Of U.S. Patent No. 6,844,990 Under 35 U.S.C. §§ 311-319 And 37 C.F.R. § 42.100 et seq. and supporting materials were served as of the below date by Federal Express on the following:

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