

UNITED STATES PATENT AND TRADEMARK OFFICE
BEFORE THE
PATENT TRIAL AND APPEAL BOARD

CANON, INC. AND CANON U.S.A., INC.,

Petitioner

v.

WSOU Investments, LLC d/b/a Brazos Licensing and Development,

Patent Owner

U.S. Patent No. 7,493,030

Original Issue Date: Feb. 17, 2009

Title: ADAPTIVE OPTICAL PLANE FORMATION
WITH ROLLING SHUTTER

Case No. TBD

PETITION FOR *INTER PARTES* REVIEW
OF U.S. PATENT NO. 7,493,030
PURSUANT TO 35 U.S.C. §§ 311-319 and 37 C.F.R. § 42

TABLE OF CONTENTS

I. INTRODUCTION	1
II. 37 C.F.R. § 42.8(B): MANDATORY NOTICES	2
A. 37 C.F.R. § 42.8(b)(1): Notice of Real-Parties-in-Interest	2
B. 37 C.F.R. § 42.8(b)(2): Notice of Related Matters	2
C. 37 C.F.R. § 42.8(b)(3) and (4): Notice of Counsel and Service Information	3
D. Fee for <i>Inter Partes</i> Review	4
III. REQUIREMENTS FOR IPR	4
A. § 42.104(a): Grounds for Standing	4
B. § 42.104(b): Identification of Challenge	4
1. § 42.104(b)(1): Challenged Claims.....	4
2. § 42.104(b)(2): The Prior Art and Statutory Grounds	5
3. Level of Ordinary Skill in the Art.....	7
4. § 42.104(b)(5): Evidence Supporting Challenge	7
IV. INSTITUTION SHOULD BE GRANTED	7
V. THERE EXISTS A REASONABLE LIKELIHOOD THAT THE CHALLENGED CLAIMS ARE UNPATENTABLE	9
A. Technology Background	9
1. Basic Photography Principles.....	10
2. Problem Addressed by the '030 Patent	12
B. The Alleged Invention	15
C. Prosecution History	18
D. Claim Constructions	19
1. “Within a Continuous Exposure Frame” (Claim 11).....	19

2. “During An Exposure Frame Period” (Claim 15).....	20
VI. THE PRIOR ART	21
A. Sugitani.....	21
B. Kubo.....	23
C. Motivation to Combine Sugitani and Kubo	26
D. Misawa	28
E. Motivation to Combine Misawa, Sugitani, and Kubo	28
F. Berge	30
G. Motivation to Combine Berge, Sugitani, and Kubo	30
H. Shibata	31
I. Kondo.....	34
J. Motivation to Combine Shibata and Kondo	36
K. Motivation to Combine Berge, Shibata, and Kondo	37
L. Motivation to Combine Kubo, Shibata, and Kondo	38
VII. THE '030 PATENT CLAIMS ARE UNPATENTABLE OVER THE PRIOR ART	39
A. GROUND 1: Sugitani in view of Kubo Renders Claims 1-9, 11-21, and 23-24 Obvious.....	39
1. Independent Claim 1	39
2. Claim 2	42
3. Independent Claim 3	43
4. Independent Claim 4	45
5. Claim 5	48
6. Claim 6	48
7. Claim 7	49
8. Claim 8	50

9. Independent Claim 9	50
10. Independent Claim 11	52
11. Claim 12	53
12. Claim 13	54
13. Claim 14	54
14. Independent Claim 15	55
15. Claim 16	56
16. Claim 17	56
17. Claim 18	56
18. Claim 19	56
19. Claim 20	57
20. Claim 21	57
21. Claim 23	57
22. Claim 24	58
B. GROUND 2: Sugitani in view of Kubo and Misawa Renders	
Claims 9 and 23 Obvious	58
1. Independent Claim 9	58
2. Claim 23	60
C. GROUND 3: Sugitani in view of Kubo and Berge Renders	
Claims 10 and 25 Obvious	61
1. Independent Claim 10	61
2. Claim 25	62
D. GROUND 4: Shibata in view of Kondo Renders	
Claims 1-5, 7-9, 15-16, and 18-24 Obvious.....	63
1. Independent Claim 1	63
2. Claim 2	67

3. Independent Claim 3	67
4. Independent Claim 4	68
5. Claim 5	70
6. Claim 7	70
7. Claim 8	72
8. Independent Claim 9	72
9. Independent Claim 15	73
10. Claim 16	74
11. Claim 18	74
12. Claim 19	75
13. Claim 20	75
14. Claim 21	75
15. Claim 22	76
16. Claim 23	76
17. Claim 24	76
E. GROUND 5: Shibata in view of Kondo and Berge Renders	
Claims 10 and 25 Obvious	77
1. Independent Claim 10	77
2. Claim 25	78
F. GROUND 6: Shibata in view of Kondo and Kubo Renders	
Claims 6, 11-14, and 17 Obvious.....	79
1. Independent Claim 11	79
2. Claim 12	82
3. Claim 13	83
4. Claim 14	83
5. Claim 6	83

6. Claim 17	83
VIII. SECONDARY CONSIDERATIONS	84
IX. CONCLUSION	84

TABLE OF AUTHORITIES

Cases

- *Apple Inc. v. Fintiv, Inc.*,
 - Case No. IPR2020-00019, Paper No. 11 (Mar. 20, 2020)
- *Netflix, Inc. v. Uniloc 2017 LLC*,
 - Case No. IPR2020-00041, Paper No. 10 at 15 (Mar. 25, 2020)
- *Tokai Corp. v. Easton Enters., Inc.*,
 - 632 F.3d 1358, 1370 (Fed. Cir. 2011)

LISTING OF EXHIBITS

Exhibit	Description
Exhibit 1001	U.S. Patent No. 7,493,030 (the “ 030 patent ”)
Exhibit 1002	Declaration of Dr. Michael Leppy (“ Leppy ”)
Exhibit 1003	Japanese Patent Application Publication No. 2002-318342 (“ Sugitani ”), including a certified English translation
Exhibit 1004	Japanese Patent Application Publication No. 2001-103366 (“ Kubo ”), including a certified English translation
Exhibit 1005	Japanese Patent Application Publication No. 2003-121913 (“ Misawa ”), including a certified English translation
Exhibit 1006	U.S. Patent No. 6,369,954 (“ Berge ”)
Exhibit 1007	Japanese Patent Application Publication No. 2003-319239 (“ Shibata ”), including a certified English translation
Exhibit 1008	U.S. Patent Application Publication No. 2003/0174234 (“ Kondo ”)
Exhibit 1009	U.S. Patent Application Publication No. 2003/0086008 (“ Nagano ”)
Exhibit 1010	U.S. Patent No. 4,410,804 (“ Stauffer ”)
Exhibit 1011	Curriculum Vitae of Dr. Michael Leppy
Exhibit 1012	Prosecution History of U.S. Patent No. 7,493,030
Exhibit 1013	U.S. Patent Application Publication No. 2003/0007076 (“ Okisu ”)
Exhibit 1014	U.S. Patent Application Publication No. 2003/0081137 (“ Yamazaki ”)
Exhibit 1015	WSOU’s Claim Chart in District Court Matter (Dkt. No. 1-4)
Exhibit 1016	U.S. Patent No. 5,282,045

CLAIM LISTING

Claim	Limitation No.	Limitation
1	[1-PRE]	A method comprising:
	[1-A]	manipulating an optical relationship between an optical lens and an image sensing surface so that the image sensing surface is spaced at different effective image distances from the lens
	[1-B]	exposing different portions of the image sensing surface synchronous with manipulating the optical relationship by adaptively exposing said portions for different exposure periods based on detected movement of at least two objects.
2	2	The method of claim 1, wherein the image sensing surface comprises an array of photosensitive pixels.
3	[3-PRE]	A method comprising:
	[3-A]	manipulating an optical relationship between an optical lens and an image sensing surface so that the image sensing surface is spaced at different effective image distances from the lens; and
	[3-B]	exposing different portions of the image sensing surface synchronous with manipulating the optical relationship by adaptively exposing said portions for different exposure periods based on detected brightness of at least two objects.
4	[4-PRE]	A method comprising:
	[4-A]	manipulating an optical relationship between an optical lens and an image sensing surface so that the image sensing surface is spaced at different effective image distances from the lens; and
	[4-B]	exposing different portions of the image sensing surface synchronous with manipulating the optical relationship,
	[4-C]	wherein the image sensing surface comprises an array of pixels in adjacent rows, wherein a first portion of the array is exposed while the image sensing surface is at a first effective image distance, and a second portion of the array is exposed while the sensing surface is at a second effective image distance, and wherein at least one pixel of the first portion is in a same row of the array as at least one pixel of the second portion.
5	5	The method of claim 4, wherein at least one of manipulating the optical relationship and exposing different portions of the image sensing surface are adaptive to objects in a scene to be imaged at the sensing surface.

Inter Partes Review
United States Patent No. 7,493,030

Claim	Limitation No.	Limitation
6	6	The method of claim 4, wherein exposing different portions of the image sensing surface comprises adaptively exposing said portions based on at least a detected first and second object distance.
7	7	The method of claim 4, wherein manipulating the optical relationship comprises manipulating between a first effective image distance and a second effective image distance, wherein the first and second effective image distances correspond respectively to the first and second object distances.
8	8	The method of claim 4, wherein manipulating the optical relationship comprises moving at least one of the lens and the sensing surface relative to one another.
9	[9-PRE]	A method comprising:
	[9-A]	manipulating an optical relationship between an optical lens and an image sensing surface so that the image sensing surface is spaced at different effective image distances from the lens; and
	[9-B]	exposing different portions of the image sensing surface synchronous with manipulating the optical relationship,
	[9-C]	wherein manipulating the optical relationship synchronously with exposing operates to impose an effective curvature to the sensing surface that approximates a Petzval surface.
10	[10-PRE]	A method comprising:
	[10-A]	manipulating an optical relationship between an optical lens and an image sensing surface so that the image sensing surface is spaced at different effective image distances from the lens; and
	[10-B]	exposing different portions of the image sensing surface synchronous with manipulating the optical relationship,
	[10-C]	wherein manipulating the optical relationship comprises altering a shape of the lens.

Claim	Limitation No.	Limitation
11	[11-PRE]	A method comprising:
	[11-A]	determining a first object distance between a first object in a scene and a lens;
	[11-B]	determining a second object distance between a second object in the scene and the lens;
	[11-C]	within a continuous exposure frame: exposing a first portion of an image sensing surface while the image sensing surface is at a first effective image distance from the lens, where the first effective image distance corresponds to the first object distance, exposing a second portion of the image sensing surface while the image sensing surface is at a second effective image distance from the lens, where the second effective image distance corresponds to the second object distance; and
	[11-D]	combining the exposed first and second portions into a single image.
12	12	The method of claim 11, wherein the single image is displayed on a digital graphical user interface.
13	13	The method of claim 11, wherein exposing the first and second portion of the image sensing surface comprises adaptively exposing said portions for a first and second exposure time based on a detected brightness of the first and second objects.
14	14	The method of claim 11, wherein exposing the first and second portion of the image sensing surface comprises adaptively exposing said portions for a first and second exposure time based on a detected speed of movement of the first and second objects.
15	[15-PRE]	A memory storing a program of machine-readable instructions, executable by a digital data processor, to perform actions directed toward operating a camera, the actions comprising:
	[15-A]	during an exposure frame period, maintaining an image sensing surface at a variable effective image distance from a lens synchronously with exposing different portions of the sensing surface,
	[15-B]	wherein the image sensing surface comprises an array of photosensitive pixels.
16	16	The memory of claim 15, wherein at least one of maintaining the image sensing surface at a variable effective image distance and exposing different portions of the image sensing surface are adaptive to objects in a scene to be imaged at the sensing surface.
17	17	The memory of claim 15, wherein exposing different portions of the image sensing surface comprises adaptively exposing said portions based on at least a detected first and second object distance.

Inter Partes Review
United States Patent No. 7,493,030

Claim	Limitation No.	Limitation
18	18	The memory of claim 15, wherein maintaining an image sensing surface at a variable effective image distance comprises varying between a first and a second image distance that respectively correspond to the first and second object distances.
19	19	The memory of claim 15, wherein exposing different portions of the image sensing surface comprises adaptively exposing said portions for different exposure periods based on detected movement of at least two objects.
20	20	The memory of claim 15, wherein exposing different portions of the image sensing surface comprises adaptively exposing said portions for different exposure periods based on detected brightness of at least two objects.
21	21	The memory of claim 15, wherein the program controls exposure of the photosensitive pixels according to rows.
22	22	The memory of claim 15, wherein the program controls exposure of the photosensitive pixels individually.
23	23	The memory of claim 15, wherein maintaining an image sensing surface at a variable effective image distance synchronously with exposing operates to impose an effective curvature to the sensing surface that approximates a Petzval surface.
24	24	The memory of claim 15, wherein maintaining the image sensing surface at a variable effective image distance from the lens comprises moving the lens relative to the sensing surface.
25	25	The memory of claim 15, wherein maintaining the image sensing surface at a variable effective image distance from the lens comprises changing a shape of the lens.

I. INTRODUCTION

Pursuant to 35 U.S.C. §§ 311-319 and 37 C.F.R. § 42, Petitioner Canon, Inc. (“**Canon**” or “**Petitioner**”) respectfully requests *inter partes* review (“**IPR**”) of Claims 1-25 (“**Challenged Claims**”) of U.S. Patent No. 7,493,030 (the “**’030 patent**”).

The ’030 patent concerns expanding depth of field (“DoF”) in an image and describes related prior art solutions that do so by taking multiple pictures of a scene with different areas in focus and compositing them together, such that the final combined image contains the in-focus areas from the source pictures. In contrast, the ’030 patent discloses changing focus during the creation of a single picture (*i.e.*, “manipulating an optical relationship between an optical lens and an image sensing surface”), and “*exposing different portions* of the image sensing surface *synchronous with*” changing the focus. ’030 patent, 3:17-32.

But this allegedly novel solution exists in the prior art. As this Petition shows in detail, it was well-known to move the lens and/or sensing surface to different positions to focus on different objects in a scene to while capturing them in a single exposure.

Petitioner requests that the PTAB institute trial and find the Challenged Claims unpatentable for the reasons set forth herein.

II. 37 C.F.R. § 42.8(B): MANDATORY NOTICES

A. 37 C.F.R. § 42.8(b)(1): Notice of Real-Parties-in-Interest

Petitioner certifies that the real parties-in-interest are: Canon Inc. and Canon U.S.A., Inc. No other parties exercised or could have exercised control over this Petition; no other parties funded or directed this Petition. *See* Office Patent Trial Practice Guide, 77 Fed. Reg. 48759-60.

B. 37 C.F.R. § 42.8(b)(2): Notice of Related Matters

To the best knowledge of Petitioner, the '030 patent has been involved in the following litigations and matters:

Case Name	Filed
<i>WSOU Investments, LLC d/b/a Brazos Licensing and Development v. Canon, Inc. and Canon U.S.A., Inc.,</i> Case No. 6:22-cv-00166 (W.D. Tex.)	Feb. 16, 2022

C. 37 C.F.R. § 42.8(b)(3) and (4): Notice of Counsel and Service Information

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Petitioner submits a Power of Attorney with this Petition. Please address all correspondence to lead counsel. Petitioner consents to service by email at the

email addresses listed above.

D. Fee for *Inter Partes Review*

The USPTO is authorized to charge the filing fee and any other fees incurred by Petitioner to the deposit account of Orrick, Herrington, & Sutcliffe LLP: 15-0665.

III. REQUIREMENTS FOR IPR

This Petition complies with all requirements under 37 C.F.R. § 42.104 for IPR.

A. § 42.104(a): Grounds for Standing

The '030 patent is available for IPR; Petitioner is not barred or estopped from requesting IPR; *and* this Petition for IPR is timely filed under 35 U.S.C. § 315(b).

B. § 42.104(b): Identification of Challenge

Pursuant to 37 C.F.R. § 42.104(b), Petitioner requests that the PTAB invalidate the Challenged Claims of the '030 patent.

1. § 42.104(b)(1): Challenged Claims

Petitioner challenges Claims 1-25 of the '030 patent.

2. § 42.104(b)(2): The Prior Art and Statutory Grounds

The application for the '030 patent was filed on June 24, 2005 and does not claim priority to an earlier filed application. This Petition therefore treats **June 24, 2005**, as the priority date for the '030 patent (the “**Priority Date**”).

The prior art references relied upon herein are:

Patent/Publication	Priority Date	Publication Date	Prior Art	Ex. No.
Japanese Patent Application Publication No. 2002-318342 (“ <i>Sugitani</i> ”), including a certified English translation	April 23, 2001	October 31, 2002	102(b)	1003
Japanese Patent Application Publication No. 2001-103366 (“ <i>Kubo</i> ”), including a certified English translation	September 28, 1999	April 13, 2001	102(b)	1004
Japanese Patent Application Publication No. 2003-121913 (“ <i>Misawa</i> ”), including a certified English translation	October 15, 2001	April 23, 2003	102(b)	1005
U.S. Patent No. 6,369,954 (“ <i>Berge</i> ”)	October 8, 1997	April 9, 2002	102(b)	1006

Patent/Publication	Priority Date	Publication Date	Prior Art	Ex. No.
Japanese Patent Application Publication No. 2003-319239 (“ <i>Shibata</i> ”), including a certified English translation	April 24, 2002	November 7, 2003	102(b)	1007
U.S. Patent Application Publication No. 2003/0174234 (“ <i>Kondo</i> ”)	April 13, 2000	September 18, 2003	102(b)	1008
U.S. Patent Application Publication No. 2003/0086008 (“ <i>Nagano</i> ”)	November 8, 2001	May 8, 2003	102(b)	1009
U.S. Patent No. 4,410,804 (“ <i>Stauffer</i> ”)	July 13, 1981	October 18, 1983	102(b)	1010

Below are the specific statutory grounds on which the claims are challenged:

Ground Number	Ground
1	Claims 1-9, 11-21, and 23-24 are obvious under 35 U.S.C. § 103 over <i>Sugitani</i> in view of <i>Kubo</i>
2	Claims 9 and 23 are obvious under 35 U.S.C. § 103 over <i>Sugitani</i> in view of <i>Kubo</i> and further in view of <i>Misawa</i>
3	Claims 10 and 25 are obvious under 35 U.S.C. § 103 over <i>Sugitani</i> in view of <i>Kubo</i> and further in view of <i>Berge</i>
4	Claims 1-5, 7-9, 15-16, and 18-24 are obvious under 35 U.S.C. § 103 over <i>Shibata</i> in view of <i>Kondo</i>

Ground Number	Ground
5	Claims 10 and 25 are obvious under 35 U.S.C. § 103 over <i>Shibata</i> in view of <i>Kondo</i> and further in view of <i>Berge</i>
6	Claims 6, 11-14, and 17 are obvious under 35 U.S.C. § 103 over <i>Shibata</i> in view of <i>Kondo</i> and further in view of <i>Kubo</i>

Apart from *Berge*, none of the references on which these grounds are based were before the Examiner during prosecution of the '030 patent.

3. *Level of Ordinary Skill in the Art*

A POSITA of the technology described in the '030 patent in 2005, and more generally in the 1995-2005 time period, would have had a bachelor's degree in electrical engineering, physics, or computer science, or an equivalent degree, and two to three years of experience in the field of optical engineering. Ex. 1002, ¶[0040].

4. *§ 42.104(b)(5): Evidence Supporting Challenge*

The Declaration of Dr. Michael Leby (Ex. 1002) ("**Leby**") and other supporting evidence in the Exhibit List are filed herewith. Dr. Leby's background and qualifications, and the information provided to him, are discussed in Ex. 1002 and 1011.

IV. INSTITUTION SHOULD BE GRANTED

This Petition establishes a reasonable likelihood of success on the merits and

all other requirements for an IPR.

No ground presented here was considered by the Examiner or otherwise previously considered by the Patent Office. As set forth below, there is a reasonable likelihood that at least one of the challenged claims is unpatentable.

The parties are litigating the '030 patent in an action brought on February 16, 2022, by WSOU Investments, LLC (“WSOU” or “Patent Owner”). *WSOU Investments, LLC d/b/a Brazos Licensing and Development v. Canon, Inc. and Canon, U.S.A., Inc.*, Case No. 6:22-cv-00166 (W.D. Tex.) (“Texas Action”). A first amended complaint was served on June 9, 2022.

Application of the factors in *Apple Inc. v. Fintiv, Inc.*, Case No. IPR2020-00019, Paper No. 11 (Mar. 20, 2020) weighs *against* discretionary denial of IPR institution.

The district court proceeding is in its early stages. Patent Owner served Petitioner with its original complaint in the Texas Action less than seven months ago, and a first amended complaint was just served on June 9, 2022. There has been no *Markman* hearing or fact discovery. The tentative trial date is not until 2024, and recent Federal Court Management Statistics show a median time to trial in civil cases of 27.2 months for WDTX, well after a final written decision here.

https://www.uscourts.gov/sites/default/files/data_tables/fcms_na_distcomparison0331.2022.pdf at p. 5.

Petitioner has been diligent in expeditiously preparing and filing this Petition. While a *Markman* hearing has been tentatively scheduled for December 8, 2022, even assuming the *Markman* hearing occurs as scheduled, it is unlikely the Court will have issued its claim construction order by the institution deadline.

Third, the grounds asserted in this Petition are strong. The Petition provides a detailed analysis as to why the Challenged Claims are unpatentable and presents multiple grounds of invalidity for each Challenged Claim.

The factors above weigh strongly against discretionary denial and outweigh any counterargument that the remaining factors weigh towards denial.

Accordingly, IPR should be instituted.

V. THERE EXISTS A REASONABLE LIKELIHOOD THAT THE CHALLENGED CLAIMS ARE UNPATENTABLE

A. Technology Background

The '030 patent relates to increasing the DoF achievable by a camera by exposing the image as a series of sub-exposures and changing the camera's focus for each sub-exposure. By the June 2005 priority date, the field of camera development was well-established and built upon the decades old understanding of basic photography principles. Ex. 1002, ¶¶[0041-0054]. It was a crowded art where the concepts employed in the field were well understood, predictable, and routinely mixed and matched as needed to achieve a POSITA's design goals. *Id.*

1. Basic Photography Principles

The '030 patent assumes a POSITA understands basic photographic principles, which are briefly described here. Ex. 1002, ¶¶[0044-0054].

Taking a photograph involves two somewhat interrelated acts: (1) placing the object to be photographed in focus; and (2) exposing the light sensitive surface of the camera (*e.g.*, film or electronic image sensor)¹ for the appropriate amount of time to capture an acceptable image.

Focusing typically involves manipulating the distance between the lens and the sensor based on the object's distance from the camera.

Selecting the appropriate exposure time depends firstly on the brightness of the object. All else being equal, dimmer objects need to be exposed for a longer period of time than brighter objects. The exposure time period in a camera is typically controlled by the camera's shutter and is called shutter speed. The specific shutter speed needed to expose a particular object depends on two other variables: lens aperture and sensor sensitivity.

¹ The light sensitive surface will simply be referred to as a sensor herein.

- Lens aperture describes the size of the opening light passes through in the lens. Most lenses have a variable aperture allowing the size of this opening to be increased or decreased. All else being equal, a larger aperture (*e.g.*, bigger opening) allows more light to hit the sensor and requires a short exposure time period, while a smaller aperture does the opposite.
- Sensor sensitivity describes the amount of light needed by the sensor to properly capture an image. All else being equal, a highly sensitive sensor will properly expose a dim object but will create a washed-out (or low contrast) image for a bright object, while a less sensitive sensor would do the opposite.

Object movement must be considered when selecting shutter speed. If an object moves while the sensor is being exposed, the object may be blurry in the image.

Aperture impacts DoF, which relates to focus. DoF refers to the range of distances from the lens that will be in acceptable focus. Small apertures have wider DoF, while larger apertures have narrower DoF. For a very small aperture—such as a pinhole—the DoF is very large and objects will tend to be in focus regardless of their distance from the camera. In contrast, wide apertures have a very shallow DoF, such that if one object is in focus another object a few inches or feet in front or behind the object might be out of focus.

Sensor sensitivity impacts noise in the image, with higher sensor sensitivity settings producing noisier images.

The three variables of shutter speed, aperture, and sensor sensitivity can be varied in an interrelated way to obtain proper exposure at a given object brightness. For example, higher sensor sensitivity can compensate for a smaller aperture or shorter exposure period. But there are trade-offs in DoF, blur, and noise that result from adjusting each variable. Photographers and camera engineers have long understood these various trade-offs and employ them based on the specific imaging conditions of the object being photographed to create the desired image results given the conditions available.

2. Problem Addressed by the '030 Patent

In view of the above principles, the '030 patent describes DoF using Fig. 2B (labeled prior art, reproduced below), which is a photograph of obliquely arranged dominos. '030 patent, 1:59-2:6. The middle domino 26, S_0 , is in sharp focus, while the dominos in front and behind it are progressively more out of focus. *Id.* The patent considers dominos 25 and 27 to be in acceptable focus.

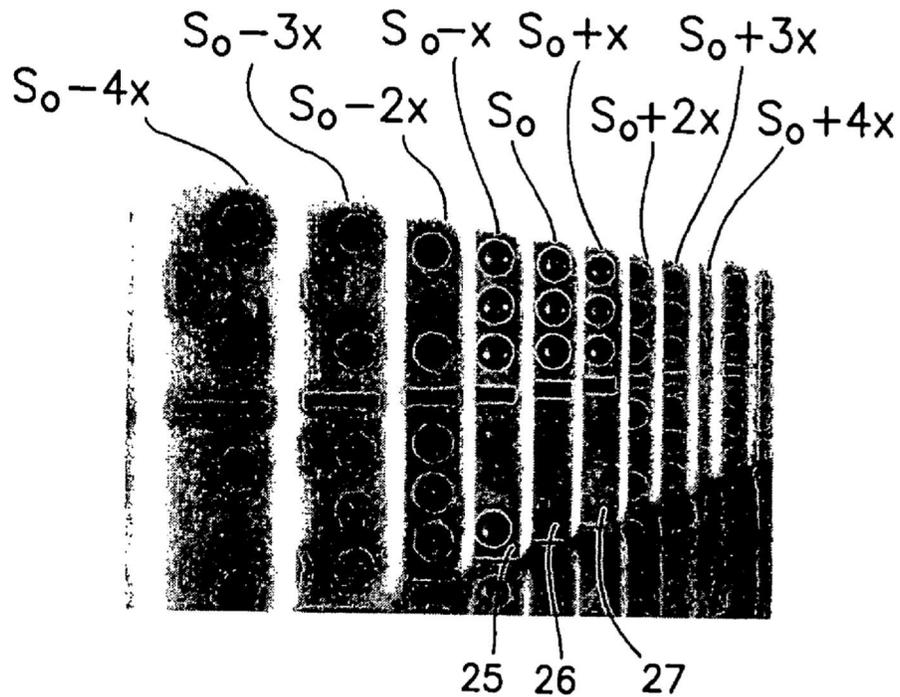
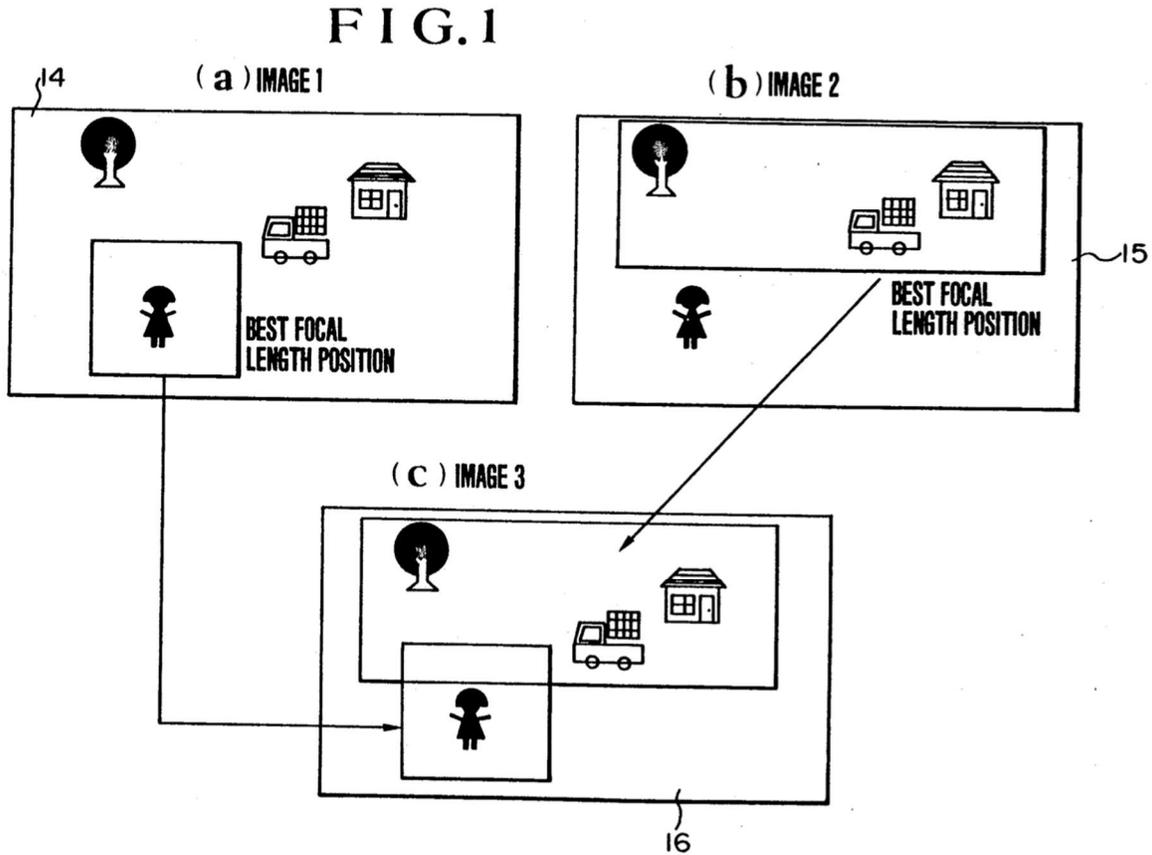


FIG. 2B
PRIOR ART

The '030 patent describes several prior art solutions for increasing the DoF. For example, U.S. Pat. No. 5,282,045, is titled "Depth of Field Control Apparatus and Image Pickup Apparatus Having the Same Therein." *Id.*, 3:6-8. As shown in Fig. 1 (below), the '045 patent recognizes that, in some scenes, the best focus for different objects in the scene might be different and a composite image like (c) is necessary to provide good focus for the entire scene. See U.S. Patent No. 5,282,045 (Ex. 1016), 4:15-27, Fig. 1:



As the '045 patent further explains, “the increase in aperture makes depth of field shallow...in the case of shooting a person, if the best focal length is set to the person, a background scenery thereof is completely out of focus.” *Id.*, 2:5-11. Further, “there has been a well-known technique in which images located in a plurality of different focal lengths are composed to obtain a wide depth of field.” *Id.*, 1:53-56. The '045 patent describes solutions for obtaining wide DoF when objects are moving, determining the timing of shifting the focal point, and performing image read out at the speed needed to capture television images.

The '030 patent acknowledges these known teachings of the '045 patent, including providing: “a mechanism for changing a focal point or length position,” using “[m]otion information...obtained by a circuit detecting a moving portion of an object to control the image composition,” and controlling the movement of the focus system in conjunction with the aperture of the camera lens. '030 patent, 3:6-32. The '030 patent, however, criticizes the '045 patent (and the other prior art described) because they require compositing, *i.e.*, blending, multiple full images. *Id.*, 3:33-36; Ex. 1002, ¶¶[0055-0061].

B. The Alleged Invention

In contrast to the above-described prior art, the '030 patent describes its purportedly invention as “manipulating an optical relationship between an optical lens and an image sensing surface, and *exposing different portions* of the image sensing surface *synchronous with manipulating the optical relationship.*” *Id.*, 3:17-32. In other words, unlike the prior art, which the '030 patent characterizes as superimposing images of the total scene taken at different object distances, the '030 patent teaches exposing different sub-regions of the sensor with the object focus distance changing for each sub-region. Ex. 1002, ¶¶[0062-0072].

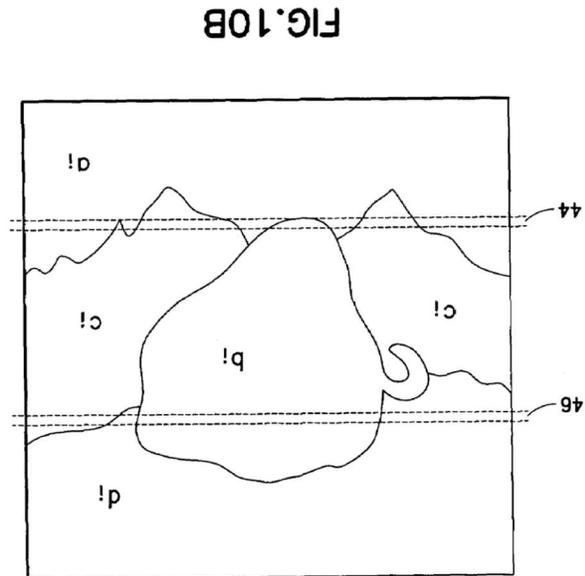
In this way, different focus distances are set for different objects and captured within a single exposure, as opposed to the prior art, which took multiple pictures of a scene with different areas in focus and composited them together,

such that the final combined image contained the in-focus areas from the source pictures.

The '030 patent shows this with reference to Fig. 10A and 10B, below, which present a mastodon and other objects at different object distances.²



FIG. 10A



The mastodon is at one distance (b_i), while the foreground (d_i), hills (c_i), and sky (a_i) are at different distances. The '030 patent explains that known distance measuring equipment (such as an auto focus apparatus) determines the distance of these objects. *Id.*, 10:61-64. "Pixels along the sensor surface 40b that correspond to the various objects are then exposed only when the lens 38 is at the proper

² Fig. 10B has been rotated to match the orientation of Fig. 10A. See '030 patent, 10:40-42.

imaged distance for that particular object.” *Id.*, 10:62-67. In some embodiments, this is done with a slit of variable width by using two curtains that travel in front of a photographic film. *Id.*, 6:16-19. Exposure time is varied by changing the time between the release of the first and second shutter curtains, and the slit width determines the total time any part of the film is exposed. *Id.*, 6:19-26. The '030 patent further explains: “Field curvature is corrected in the resulting image to the precision of the distance measuring equipment, depth of field is greatly increased because the resulting image is made from four image distances rather than one.” *Id.*, 11:20-24.

The '030 patent further discloses that exposure for each independently exposed region of the sensor in Fig. 10B, (*i.e.*, a_i , b_i , c_i , and d_i) can be independently set. *Id.*, 11:26-58. In other words, since the camera is effectively taking four independent pictures, each picture created by a sub-region of the image sensor, each can be treated like a traditional independent picture with the exposure settings being set for the subject matter. Similarly, object motion can be accounted for when photographing each sub-image “[u]sing **known** movement detection equipment that operates on **the same principle** of distance measuring equipment, movement of different objects within a scene may be categorized, and pixels corresponding to the individual objects may be exposed for short or longer period[s] depending on the relative movement of the objects themselves.” *Id.*

11:64-12:7 (emphasis added). The brevity of these descriptions, which provide no detail regarding implementation, demonstrates the '030 patent's recognition that the technology implementing the invention was well known to a POSITA. Ex. 1002, ¶[0071].

The '030 patent also does not describe how to embody distance measuring equipment (or auto focus mechanism), light sensing equipment, and/or motion sensing equipment, correctly assuming all those devices were well known to POSITAs. *Id.*

C. Prosecution History

The '030 patent stems from Application No. 11/165,992. A non-final Office Action rejected the claims based on anticipation by U.S. Patent 3,537,373 to Land, and obviousness by Land in view of U.S. Patent 4,484,233 to Strout. Ex. 1012, pp. 104-122 (July 1, 2008, Office Action). Selected claims were also rejected on the ground of nonstatutory obviousness-type double patenting over a co-pending application (U.S. Application Publication 2007/0031136). *Id.*

The Examiner found selected dependent claims allowable. The Applicant amended the claims to recite this subject matter and submitted a terminal disclaimer to address the double patenting rejection. *Id.*, pp. 134-143.

On December 11, 2008, a Notice of Allowance was issued. *Id.*, pp. 146-151.

D. Claim Constructions

IPR claims are construed according to a POSITA's understanding of the term's ordinary and customary meaning in the art and the prosecution history. 42 C.F.R. §42.100(b).

Aside from the two proposed claim constructions below, Petitioner does not believe that any other constructions are needed to address the validity issues raised in this petition. *See, e.g., Netflix, Inc. v. Uniloc 2017 LLC*, Case No. IPR2020-00041, Paper No. 10 at 15 (Mar. 25, 2020). Petitioner reserves the right to respond to any constructions offered by the Patent Owner.

1. “Within a Continuous Exposure Frame” (Claim 11)

The term “within a continuous exposure frame” in Claim 11 should be construed as “within the period from the start of an exposure of the imaging sensing surface until the entire image sensing surface is exposed once.”

A POSITA would have understood this is the proper construction because the '030 patent defines the term to have that definition at 9:20-25: “FIG. 8 illustrates the condition where the lens 38 moves continuously in one direction during a single frame period.... A single frame period is the continuous exposure time over which any of the entire array of pixels or plate of film is exposed.” Ex. 1002, ¶¶[0078-0081].

The '030 patent further explains that no matter the way the claimed

invention is practiced (*e.g.*, “[m]oving a traditional lens relative to the sensing surface, or changing the lens shape or refractive index, or changing the refractive index of some medium between the lens and sensing surface”), these “are all ways to change the optical relationship between the lens and the sensing surface so as to maintain the sensing surface at different effective image distances during the imaging of a single scene in a single, continuous exposure of the sensing surface.” ’030 patent, 13:48-57.

This construction distinguishes the ’030 patent claims from the prior art discussed in the patent, *e.g.*, the ’045 patent, which took multiple pictures of a scene with different areas in focus and composited them together, such that the final combined image contained the in-focus areas from the source pictures.

2. “During An Exposure Frame Period” (Claim 15)

The term “during an exposure frame period” in Claim 15 should be construed as “during the time over which the entire image sensing surface is exposed once.”

A POSITA would have understood that this is the proper construction for the same reasons as the “continuous exposure frame” term discussed above. Ex. 1002, ¶¶[0082-0083].

Additionally, in the related district court matter, WSOU has asserted with respect to this limitation that: “As described in the patent US'030B2 [Page 14,

Column number 9, Line numbers 23-25] ‘A single frame period is the continuous exposure time over which any of the entire array of pixels or plate of film is exposed.’” *See* Ex. 1015, p. 4.

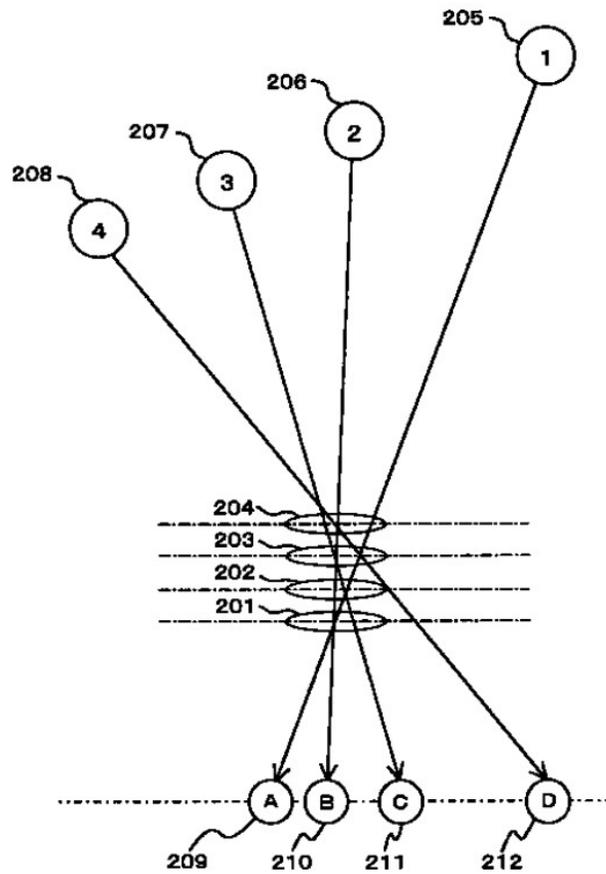
VI. THE PRIOR ART

A. Sugitani

Sugitani discloses a camera changing focus during an exposure to obtain an in-focus image of obliquely arranged objects. Ex. 1003, ¶[0004], Abstract; Ex. 1002, ¶¶[0084-0089].

Sugitani recognized that to increase DoF it was well-known to: (1) reduce aperture; or (2) use a tilting lens. *Id.*, ¶[0002]. However, *Sugitani* also understood the relevant tradeoffs: (1) reducing aperture requires a slower shutter speed, introducing the risk of blurring; and (2) using a tilting lens requires advanced technical skill. *Id.*, ¶[0003]. *Sugitani* therefore discloses a device that changes the focus of the image during exposure.

Fig. 2 (below) explains *Sugitani*’s operation:



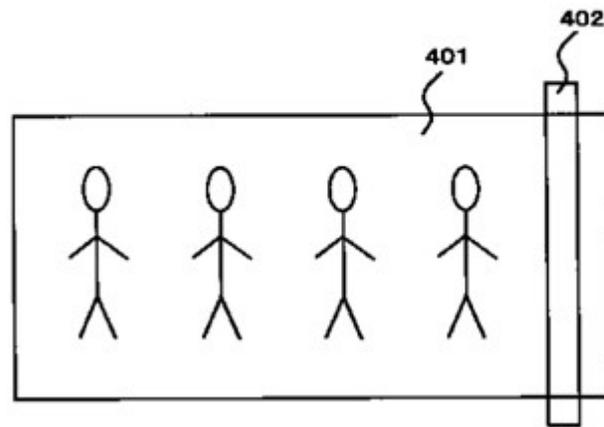
As shown, the distance between the lens and the exposure surface is modified to bring each object (205-208) into focus by moving the lens position from 201 to 204. When exposing an object 205, the lens is placed at a position 201 and the image is formed on the exposure surface at position 209. *Id.*, ¶[0014]. When exposing the object 206, the lens is then moved to position 202 and the image is exposed at position 210. *Id.*

Sugitani further teaches that the exposure area needs to be limited every time the lens is moved. *See id.*, ¶[0016]. Therefore, the area in which distance

measurement is performed is used as the area that is exposed and the lens is moved based on object distance measurement. *See id.*, Fig. 4 (below), ¶[0017].

(FIG. 4)

Explanatory diagram of the principles of the present invention (part 3)



Thus, while 401 is the entire exposure surface, only the area of the slit 402 is exposed. *See id.* The slit 402 (and exposure) moves in the left-right direction. *Id.* And distance measurement is performed on the object area currently aligned with slit 402 and the lens is moved to focus based on this distance measurement while synchronously exposing the sensor area under the slit 402. *Id.* And a photograph where the obliquely arranged objects are in focus is taken.

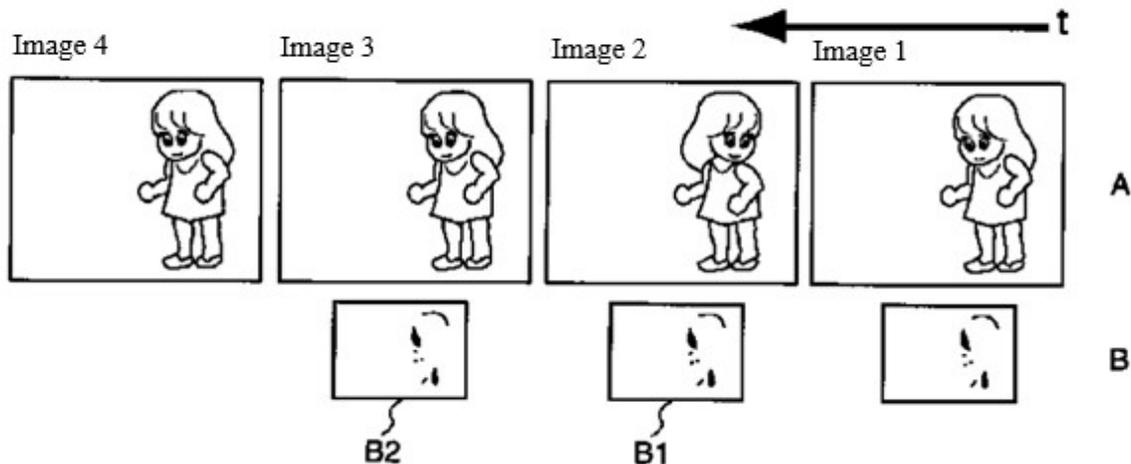
B. Kubo

Kubo discloses a method for reducing motion blur of a digital camera by automatically setting appropriate exposure conditions according to an object's movement. Ex. 1004, ¶[0004], Abstract; Ex. 1002, ¶¶[0090-0094].

Kubo describes a process for determining the degree of an object's movement and varying the exposure period based on this determined movement.

Kubo first considers a "static" state with negligible object movement. With reference to Figs. 3A-B (below), images 1-3 are photographed at a predetermined frequency. *Id.*, ¶[0037].

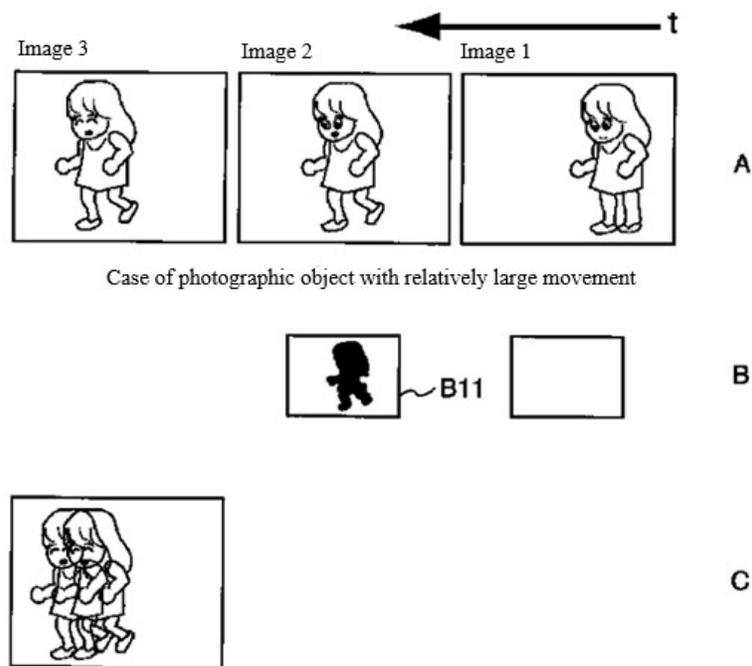
(FIG. 3)



The difference between adjacent frame images 2 and 1 and images 3 and 2 are used to obtain non-correlating portion data B1 and B2, respectively. *See id.* If the area ratio of the non-correlating portion data B2 is less than a predetermined percentage (*e.g.*, 5%), the object movement is considered small and a smaller aperture (larger aperture number) is applied using a focal depth priority program line P2, resulting in a longer exposure time than standard program line P1. *Id.*

Kubo then considers a moving object. With reference to Figs. 4A-C (below), Fig. 4A shows the images of the object; Fig. 4B shows the non-correlating portion, and Fig. 4C shows the blurry image that would result with the conventional standard program line P1. *Id.*, ¶[0035]. If non-correlating portion B11 is greater than a predefined amount (e.g., 20%), the object movement is considered large and a shorter exposure time determined by speed priority program line P3 is used. *Id.*, ¶[0040].

(FIG. 4)



Kubo also considers scene brightness. For example, in a case where object movement is low (e.g., non-correlated data less than 5%) and has low brightness, a

larger aperture (smaller aperture number) is applied using the standard program line P1, which results in a shorter exposure time and minimizing of motion blur. *See id.*, ¶[0036]. If the object brightness is at or above normal brightness, a shorter exposure time than normal is set. *Id.*, ¶[0051].

C. Motivation to Combine Sugitani and Kubo

A POSITA would have found it obvious to combine *Kubo* with *Sugitani*. *Sugitani* discloses exposing different portions of an image frame with different focus distances corresponding to each of four obliquely arranged objects to increase DoF, thereby reducing blurring. *Sugitani* confirms that prior art techniques of reducing aperture to increase DoF can introduce the risk of blurring because it limits the amount of light at the sensor and, therefore, requires longer exposure time. *Sugitani*, ¶¶[0002]-[0003]. *Sugitani* does not describe how to choose exposure settings for an image to account for object motion or different lighting conditions, but such information was available in the prior art, and a POSITA building a complete camera system would have been motivated to add the enhanced exposure setting teachings of references like *Kubo* to *Sugitani*'s depth of field expansion to build a more fully-featured camera. Ex. 1002, ¶¶[0115].

For example, analogous art *Kubo* recognizes that object motion can cause a blurry image, which can be corrected to improve image quality by detecting motion and setting exposure accordingly. *Kubo*, ¶¶[0004],[0006],[0010-0012].

This teaching would have been readily applied to *Sugitani* to further improve exposure settings for moving objects, another photographic condition that must be accounted for independent of the oblique arrangement of objects. Ex. 1002, ¶¶[0116-0118]. A POSITA, thus, would have been motivated to combine *Sugitani*'s teachings with *Kubo* to provide a digital camera that adjusts exposure settings for both object motion and objects arranged at different distances (including shutter speed) to create an image where the focus distance is correctly determined for objects and motion blur is avoided, while limiting the tradeoffs otherwise required in seeking wide depth of field. *Id.*, ¶¶[0118]. This combination would have been readily and predictably made by a POSITA because *Kubo* discloses the technology for distance measuring to determine focus, focusing processing, and exposure control, which the '030 patent recites without detail. *Kubo*, ¶¶[0043-0046], Fig. 6; Ex. 1002, ¶¶[0119].

Sugitani and *Kubo* both not only recognize exposure setting selection can avoid blurring, but also disclose techniques for controlling focus measurement, focusing processing, and exposure selection, in order to predictably improve the quality of images. Thus, a POSITA would be motivated to combine the advantageous teachings of *Kubo*, explaining how to detect object movement and adjust focus and exposure settings to improve the imaging of moving objects, with

Sugitani, which increases flexibility in aperture selection by separately focusing and exposing different parts of scene to increase DoF. Ex. 1002, ¶¶[0120].

D. Misawa

Misawa describes a lens-interchangeable camera that receives “curvature of field information peculiar to [the attached] imaging lens,” then measures “the contrast of a subject image to detect a focusing position,” next “correct[s] the detected focusing position on the basis of the received curvature of field information and generat[es] a control signal for adjusting the focusing position of the subject image formed by the imaging lens,” and finally “transmits the generated control signal to the lens barrel.” Ex. 1005, Abstract; *see also, e.g.*, ¶¶[0003-0004],[0052],[0058-0059],[0065],[0067],[0110],[0134], Figs. 2, 5.

A POSITA would have understood *Misawa*’s extensive discussion of correcting the field curvature of its camera lens and adjusting the focusing positions of subject images to be the routine prior art practice of approximating a *Petzval* surface. Ex. 1002, ¶¶[0095-0097].

E. Motivation to Combine Misawa, Sugitani, and Kubo

A POSITA would have found it obvious to combine the features of *Misawa* with *Sugitani* and *Kubo* to achieve the lens correction advantages taught by *Misawa*.

As discussed in detail in the Ground 1 analysis of Claim 9 below, while *Sugitani* describes the concept of imposing an effective curvature to the sensing surface that approximates a Petzval surface, *Misawa* provides a detailed theoretical teaching of that concept and the issues to be considered in implementing correction.

Because *Misawa* provides additional detail, and the ability to practice the concept on a “lens-interchangeable camera” in order to take into account the curvature of field information “peculiar to an imaging lens” (*Misawa*, Abstract), a POSITA would have been motivated to combine *Sugitani* with *Misawa* to take advantage of these benefits. Ex. 1002, ¶¶[0123-0125].

Because both *Sugitani* and *Misawa* involve lens-based cameras and *Misawa* specifically relates to compensating for a wide variety of lenses and curvatures, implementing *Misawa*’s procedure would have been an obvious enhancement to *Sugitani*. *Id.*

The Background section of the ’030 patent notes that “optical lenses are known to define a Petzval surface or Petzval field curvature as shown in FIG. 5.” ’030 patent, 3:36-38, Fig. 5 (labeled “prior art”). This acknowledges that a POSITA would have been aware of the advantages of approximating a Petzval surface, and it would have been obvious to do so in *Sugitani* using *Misawa*’s technique. Ex. 1002, ¶[0126].

F. Berge

Berge teaches a variable focus lens comprised of a mixture of insulating and conductive liquids that can be electrically manipulated to alter the shape of the lens. Ex. 1006, Figs. 1-6, 3:18-39, 4:12-15, 39-43, 5:4-7, 24-27, 61-64; Ex. 1002, ¶[0098]. *Berge* describes using such a lens to continuously adjustable focus in a way simple to manufacture and use. *Id.*, 1:42-49.

G. Motivation to Combine Berge, Sugitani, and Kubo

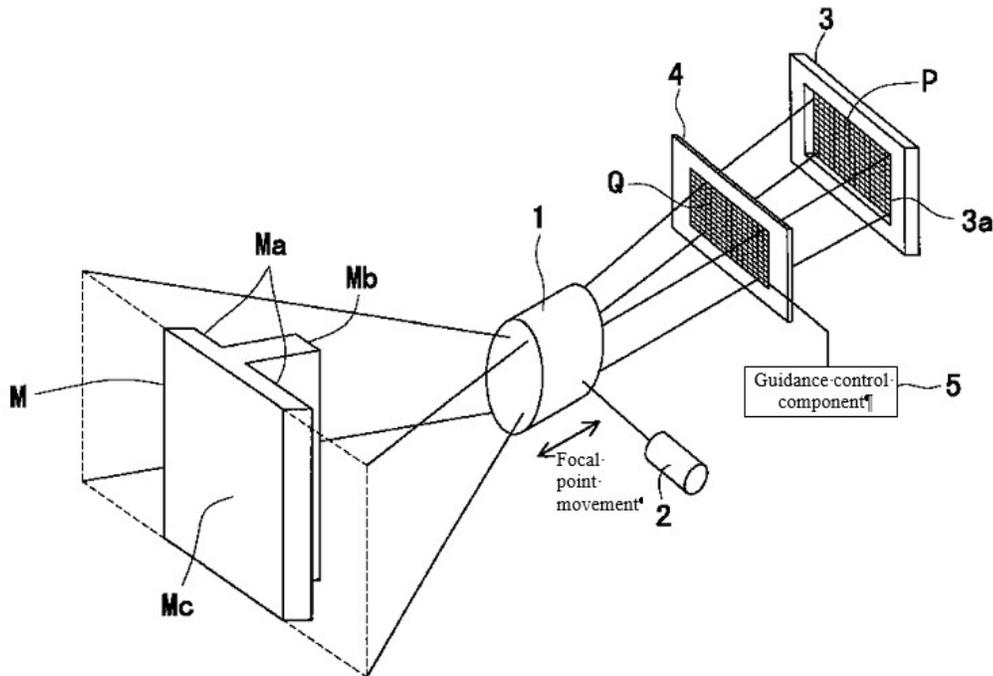
A POSITA would have found it obvious to combine *Berge* with *Sugitani* and *Kubo* to implement *Berge*'s lens advantages. *Sugitani*'s system is not dependent on lens structure, and rather describes how to functionally focus on different objects to achieve enhanced depth of field, and a POSITA would understand that it could be supported by different lens types as a routine implementation detail. Ex. 1002, ¶[0128]. *Berge* teaches a liquid lens that performs the same light focusing function as traditional lenses. *See, e.g., Berge*, 1:6-8, 3:4-6, Fig. 1. Because *Sugitani* simply requires focus to be changed for different objects in the image, without limiting how the lens achieves that focus, combining *Sugitani* with *Berge* simply involves obvious substitution of one type of lens for another. Ex. 1002, ¶¶[0129-0132].

H. Shibata

Shibata discloses increasing the DoF of a digital camera without needing to take multiple photographs to generate a composite image. Ex. 1007, ¶[0004]; Ex. 1002, ¶¶[0099-0106].

Like the '030 patent, *Shibata* recognizes the prior art disclosed combining multiple images with different focal points to create a composite image with increased DoF. *Id.*, ¶¶[0003-0004]. But it criticized this technique as time-consuming and requiring linear processing. *Id.*, ¶¶[0003-0004]. *Shibata*, therefore, disclosed capturing a scene that is entirely in-focus, without requiring multiple photographs or high-capacity image memory. *Id.*, ¶[0006].

Like the '030 patent, *Shibata*'s camera has a focal point control component 2 that varies the focal position of a lens 1 during exposure of a single frame. *Id.*, Fig. 1 (below), ¶[0016].



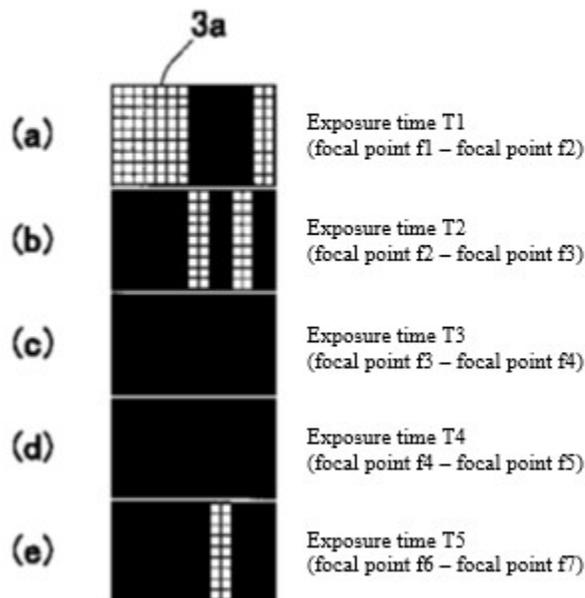
Photographic lens 1 captures and forms an optical image of objects M_A and M_B on imaging element 3. *Id.*, ¶[0017]. Focal point control component 2 serves to variably control the focal point position of photographic lens 1 within the movable range from one end to the other in the optical route direction. *Id.*, ¶[0018].

Shibata teaches that imaging element 3 is a charged-coupled CCD that receives the optical image captured by photographic lens 1, photoelectrically converts the optical image, and outputs an analog image signal. *Id.*, ¶[0019].

Fig. 6 shows the light-receiving face 3a of the CCD. The white areas indicate pixels that are being exposed because they are in focus, and black areas indicate pixels not being exposed because they are not in focus. *Id.*, Fig. 6 (below), ¶[0048]. When the focal point position is at f_1 - f_2 , the focus is at a

distance even with rear face M_C . *Id.* When the focal point position reaches f_1 , the shutter elements are controlled to start exposure of only those pixels corresponding to the left and right sides of the scene (shown in Fig. 6(a)), which are at the focus distance M_C , and this exposure is continued for a time T_1 . *Id.*

(FIG. 6)



When the focal point position is at f_2 - f_3 , the focus is on M_A . *Id.*, ¶[0049].

When the focal point position progresses and reaches focal point position f_2 , the shutter elements are controlled to start exposure of only those pixels corresponding to M_A (shown in Fig. 6(b)), and this exposure is continued for a time T_2 . *Id.*

When the focal point position is at f_3 - f_5 , none of the scene is in focus, all shutter

elements are set to “obstruct” (shown in Fig. 6(c)-(d)) and none of the sensor pixels are exposed. *Id.*

When the focal point position is at f5-f6, the focus is on M_B and the shutter elements start exposure of only those pixels corresponding to M_B (shown in Fig. 6(e)), for a time T5. *Id.*

I. Kondo

Kondo teaches a camera that varies exposure time for selected pixels to photograph an object of high contrast without losing its detail. Ex. 1008, ¶¶[0001],[0007],[0059],[0064]; Ex. 1002, ¶¶[0107-0113].

Kondo recognized that adjusting shutter speed can result in under- or over-exposure, so the exposure time should be selected so that the area where the picture image is most bright up to the portion where it is most dark has suitable brightness in the final image. *Id.*, ¶[0003]. In conventional cameras, the same exposure time is generally used for the entire sensor, which results in object details being lost when imaging high contrast scenes (the bright portion is overexposed while the dark portion is underexposed). *Id.*, ¶[0004].

Kondo therefore proposes varying exposure time with respect to individual pixels based on the amount of light received at each pixel. *Id.*, ¶¶[0006]-[0008]. With reference to Fig. 5 (below), evaluating section 23 evaluates pixel values

stored in buffer 21 and delivers its evaluation result to exposure time determining section 24. *Id.*, ¶[0059].

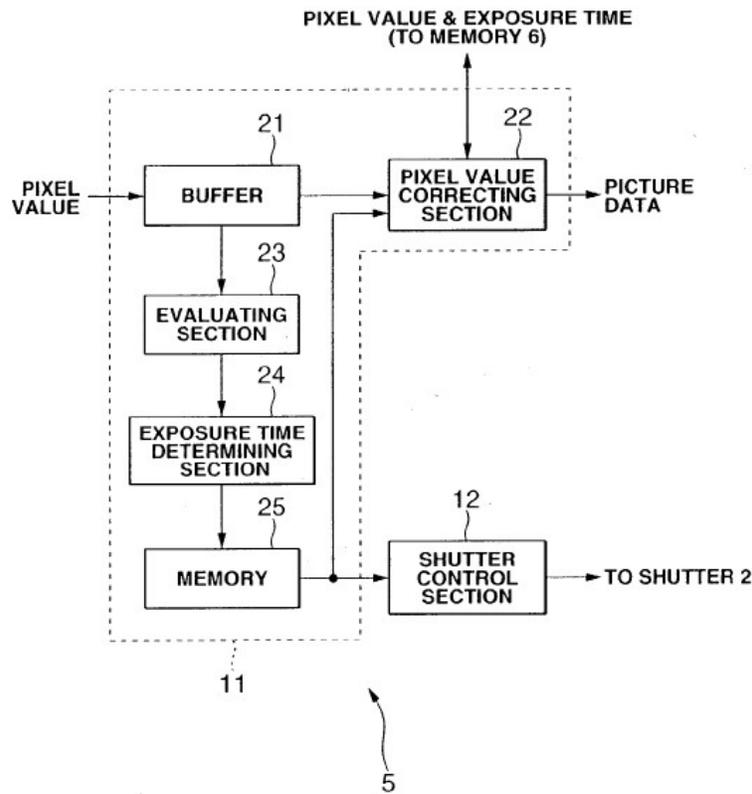


FIG.5

Exposure time determining section 24 sets exposure time with respect to the pixel values stored in buffer 21 on the basis of the result from evaluating section 23. *Id.* Specifically, evaluating section 23 evaluates pixel values stored in buffer 21 to determine whether the pixel value is above or below a predetermined limit (or similarly movement quantity of the object). *Id.* Exposure time determining section 24 sets exposure time with respect to corresponding pixel values (shorter if

the value is above the predetermined limit and would otherwise result in overexposure; longer if the value is below the predetermined limit and would otherwise result in underexposure). *Id.*

Kondo similarly considers varying exposure time with respect to individual pixels based on the amount of movement detected for each pixel or group thereof. *Id.*, Fig. 6, ¶[0064].

J. Motivation to Combine Shibata and Kondo

A POSITA would have found it obvious to combine *Kondo* with *Shibata* to maximize picture quality by varying exposure conditions. They describe complementary systems for enhancing picture quality, as *Shibata* describes how to change focus during a single exposure frame to make sure all areas of the image are in focus and enhance depth of field, and *Kondo* describes how to change exposure settings across the frame within a single exposure to enhance dynamic range. Ex. 1002, ¶¶[0133-0135].

Shibata determines the optimal focal point position of the lens for a particular pixel (or area including that pixel) by changing the focal point to vary certain exposure conditions. *Shibata* ¶[0007]. *Kondo* similarly varies exposure time with respect to corresponding pixels to provide unity in brightness. *Kondo* ¶¶[0046],[0059],[0064],[0075].

Motivation to combine *Kondo* with *Shibata* is further evidenced by the fact that both references rely on a liquid crystal shutter to adjust exposure time of a subset of the pixels of the CCD and allow exposure of some pixels without exposing others. *See, e.g., Shibata* ¶[0022]; *Kondo*, ¶[0053]. A POSITA would understand that the use of the same hardware for a similar purpose is predictable and confirms that *Kondo* can be successfully combined with *Shibata* without requiring undue experimentation. Ex. 1002, ¶¶[0136-0138].

A POSITA would also look to both references because each addresses similar problems: maximizing the use of memory to avoid creating composite images from a series of planar images. *See, e.g., Shibata*, ¶¶[0004],[0006]; *Kondo*, ¶[0049].

K. Motivation to Combine Berge, Shibata, and Kondo

A POSITA would have found it obvious to combine *Berge* with *Shibata* and *Kondo* to use *Berge*'s lens advantages. *Shibata*'s and *Kondo*'s systems are not dependent on lens structure, and a POSITA would understand that they could be supported by different lens types without affecting their depth of field and exposure benefits. Ex. 1002, ¶¶[0139-0141]. And the '030 patent expressly admits that lens type is not relevant to the invention. '030 patent, 13:26-33. As described above, the combination of *Shibata* and *Kondo* similarly teaches the

movement of lenses to maximize DoF, which may be similarly accomplished using the liquid lens of *Berge*.

L. Motivation to Combine Kubo, Shibata, and Kondo

A POSITA would have found it obvious to combine *Kubo* with *Shibata* and *Kondo* to achieve accurate focus and maximize picture quality by varying exposure conditions. *Kubo*'s autofocus system measures distance to the subject independently of the optical system, whereas *Shibata* describes determining the proper focus position for each of its pixels, which is based on the distance of multiple objects. It would have been obvious for a POSITA to combine *Kubo* and *Shibata* to achieve the most accurate focus, because it was well-known in the art to use distance-measuring autofocus or contrast autofocus, and because it was well known that camera systems could measure distance to objects to determine focus in multiple ways. *See* Ex. 1002, ¶¶[0143-0147]. These determinations are shown to simply be design choices in prior art references like U.S. Pub. No. 2003/0081137 to Yamazaki (Ex. 1014) and U.S. Pub. No. 2003/0007076 to Okisu (Ex. 1013). *Id.*

A POSITA would also have been motivated to combine *Kubo* with *Shibata* and *Kondo* because all of them describe varying exposure conditions to achieve optimal picture quality. *Id.*

VII. THE '030 PATENT CLAIMS ARE UNPATENTABLE OVER THE PRIOR ART

A. GROUND 1: Sugitani in view of Kubo Renders Claims 1-9, 11-21, and 23-24 Obvious

A POSITA would have found it obvious to predictably combine *Sugitani* with *Kubo* to achieve *Sugitani*'s design objectives and combined advantages, as explained in Section VI.C. Ex. 1002, ¶¶[0148-0149].

1. Independent Claim 1

Sugitani and *Kubo* disclose Claim 1. Ex. 1002, ¶[0150].

a) [1-PRE]

Although claim 1's preamble, "a method," should not be limiting, *Sugitani* discloses a "method." *See, e.g., Sugitani*, ¶¶[0004-0005],[0011-0012],[0023]-[0026]; Ex. 1002, ¶[0151].

b) Element [1-A]

Sugitani discloses "manipulating an optical relationship between an optical lens and an image sensing surface so that the image sensing surface is spaced at different effective image distances from the lens," which simply describes focusing a camera. Ex. 1002, ¶¶[0153-0155]. For example, *Sugitani* teaches changing "the distance between the lens and the exposure surface," (by moving the lens or the sensor) thereby allowing multiple obliquely-arranged objects to be focused. *Sugitani*, ¶¶[0014-0015],[0030-0032],Fig. 2. This movement is a

manipulation of the optical relationship between the lens and image sensing surface that changes their spacing, as claimed. *Kubo* also discloses focusing. *See, e.g., Kubo*, ¶¶[0012],[0038]

c) Element [1-B]

Sugitani combined with *Kubo* discloses “exposing different portions of the image sensing surface synchronous with manipulating the optical relationship by adaptively exposing said portions for different exposure periods based on detected movement of at least two objects.” Ex. 1002, ¶¶[0156-0165].

Sugitani teaches exposing different portions of the sensor synchronous with changing focus to adaptively exposing different portions for different exposure periods. For example, in connection with Figs. 2-4, *Sugitani* explains that when photographing four obliquely-arranged objects (*i.e.*, four people arranged at different distances), the scene comprises sub-regions (areas 305-308) each having a different focus distance, and a slit 402 is moved in a left-right direction to expose the sensor area corresponding to the different sub-regions, while the lens is moved to acquire proper focus for the person in each sub-region. *Sugitani*, ¶¶[0015]-[0017].

Sugitani explains that each image area is separately exposed (¶¶[0014]-[0017]) but does not provide detail regarding how the exposure for each sub-region is determined, for example, based on varying brightness or movement of two

objects. However, because *Sugitani* exposes a series of different sub-regions across the image field, each with its own focus, a POSITA would be motivated to apply existing image exposure techniques to each sub-region, as it was well-known in the art to consider the movement of an object when selecting exposure characteristics. Ex. 1002 ¶¶[0158-0159]. Choosing exposure characteristics based on the content of an image field is a fundamental aspect of photography and one of the first things taught to photographers. *Id.*, ¶[0160]. And one of the basic rules of choosing exposure characteristics is that a camera operator should select shorter exposure periods (*i.e.*, faster shutter speeds) when the object being photographed is moving because a longer exposure period will result in a blurry image due to object movement. *Id.* Indeed, starting in the 1980s, film cameras such as Canon's AE-1 Program included shutter priority modes that allowed a photographer to select the exposure period appropriate for objects being photographed, while the camera automatically selected the corresponding aperture required to obtain a proper exposure. *Id.*, ¶[0161].

Based on this well-known need to account for object movement in selecting exposure characteristics, a POSITA seeking to implement *Sugitani* in a camera would be motivated to incorporate *Kubo's* automated exposure systems to program the camera to expose each object while accounting for its movement. *Id.*, ¶¶[0162-0165].

Kubo, for example, teaches with reference to figures 3A and 3B how to analyze the degree of non-correlation between two rapidly captured images to detect object movement. *Kubo*, ¶[0038]. *Kubo* then teaches setting the “exposure period” based on this detected movement. A small degree of movement results in a longer exposure, whereas a large degree of movement results in a shorter exposure. *Kubo*, ¶¶[0038]-[0040]. Because *Sugitani* teaches exposing each of the objects in its image field in sub-exposure regions with separate focus to achieve a superior overall image, a POSITA would similarly apply *Kubo*’s exposure time calculation technique to each object’s sub-exposure. Ex. 1002, ¶¶[0162-0164]. *Sugitani* discloses the four people in the scene will be exposed at different times with different focal distances, essentially making them akin to distinct photographs. Thus, when applying the *Kubo*’s exposure time calculation technique to each person, it would be obvious to calculate exposure based on the movement of each person independently, such that the motion and brightness of at least two objects (*i.e.*, each person) are considered as claimed. *Id.*, ¶[0165].

2. Claim 2

Claim 2 depends on Claim 1 and requires that the image sensing array comprises “an array of photosensitive pixels.” *Sugitani* discloses a “CCD of a digital camera,” which comprises an array of photosensitive pixels. *Sugitani*, ¶[0027]; Ex. 1002, ¶¶[0166-0168].

Kubo also discloses this. *Kubo*, ¶¶[0005],[0017].

3. Independent Claim 3

Claim 3 is an independent claim that differs from Claim 1 only by changing the word “movement” to “brightness”: see comparison below.

CLAIM 1	CLAIM 3
<p>1. A method comprising: manipulating an optical relationship between an optical lens and an image sensing surface so that the image sensing surface is spaced at different effective image distances from the lens; and exposing different portions of the image sensing surface synchronous with manipulating the optical relationship by adaptively exposing said portions for different exposure periods based on detected movement of at least two objects.</p>	<p>3. A method comprising: manipulating an optical relationship between an optical lens and an image sensing surface so that the image sensing surface is spaced at different effective image distances from the lens; and exposing different portions of the image sensing surface synchronous with manipulating the optical relationship by adaptively exposing said portions for different exposure periods based on detected brightness of at least two objects.</p>

Other than expressly discussing setting exposure periods based on “brightness,” the limitations of Claim 3 have been shown above for Claim 1. But brightness detection is required for proper exposure. Ex. 1002, ¶[0171]. And, as discussed above, *Sugitani* discloses taking different sub-exposures of objects in a scene each with a different focus setting appropriate for the object. *Sugitani* does not describe the well-known process for detecting brightness and selecting the exposure period for each sub-image based on brightness. But, just like object motion, it was a basic well-known fact of photography that object brightness must be accounted for when determining exposure periods. *Id.*, ¶[0172]. It is a required input value to calculate the proper exposure period (shutter speed). *Id.*

Darker objects require longer exposure periods to acquire a properly exposed image, while brighter objects will take less time.

Because setting focus and exposure are the basic required steps to photograph an object, a POSITA seeking to implement *Sugitani* would read its teaching of setting separate focus for each object and be motivated to also set exposure for each object and incorporate automated exposure systems that account for object brightness, like *Kubo*. Ex. 1002, ¶[0173].

Kubo teaches that detected brightness is used to select exposure period, such that the period is shorter for bright objects detected brightness and longer for dim objects. *Kubo*, ¶¶[0011],[0036],[0051-0052]; see also Fig. 8 (program settings for selecting shutter speed based on brightness).

Fig. 8

THE RATIO OF THE NON-CORRELATED AREA	THE BRIGHTNESS OF THE SUBJECT	SELECTED PROGRAM CHARACTERISTIC		
		DEPTH PRIORITY PROGRAM	STANDARD PROGRAM	SPEED PRIORITY PROGRAM
LESS THAN 5%	NORMAL BRIGHTNESS	○		
	LOW BRIGHTNESS		○	
NOT LESS THAN 5%	NORMAL BRIGHTNESS		○	
	LOW BRIGHTNESS		○	
NOT LESS THAN 20%	NORMAL BRIGHTNESS			○
	LOW BRIGHTNESS		○	

Because *Sugitani* teaches independently setting focus for each object in a scene during a single exposure to achieve a superior overall image, a POSITA would have been motivated to similarly apply *Kubo*'s exposure time calculation independently to each of *Sugitani*'s objects to set the exposure of that object based on the object's brightness to achieve the best image. Ex. 1002, ¶¶[0174-0175]. Because *Sugitani* discloses that the four people are not simultaneously exposed, when applying the *Kubo* exposure time calculation technique to the exposure of each person in *Sugitani*, the exposure is calculated based on the brightness of at least two objects (*i.e.*, each person) as claimed. *Id.*, ¶¶[0176-0177].

4. Independent Claim 4

Sugitani discloses Claim 4. Ex. 1002, ¶[0178].

a) [4-PRE] and Element [4-A]

Independent Claim 4 has the same preamble and first element as Claim 1. Thus, those portions of Claim 4 are taught by *Sugitani* as discussed above. See Section VII.A.1, *supra*. Ex. 1002, ¶¶[0178-0179].

b) Additional Elements

Sugitani also discloses the additional elements of Claim 4:

[4-B]: “*exposing different portions of the image sensing surface synchronous with manipulating the optical relationship*”

[4-C]: “*wherein the image sensing surface comprises an array of*

photosensitive pixels in adjacent rows,

wherein a first portion of the array is exposed while the image sensing surface is at a first effective image distance, and a second portion of the array is exposed while the sensing surface is at a second effective image distance,

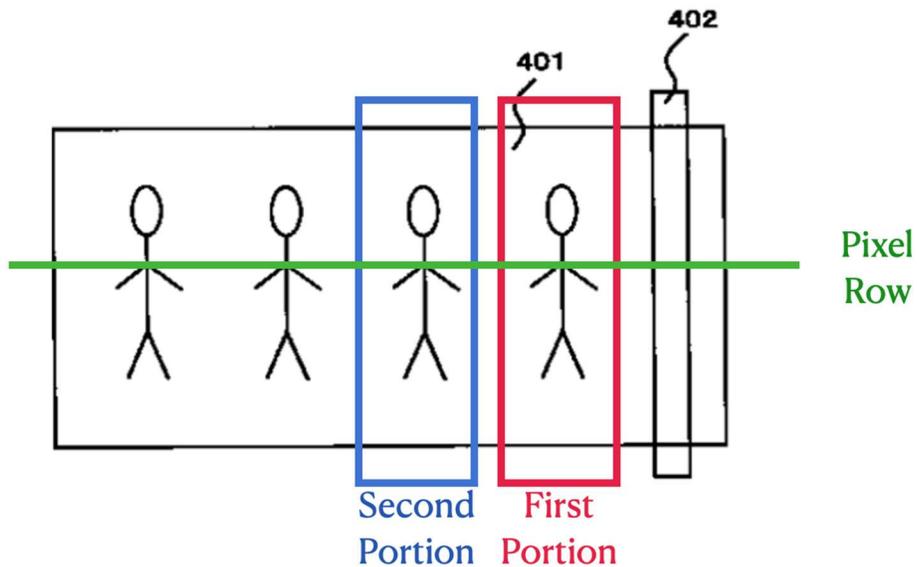
and wherein at least one pixel of the first portion is in a same row of the array as at least one pixel of the second portion.”

Ex. 1002, ¶¶[0181-0186].

As explained above for Elements [1-A] and [1-B], *Sugitani* teaches creating multiple sub-exposures of the exposure surface with each sub-exposure capturing a different object at a different “effective image distance” (focus distance), which involves changing the spacing between the lens and exposure surface, disclosing Element [4-B].

Regarding Element [4-C], as explained above for Claim 2, *Sugitani* and *Kubo* teach an exposure surface comprising an array of photosensitive pixels in adjacent rows. As shown in annotated *Sugitani* Fig. 4 (below), *Sugitani* also discloses that “a first portion of the array is exposed while the image sensing surface is at a first effective image distance” when the first person (red box) is placed in focus and exposed. *Sugitani* discloses that “a second portion of the array is exposed while the sensing surface is at a second effective image distance” when

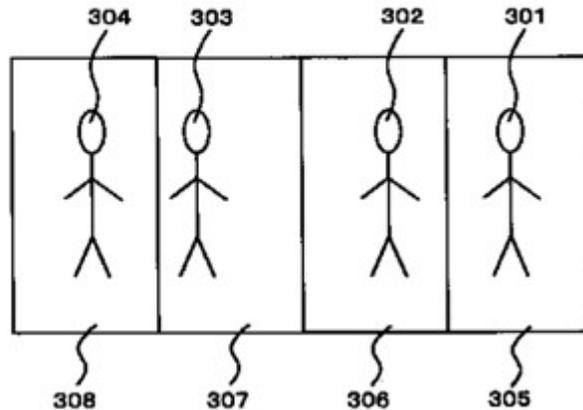
the second person (blue box) is placed in focus and exposed. Ex. 1002, ¶¶[0184-0186].



Sugitani also discloses that the different exposed portions of the exposure surface (areas 305-308) are arranged horizontally, such that pixels in the same row are exposed with different focus settings, *i.e.*, when each of the first and second portions are exposed. *Id.*; *Sugitani*, ¶¶[0015-0017], Fig. 3:

(FIG. 3)

Explanatory diagram of the principles of the present invention (part 2)



5. Claim 5

Claim 5 depends from Claim 4 and requires “wherein at least one of manipulating the optical relationship and exposing different portions of the image sensing surface are adaptive to objects in a scene to be imaged at the sensing surface.”

Sugitani discloses this in Fig. 6 and its corresponding disclosure, which teach that slit 402 is positioned over a portion of the exposure surface, the distance *to the object* in that object field is measured, and then “driving of the lens is performed on the basis of results of distance measurement.” *Sugitani* ¶¶[0023]-[0024]; Ex. 1002, ¶¶[0187-0189]. Thus, focusing the lens (the optical relationship) is adaptive to the measured distance of the objects in the scene.

6. Claim 6

Claim 6 depends from Claim 4 and requires “wherein exposing different

portions of the image sensing surface comprises adaptively exposing said portions based on at least a detected first and second object distance.”

Sugitani discloses this by teaching that the slit for exposing portions of the exposure surface can be moved to the position currently in focus. *Sugitani* ¶[0018] (moving “slit 506 to the exposure position in focus” so “an image of the object is formed on the exposure surface”). The focus is dictated by the distance measurement to an object obtained from autofocus sensor 501. *Id.*, ¶[0018, 0023-24]. This results in adaptive exposure of portions of the exposure surface performed on the basis of the distance to more than one object. *Id.* ¶¶[0017],[0024]-[0025]; Ex. 1002, ¶¶[0191-0192].

7. Claim 7

Claim 7 depends from Claim 4 and requires “wherein manipulating the optical relationship comprises manipulating between a first effective image distance and a second effective image distance, wherein the first and second effective image distances correspond respectively to the first and second object distances.”

As explained above for Claims 4 and 5, *Sugitani* teaches moving the lens to different positions (*i.e.*, the first and second effective image distances) during exposure based on distance measurements to different objects, such as persons 301-304. *Sugitani*, ¶¶[0016]-[0017],[0023]-[0024]; Ex. 1002, ¶¶[0193-0194].

8. Claim 8

Claim 8 depends from Claim 4 and requires “wherein manipulating the optical relationship comprises moving at least one of the lens and the sensing surface relative to one another.”

Sugitani discloses both moving the lens relative to a fixed sensor and fixing the lens and moving the sensor. *Sugitani*, ¶¶[0014]-[0017],[0031]; Ex. 1002, ¶¶[0195-0196].

9. Independent Claim 9

Sugitani discloses Claim 9. Ex. 1002, ¶[0197].

a) [9-PRE] and Element [9-A]

Independent Claim 9 has the same preamble and first element as Claim 1. *Sugitani* teaches them as described above regarding Claim 1.

b) Element [9-B]

Claim 9 additionally requires “exposing different portions of the image sensing surface synchronous with manipulating the optical relationship, wherein manipulating the optical relationship synchronously with exposing operates to impose an effective curvature to the sensing surface that approximates a Petzval surface.”

As explained for Elements [1-A] and [1-B], *Sugitani* teaches exposing different portions of exposure surface in conjunction with changing the “effective

thereby, approximate a Petzval surface. *Id.*, ¶[0205]. In other words, exposing on a Petzval surface minimizes the loss of focus around the edges of the frame, which is what *Sugitani* accomplishes by serially focusing the lens on each object. *Id.*

10. Independent Claim 11

Sugitani discloses Claim 11. Ex. 1002, ¶[0207].

a) [11-PRE], Elements [11-A] and [11-B]

Claim 11 and Claim 1 have the same preamble, which is taught by *Sugitani* as discussed above. *See* Section VII.A.1, *supra*.

Step [11-A] requires “determining a first object distance between a first object in a scene and a lens,” and [11-B] requires the same for a second object. *Sugitani* discloses in connection with Fig. 6 that the distance to one object is measured in step 603 and this is repeated for each object in the scene, thus including a first and second object. *Sugitani*, ¶¶[0024-0026]; Ex. 1002, ¶¶[0209-0210].

b) Elements [11-C] and [11-D]

Steps [11-C] and [11-D] require “within a continuous exposure frame: exposing a first portion of an image sensing surface while the image sensing surface is at a first effective image distance from the lens, where the first effective image distance corresponds to the first object distance,” doing the same exposing and focusing for a second object, and “combining the exposed first and second

portions into a single image.”

Sugitani teaches each of these steps, both under a plain meaning construction of “within a continuous disclosure frame” and the construction proposed in Section V.D.1 above, by disclosing driving the lens to a position based on object distance in step 604 and exposing the corresponding portion of exposure surface in step 605. *Sugitani*, ¶[0024]; Ex. 1002, ¶¶[0211-0215].

Sugitani explains that the distance measurement area and exposure slit are moved and the above steps are repeated for a second object corresponding to a second portion of the surface and a second focus position based on the distance to the second object. *Sugitani*, ¶¶[0025]-[0026]; *see also* Ex. 1002, ¶¶[0213-0215].

Sugitani further teaches that the lens, distance measurement area, and slit are moved during a single exposure (*i.e.*, “within the same continuous exposure frame”). *Id.*, ¶[0024]. *Sugitani* also teaches that the exposed first and second portions are combined into a single image and “makes it possible to take a photograph such that the entire surface of the exposure surface 401 is in focus.” *Id.*, ¶[0017].

11. Claim 12

Claim 12 depends from Claim 11 and requires that the single image be displayed on a digital GUI.

Sugitani combined with *Kubo* renders Claim 12 obvious. Ex. 1002,

¶¶[0216-0218].

Sugitani discloses a camera with a digital display but does not explicitly state that it is used to display captured images. *Sugitani*, ¶¶[0017],[0024],[0027]. However, by the June 2005 priority date, digital cameras were ubiquitous and displaying captured images on their internal displays was well known. Ex. 1002, ¶¶[0217]. Moreover, *Kubo* expressly discloses that monitor 10 displays images as they are taken. *Kubo*, ¶¶[0044-0045]. Because instantly previewing images was a key and heavily desired feature of digital cameras, a POSITA would expect that *Sugitani*'s display showed captured images, or at least would have found it obvious to modify *Sugitani* in light of *Kubo* to add that feature. Ex. 1002, ¶¶[0218].

12. Claim 13

Claim 13 depends from Claim 11 and requires that “exposing the first and second portion of the image sensing surface comprises adaptively exposing said portions for a first and second exposure time based on a detected brightness of the first and second objects.” Claim 13 adds the same requirement as Element [3-B] and *Sugitani* combined with *Kubo* renders Claim 13 obvious for the same reasons set forth above for Element [3-B].

13. Claim 14

Claim 14 depends from Claim 11 and requires that “wherein exposing the first and second portion of the image sensing surface comprises adaptively

exposing said portions for a first and second exposure time based on a detected speed of movement of the first and second objects.” This is the same requirement as Element [1-B].

Sugitani combined with *Kubo*, therefore, renders Claim 13 obvious for the same reasons as Element [1-B], discussed above.

14. Independent Claim 15

Sugitani discloses Claim 15. Ex. 1002, ¶¶[0223].

a) [15-PRE]

Claim 15’s preamble requires “A memory storing a program of machine-readable instructions, executable by a digital data processor, to perform actions directed toward operating a camera.”

Sugitani teaches that its disclosed focusing and exposure method is carried out by CPU 502, executing program code stored in ROM 510 of the camera.

Sugitani, ¶¶[0019],[0023], Fig. 5; Ex. 1002, ¶¶[0224-0225].

b) Element [15-A]

Element [15-A] requires “during an exposure frame period, maintaining an image sensing surface at a variable effective image distance from a lens synchronously with exposing different portions of the sensing surface, wherein the image sensing surface comprises an array of photosensitive pixels.”

Sugitani discloses Element [15-A], both under a plain meaning construction

of “during an exposure frame period” and the construction proposed in Section V.D.2 above. Ex. 1002, ¶¶[0226-0229].

As discussed above, *Sugitani*’s programming adjusts the lens position relative to the exposure surface and simultaneously adjusts the portion of the exposure surface being exposed by moving a slit over the course of an exposure period of one frame. *Sugitani*, ¶¶[0014],[0015],[0017],[0024]-[0027]. *Sugitani*’s CCD exposure surface is an array of photosensitive pixels. See Claim 2. Ex. 1002, ¶[0229].

15. Claim 16

Claim 16 depends from Claim 15 and adds the same requirement as Claim 5. *Sugitani* teaches Claim 16 for the same reasons set forth above for Claim 5.

16. Claim 17

Claim 17 depends from Claim 15 and adds the same requirement as Claim 6. *Sugitani* teaches Claim 17 for the same reasons set forth above for Claim 6.

17. Claim 18

Claim 18 depends from Claim 15 and adds the same requirement as Claim 7. *Sugitani* teaches Claim 18 for the same reasons set forth above for Claim 7.

18. Claim 19

Claim 19 depends from Claim 15 and effectively adds the same requirements of adaptively exposing portions of the surface based on detected

movement as Element [1-B].

Sugitani combined with *Kubo* renders Claim 19 obvious for the same reasons set forth above for Element [1-B].

19. Claim 20

Claim 20 depends from Claim 15 and effectively adds the same requirements of adaptively exposing portions of the surface based on detected brightness as Element [3-B].

Sugitani combined with *Kubo* renders Claim 20 obvious for the same reasons set forth above for Claim 3.

20. Claim 21

Claim 21 depends from Claim 15 and adds that “the program controls exposure of photosensitive pixels according to rows.”

Sugitani teaches Claim 21. As explained above for Claim 2, *Sugitani* discloses a CCD exposure surface that is an array of pixels and therefore includes rows. And *Sugitani* explains that the movement of the slit during *Sugitani*'s focus-by-portion method can be horizontal (*i.e.*, according to columns) or vertical (*i.e.*, according to rows). *Sugitani*, ¶¶[0030], Figs. 8-9; Ex. 1002, ¶¶[0240-0242].

21. Claim 23

Claim 23 depends from Claim 15 and adds the same requirement as Claim 9.

Sugitani teaches Claim 23 for the same reasons set forth above for Claim 9.

22. Claim 24

Claim 24 depends from Claim 15 and adds the requirement of “maintaining the image sensing surface at a variable effective image distance from the lens comprises moving the lens relative to the sensing surface.”

Sugitani teaches Claim 24 for the same reasons set forth above for Claim 8, as *Sugitani* discloses moving the lens relative to the sensor surface.

B. GROUND 2: Sugitani in view of Kubo and Misawa Renders Claims 9 and 23 Obvious

A POSITA would have found it obvious to predictably combine *Misawa*'s teachings with those of *Sugitani* and *Kubo* to achieve the lens advantages taught by *Misawa*, as explained in Section VI.E. Ex. 1002, ¶¶[0247-0248].

1. Independent Claim 9

As discussed above in Ground 1, *Sugitani* discloses Claim 9. Ex. 1002, ¶¶[0249-0257].

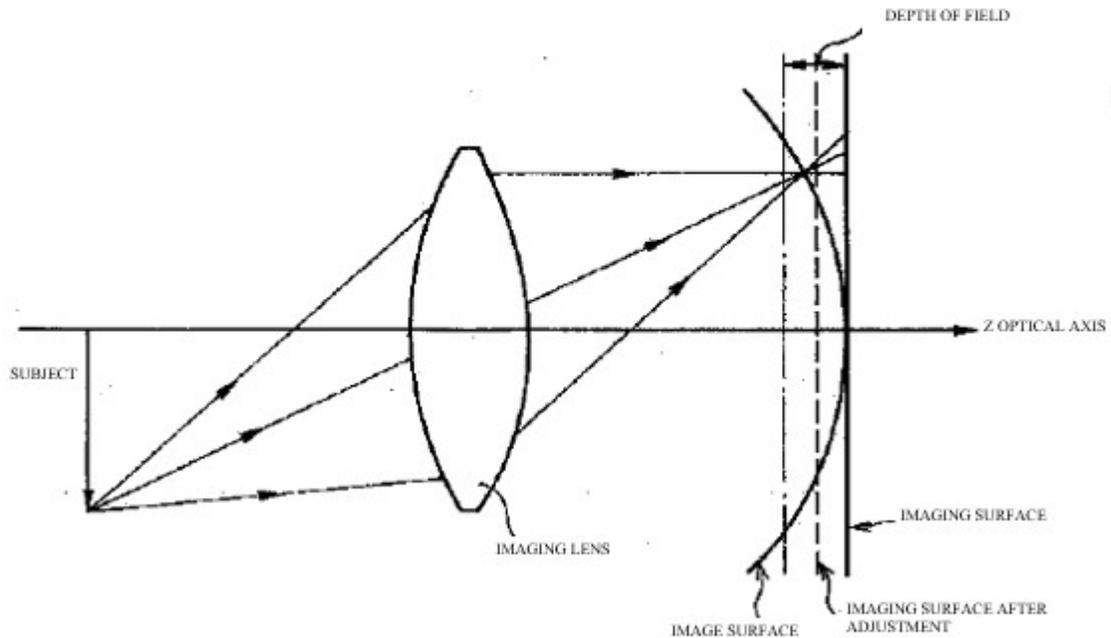
However, to the extent there is any question regarding *Sugitani*'s disclosure of it operating “to impose an effective curvature to the sensing surface that approximates a Petzval surface,” *Misawa* clearly discloses that concept and would motivate a POSITA to add approximating a Petzval surface to *Sugitani*. Ex. 1002, ¶¶[0252-0257].

Misawa addressed a problem in the prior art where the focusing position for an image that was out of focus could not be corrected during image processing by acquiring the lens's unique curvature of field of information and position adjustment information at the time of imaging. *Misawa*, ¶¶[0003-0004]; *see also* Abstract, ¶[0052].

Misawa addressed this problem by measuring the lens's curvature of field information, the "relationship between the distance from the optical axis and the image surface or the position of the imaging surface to be adjusted," and adjusting the focus of the image based on the measured distance. *Id.*, ¶¶[0059],[0065],[0115],Fig. 5.

The relationship between the imaging surface and the adjustment to that surface can be seen in Fig. 2 (below). *Id.*, ¶[0065].

(FIG. 2)



By performing this adjustment, *Misawa* teaches approximating a Petzval surface as claimed.

2. Claim 23

Similarly, to the extent the Board concludes *Sugitani* does not disclose this same concept in Claim 23 (which Petitioner does not believe is the case), *Misawa* does so. Ex. 1002, ¶¶[0258-0260].

C. GROUND 3: Sugitani in view of Kubo and Berge Renders Claims 10 and 25 Obvious

A POSITA would have found it obvious to predictably combine *Berge*'s teachings with those of *Sugitani* and *Kubo* to achieve the lens advantages taught by *Berge*, as explained in Section VI.G. Ex. 1002, ¶¶[0261-0262].

1. Independent Claim 10

Sugitani, *Kubo*, and *Berge* render obvious Claim 10. Ex. 1002, ¶[0263].

a) [10-PRE] and [10-A]

[10-PRE] and [10-A] are identical to [1-PRE] and [1-A] and are therefore disclosed by *Sugitani* for the same reasons set forth above in Ground 1 for [1-PRE] and [1-A]. Ex. 1002, ¶¶[0264-0265].

b) Element [10-B]

Claim 10 also requires “exposing different portions of the image sensing surface synchronous with manipulating the optical relationship, wherein manipulating the optical relationship comprises *altering a shape of the lens.*”

Sugitani does not disclose manipulating the optical relationship by altering a shape of the lens, *e.g.*, by using a liquid lens that achieves focus by changing shape. But *Sugitani* does not limit its disclosed technique to requiring any particular type of lens and its main thrust is adjusting focus based on object position. *Sugitani*, ¶[0006]. And because different lens types, including lenses that changed focus by changing their shape, were known in the art, a POSITA

would have readily applied the *Sugitani* method to cameras with shape altering lenses to achieve the known benefits of shape altering lenses. Ex. 1002, ¶¶[0266-0269].

For example, a POSITA would have found it obvious to combine *Sugitani* with *Berge*, which teaches a variable focus lens comprised of a mixture of insulating and conductive liquids that can be electrically manipulated into different forms and thereby alter the shape of the lens. *Berge*, Figs. 1-6, 3:18-39, 4:12-15, 39-43, 5:4-7, 5:24-27, 5:61-64. *Berge's* approach provides for a lens with continuously adjustable focus that is both simple to manufacture and use. *Id.*, 1:42-49. Further, a POSITA would recognize that *Berge's* ability to avoid moving parts in focusing would increase the durability and longevity of the focusing mechanism. Ex. 1002, ¶¶[0269-0270].

2. Claim 25

Claim 25 depends from Claim 15 and adds the requirements of Element [10-B] concerning altering the shape of the lens.

As explained above in Ground 1 regarding Claim 15, *Sugitani* discloses the limitations of Claim 15. Further, *Sugitani* combined with *Kubo* and *Berge* renders the dependent limitations of Claim 25 obvious for the same reasons set forth above for Claim 10. Ex. 1002, ¶¶[0271-0273].

D. GROUND 4: Shibata in view of Kondo Renders Claims 1-5, 7-9, 15-16, and 18-24 Obvious

A POSITA would have found it obvious to predictably combine *Shibata*'s system with the teachings of *Kondo* to achieve the particular design objectives in *Shibata*'s system, as explained in Section VI.J. Ex. 1002, ¶¶[0274-0275].

1. Independent Claim 1

Shibata and *Kondo* disclose Claim 1.

a) [1-PRE]

Although claim 1's preamble, "a method," should not be limiting, *Shibata* discloses a "method." *See, e.g., Shibata*, ¶[0025], Fig. 4; Ex. 1002, ¶¶[0276-0277].

b) Element [1-A]

Shibata discloses element [1-A]. Ex. 1002, ¶¶[0278-0281]. This limitation describes the well-known act of focusing a camera system. *Id.*, ¶[0279]. *Shibata* discloses this through a "focal point control component 2" that adjusts the position of "photographic lens 1." *Shibata*, ¶¶[0017]-[0018], Fig. 1. *Shibata* explains that the focal point is serially repositioned to obtain focus on the entire scene during image capture. *Id.*, ¶[0046] ("while moving the focal point position, for each pixel P of the CCD 3, when the focal point position reaches the aforesaid designated focal point position, the shutter element Q of the aforesaid liquid crystal shutter 4 corresponding to that pixel P is opened"); *see also* ¶¶[0036]-[0051], Figs. 4-6.

c) Element [1-B]

Shibata combined with *Kondo* discloses element [1-B]. Ex. 1002, ¶¶[0282-0296].

In connection with Figs. 5 and 6, *Shibata* explains that shutter element Q, including a liquid crystal shutter 4, obstructs exposure to pixels on *Shibata*'s CCD. *Shibata*, ¶¶[0048]-[0051]. Shutter element Q only exposes those pixels that are in focus based on the current position of lens 1. When lens 1 is repositioned, shutter element Q obscures pixels not in focus and exposes the in focus pixels. *Id.*; see also Fig. 6 (showing obstruction and exposure of pixels at different focal points).

Shibata also discloses that the duration of each sub-exposure is calibrated based on the illuminance distribution of the object detected during a preliminary analysis. *Shibata*, ¶¶[0013],[0032],[0042],[0055].

While *Shibata* discloses setting exposure characteristics to correspond to the specific conditions of each sub-image, *Shibata* does not expressly disclose calibrating the exposure period based on the detected movement of two objects. However, because *Shibata* exposes a series of independent-sub images across the image field, a person of skill in the art would be motivated to apply existing image exposure calculation techniques to each sub-image as it was well-known to consider the movement of an object selecting exposure characteristics. Ex. 1002, ¶¶[0287]. Choosing exposure characteristics based on the content of an image

field, including object motion, is a fundamental aspect of photography and one of the first things photographers learn. *Id.* It was well-known that exposure periods should be adapted to account for object movement to prevent blurriness. *Id.*

¶¶[0287-0290]. Specifically, a basic rule of photography is that a camera operator should select shorter exposure periods (*i.e.*, faster shutter speeds) when photographing a moving object because longer exposure periods will result in a blurry image due to object movement. *Id.* Indeed, starting in the 1980s, film cameras such as Canon's AE-1 Program included shutter priority modes that allowed a photographer to select the shutter speed appropriate for the motion of the objects being photographed, while the camera automatically selected an appropriate corresponding aperture. *Id.*

Based on this well-known need to account for object movement in selecting exposure characteristics, a POSITA seeking to implement *Shibata* in a camera would be motivated to incorporate exposure systems like *Kondo's* that automatically account for object movement.

Kondo, like *Shibata*, teaches varying exposure based on detected pixel brightness. *Kondo*, ¶¶[0059],[0064]. But *Kondo* adds the additional advantage that objects are analyzed across frames to detect movement and calibrate the exposure duration to, *e.g.*, reduce duration in situations where large amounts of movement are detected. *Id.*

A POSITA would recognize that *Shibata's* and *Kondo's* teachings are not limited to photographing a single object. Indeed, although *Shibata* refers to photographing “the subject” in the singular, a POSITA would understand that *Shibata* uses “subject” to refer to the entire scene of the photograph without regard to how many different objects are in the scene and without any intent to limit *Shibata's* method to only photographing single objects. Ex. 1002, ¶[0293]. Both *Shibata* and *Kondo* analyze the imaging field on the basis of pixels, therefore making no distinction on the numbers of objects in the picture. *See, e.g., Kondo*, ¶[0064].

Accordingly, a POSITA implementing *Shibata's* teachings combined with *Kondo's* teachings regarding adjusting exposure based on movement detection would understand (or at least find it obvious) that the method would adjust exposure based on the movement of at least two objects, as claimed. Ex. 1002, ¶¶[0293-0296]. This combination would be readily implemented because both *Shibata* and *Kondo* disclose liquid crystal shutters that can be controlled at the pixel level to selectively expose only discrete portions of the sensor. *Shibata*, ¶¶[0044-0047], Fig. 6; *Kondo*, ¶¶[0051-0053], Fig. 3.

2. Claim 2

Claim 2 depends on Claim 1 and requires that the image sensing array comprises “an array of photosensitive pixels,” which *Shibata* discloses as “CCD 3.” *Shibata*, ¶[0019] (CCD 3 is an m x n pixel array); Ex. 1002, ¶[0298]. *Kondo* likewise discloses a CCD pixel array. *Kondo*, ¶[0045]; Ex. 1002, ¶[0299].

3. Independent Claim 3

Claim 3 is an independent claim that differs from Claim 1 only by changing the word “movement” to “brightness,” see comparison below.

CLAIM 1	CLAIM 3
<p>1. A method comprising: manipulating an optical relationship between an optical lens and an image sensing surface so that the image sensing surface is spaced at different effective image distances from the lens; and exposing different portions of the image sensing surface synchronous with manipulating the optical relationship by adaptively exposing said portions for different exposure periods based on detected movement of at least two objects.</p>	<p>3. A method comprising: manipulating an optical relationship between an optical lens and an image sensing surface so that the image sensing surface is spaced at different effective image distances from the lens; and exposing different portions of the image sensing surface synchronous with manipulating the optical relationship by adaptively exposing said portions for different exposure periods based on detected brightness of at least two objects.</p>

All aspects of Claim 3 other than “brightness” are thus discussed above for Claim 1.

As discussed above for Element [1-B], *Shibata* teaches adjusting the exposure times based on the detected illuminance of pixels to account for uneven distribution of illuminance. *Shibata*, ¶¶[0013],[0032],[0042],[0055]; Ex. 1002, ¶[0303]. *Shibata*’s description of different faces of subject M are photographed.

These faces have different focus distances and different illuminance characteristics and are different “objects,” as claimed. Ex. 1002, ¶[0304]. A POSITA would also readily recognize that *Shibata*’s method for detecting brightness and adjusting exposure times would be equally applicable to photographing multiple non-contiguous objects. *Id.*, ¶[0305].

4. Independent Claim 4

Shibata discloses Claim 4.

a) [4-PRE] and Element [4-A]

Claim 4 has the same preamble and first element as Claim 1 and is taught by *Shibata* for the reasons set forth above. *See* Section VII.D.1.a-b, *supra*.

b) Additional Elements

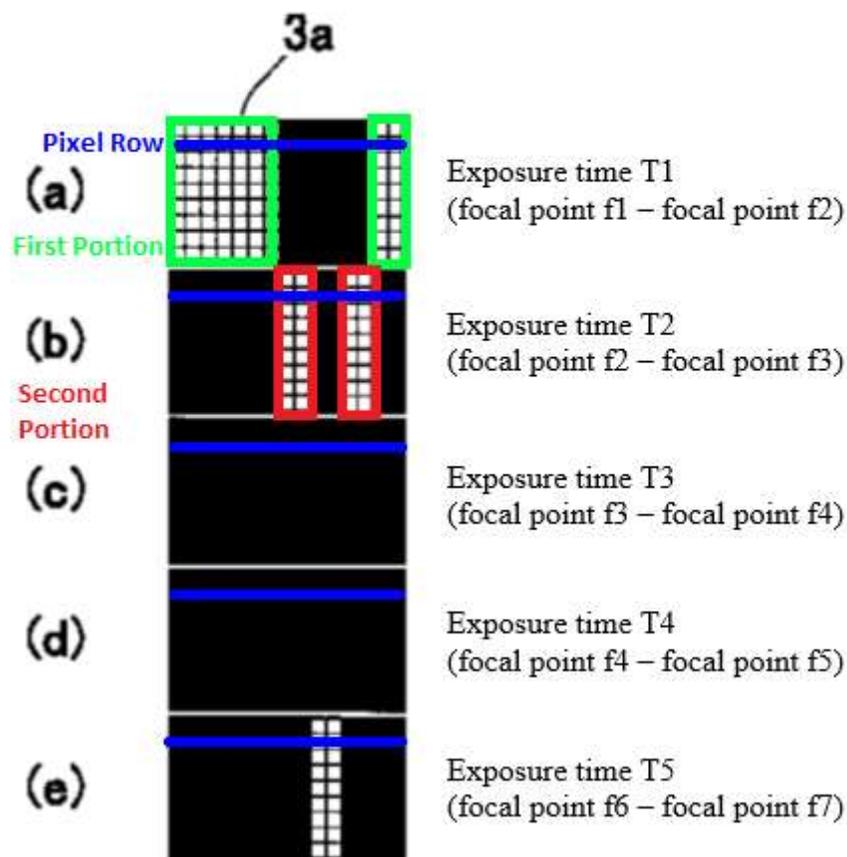
Shibata also discloses Elements [4-B]–[4-C]. Ex. 1002, ¶¶[0308-0311].

As explained above for Elements [1-A] and [1-B], *Shibata* teaches exposing different groups of pixels at different “effective image distances” (*i.e.*, the focus distance), which changes spacing between the lens and exposure surface, disclosing Element [4-B].

Regarding Element [4-C], as explained above for Claim 2, *Shibata* teaches an exposure surface comprising an array of photosensitive pixels in adjacent rows. And as shown in annotated Fig. 6 (below), *Shibata* discloses “a first portion of the array is exposed while the image sensing surface is at a first effective image

distance.” For example, 6(a) which illustrates a first white portion of the image sensing surface (green) being exposed when the lens is positioned at first effective image distance f_1 - f_2 . Then, in 6(b), a second portion of the surface (red) is exposed at a second focal distance f_2 - f_3 , in the same pixel row of the array as for the first portion:

(FIG. 6)



See also *Shibata*, ¶¶[0048-0051].

Shibata also discloses Elements [4-B]-[4-C] by disclosing that the different

portions of the exposure surface are arranged horizontally with different portions in the same row of the array independently exposed (*see* blue pixel row shown at each exposure stage above). *Id.*; Ex. 1002, ¶[0311].

5. Claim 5

Shibata discloses that both of the concepts recited in Claim 5—“manipulating the optical relationship” and “exposing different portions of the image sensing surface”—are adaptive to objects in the scene. Ex. 1002, ¶¶[0312-0316].

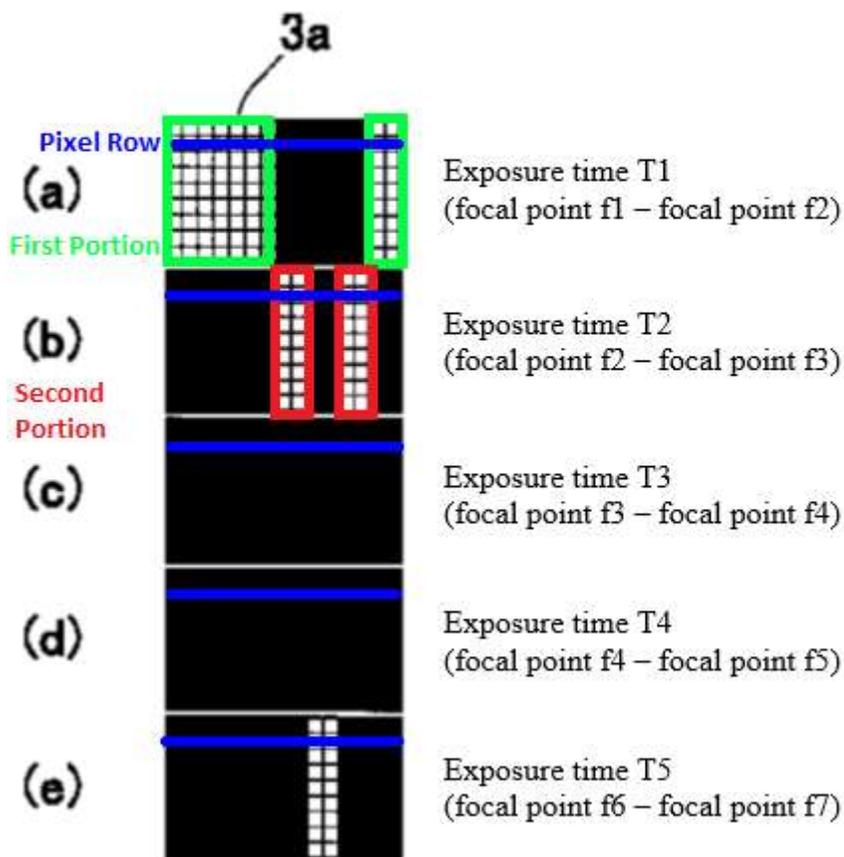
Shibata describes that prior to taking the photograph, the image is sampled multiple times while the lens is positioned at each available focal point. *Shibata*, ¶¶[0035]-[0037]. *Shibata*'s camera analyzes the sampled data to determine what focal point achieved focus for each pixel and stores that data in RAM. *Id.*, ¶¶[0008],[0038]. This data is used by guidance control component 5 to control the shutter when taking a photograph to only expose pixels when the lens is positioned at those pixels' correct focal point. *Shibata*, ¶¶[0024],[0031],[0046]-[0047]. Accordingly, the focal point (optical relationship) and the exposed pixels (portion exposure), are adaptive to the objects being imaged. Ex. 1002, ¶¶[0313-0316].

6. Claim 7

Shibata discloses Claim 7 because, as explained above for Claims 4-6, *Shibata* teaches that the lens moves to different positions (*i.e.*, first and second

effective image distances) to focus on the pixels corresponding to first and second objects at those distances in the scene. *Shibata*, ¶¶[0017],[0024]-[0025]; Ex. 1002, ¶¶[0317-0320]. This is shown in annotated Fig. 6, below. The red outlined pixels correspond to objects at focal position f_2 - f_3 , such as two similarly distant people, whereas the green portions corresponding to objects at focal points f_1 - f_2 might depict background trees at a greater distance:

(FIG. 6)



Ex. 1002, ¶¶[0319]. *Shibata*'s focal point is moved between these “effective image

distances” corresponding to the tree and people objects. *Id.*, ¶¶[0320].

7. Claim 8

Shibata discloses Claim 8 through its focal point control component 2, which moves the lens relative to the image sensing surface. *Shibata*, ¶¶[0017],[0039]; Ex. 1002, ¶¶[0321-0322].

8. Independent Claim 9

Shibata discloses Claim 9.

a) [9-PRE] and Element [9-A]

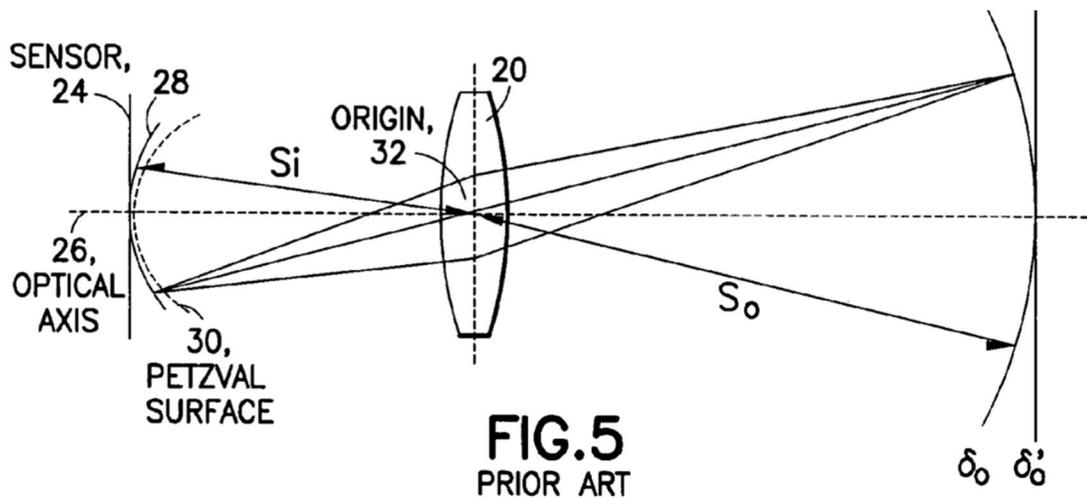
Claim 9 has the same preamble and first element as Claim 1, which *Shibata* teaches for the same reasons as Claim 1.

b) Element [9-B]

As explained above for Elements [1-A] and [1-B], *Shibata* teaches exposing different sets of pixels (portions of the exposure surface) while changing the “effective image distance” between the lens and exposure surface. *Shibata* also teaches Element [9-B] by imposing an effective curvature that approximates a Petzval surface. Ex. 1002, ¶¶[0325-0329].

For some lenses, if an object in the center of a frame is in focus, then objects the same distance from the camera, but at the edges of the frame, will not be in focus. The '030 patent illustrates this in Fig. 5 (labeled “prior art”). For such lenses, to achieve proper focus for objects at the edges of the image, the

sensor/lens optical relationship needs to be adjusted, even if the objects at the edge of the frame are at the same distance from the camera as the objects at the center of the frame. Making these adjustments for objects at the edges of the frame will approximate a Petzval surface. Ex. 1002, ¶[0327].



Because *Shibata* only exposes pixels when the lens is positioned such that those pixels are in focus, it will achieve proper focus for objects at the edge of the scene according to their distance and, thereby, approximate a Petzval surface. *Id.*, ¶¶[0328-0329]. In other words, exposing on a Petzval surface minimizes the loss of focus around the edges of the frame, which is precisely what *Shibata* accomplishes by only exposing portions of the image field when the lens is positioned to put them in focus. *Id.*

9. Independent Claim 15

Shibata discloses Claim 15.

a) [15-PRE]

Shibata discloses [15-PRE] by teaching that its sub-frame focus and exposure method is carried out by a CPU 11 executing program code stored in ROM 13. *Shibata*, ¶¶[0032]-[0033], Fig. 3; Ex. 1002, ¶¶[0330-0332].

b) Element [15-A]

Shibata discloses element [15-A], both under a plain meaning construction of “during an exposure frame period” and the construction proposed in Section V.D.2 above. Ex. 1002, ¶¶[0333-0336].

As discussed in more detail for elements [11-C]-[11-D] in Ground 6, *Shibata*’s programming adjusts the lens position relative to the exposure surface and simultaneously adjusts the portion of pixels exposed during a single exposure period using shutter element Q. *Shibata*, ¶¶[0044]-[0051]. *Shibata*’s CCD exposure surface is an array of photosensitive pixels. *See* Claim 2; Ex. 1002, ¶[0336].

10. Claim 16

Claim 16 depends from Claim 15 and adds the same requirement set forth in Claim 5, which *Shibata* teaches for the same reasons set forth above for Claim 5.

11. Claim 18

Claim 18 depends from Claim 15 and adds the same requirements set forth in Claim 7, which *Shibata* teaches for the same reasons set forth above for Claim 7.

12. Claim 19

Claim 19 depends from Claim 15 and effectively adds the same requirements pertaining to adaptively exposing portions of the surface based on detected movement set forth in Element [1-B], which *Shibata* combined with *Kondo* renders obvious for the same reasons set forth above for Element [1-B].

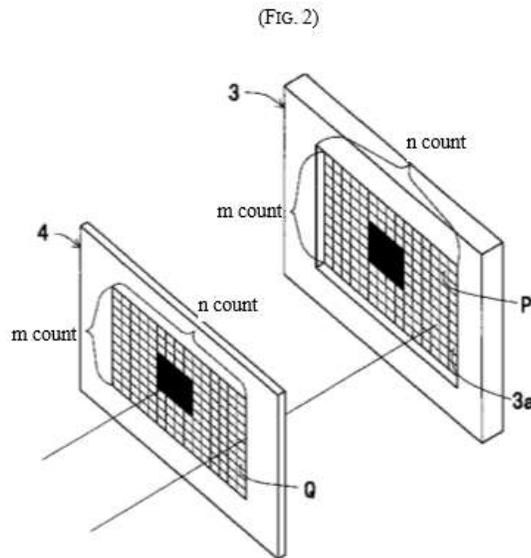
13. Claim 20

Claim 20 depends from Claim 15 and effectively adds the same requirements pertaining to adaptively exposing portions of the surface based on detected brightness set forth in Element [3-B], which *Shibata* teaches for the same reasons set forth above for Element [3-B].

14. Claim 21

Shibata discloses Claim 21. Ex. 1002, ¶¶[0345-0347].

As explained above for Claim 2, *Shibata* discloses a CCD exposure surface that is an array of pixels that therefore includes rows. *Shibata* also explains that guidance control component 5 governs when pixels will be exposed during *Shibata*'s method, by employing a matrix row control component 51 that "controls the opening and closer of the shutters Q in the m rows of the aforesaid liquid crystal shutter." *Shibata*, ¶[0031], see also Figs. 2-3, ¶¶[0019],[0057-0058]; Ex. 1002, ¶¶[0346-0347].



15. Claim 22

Shibata teaches Claim 22 by controlling the exposure of individual pixels.

Shibata, ¶¶[0020] (the liquid crystal shutter 4 controls each pixel of CCD 3); [0041] (S106 controls the exposure time (T_s) for each pixel P of the CCD 3), [0047],[0057-0058], Fig. 4; Ex. 1002, ¶[0349].

Kondo also teaches Claim 22. *Kondo*, ¶[0132] (“shutter capable of controlling exposure every respective pixels of CCD 3 is used as shutter 2 in the embodiments of FIGS. 2 to 4”); Ex. 1002, ¶[0350].

16. Claim 23

Claim 23 depends from Claim 15 and adds the same requirement set forth in Claim 9, which *Shibata* teaches for the same reasons set forth above for Claim 9.

17. Claim 24

Shibata teaches Claim 24 for the same reasons set forth above for Claim 8, where it was discussed how *Shibata* discloses moving the lens, which shows that *Shibata* discloses moving the lens relative to the sensing surface.

E. GROUND 5: *Shibata* in view of *Kondo* and *Berge* Renders Claims 10 and 25 Obvious

A POSITA would have found it obvious to predictably combine *Berge*'s teachings with those of *Shibata* and *Kondo* to achieve the lens advantages taught by *Berge*, as explained in Section VI.K. Ex. 1002, ¶¶[0355-0356].

1. Independent Claim 10

Shibata, *Kondo*, and *Berge* render obvious Claim 10.

a) [10-PRE] and Element [10-A]

[10-PRE] and [10-A] are identical to [1-PRE] and [1-A] and are therefore disclosed by *Shibata* for the reasons set forth above in Ground 4 for [1-PRE] and [1-A].

b) Element [10-B]

Shibata does not disclose manipulating the optical relationship by altering a shape of the lens, *e.g.*, by using a liquid lens that achieves focus by changing shape. But *Shibata* does not limit its disclosed technique to any particular type of lens—rather, *Shibata*'s main thrust is selectively exposing pixels at a range of varying focus points allowing each pixel to be in focus. Because different lens

types, including lenses that changed focus by changing their shape, were known in the art, a POSITA would have readily applied the *Shibata* method to cameras with shape altering lenses to achieve the known benefits of shape altering lenses. Ex. 1002, ¶¶[0361-0364].

For example, a POSITA would have found it obvious to combine *Shibata* with *Berge*, which teaches a variable focus lens comprised of a mixture of insulating and conductive liquids that can be electrically manipulated into different forms and thereby alter the shape of the lens. *Berge*, Figs. 1-6, 3:18-39, 4:12-15, 39-43, 5:4-7, 5:24-27, 5:61-64. *Berge's* approach provides for a lens with continuously adjustable focus that is both simple to manufacture and use. *Id.*, 1:42-49. Further, a POSITA would recognize that *Berge's* ability to avoid moving parts in focusing would increase the durability and longevity of the focusing mechanism. Ex. 1002, ¶¶[0365].

2. Claim 25

Claim 25 depends from Claim 15 and adds the requirements of Element [10-B] concerning altering the shape of the lens.

As explained above in Ground 4 regarding Claim 15, *Shibata* discloses the limitations of Claim 15. Further, *Shibata* combined with *Kondo* and *Berge* renders the dependent limitations of Claim 25 obvious for the same reasons set forth above for Claim 10.

F. GROUND 6: Shibata in view of Kondo and Kubo Renders Claims 6, 11-14, and 17 Obvious

A POSITA would have found it obvious to predictably combine *Kubo*'s teachings with those of *Shibata* and *Kondo*, as explained in Section VI.L. Ex. 1002, ¶¶[0368-0369].

1. Independent Claim 11

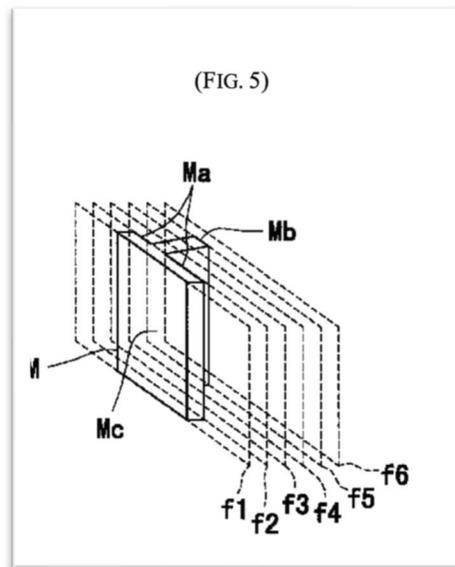
Shibata, *Kondo*, and *Kubo* render obvious Claim 11.

a) [11-PRE], Elements [11-A] and [11-B]

Claim 11's preamble is the same as Claim 1, which is taught by *Shibata* for the same reasons set forth above in Ground 4. *See* Section VII.D.1. *supra*.

Element [11-A] requires "determining a first object distance between a first object in a scene and a lens," and [11-B] requires doing the same for a second object. *Shibata* combined with *Kubo* renders this obvious. Ex. 1002, ¶¶[0371-0381].

Shibata discloses moving the focus through a range of focus distances f1-f6, as shown in Fig. 5 (below). *Shibata*, ¶¶[0036-0041].



Shibata further discloses determining the proper focus position for each pixel based on the distance of objects, such as M_A and M_B . *Id.*; Ex. 1002, ¶[0373].

Kubo teaches a method for varying exposure based on detected object movement. *Kubo* describes detecting an object's movement and determining the exposure period. *Kubo* ¶¶ [0038]-[0044]. *Kubo* further describes performing a distance measurement in order to determine autofocus setting. *Kubo* ¶ [0044]; Fig. 6. This is unlike *Shibata*, which determines focus by analyzing each pixel but does not involve actual distance measurement.

Both distance measuring autofocus and contrast autofocus, as well as the use of both in combination to achieve optimal focus, were well-known in the prior art. Ex. 102, ¶¶[0376-0379]. Indeed, at least by the Priority Date, it was well-known to combine distance measuring autofocus and contrast autofocus to achieve higher

speed and accuracy, and it was well known that camera systems could measure distance to objects to determine focus in multiple ways, and that this determination was simply a design choice. *Id.*

Prior art references like U.S. Pub. No. 2003/0081137 to Yamazaki (Ex. 1014) provide an example of first using distance-measuring autofocus to measure distance and, depending on how far the subject is, using contrast autofocus to search within a narrow area to achieve optimal focus. *Id.*; Yamazaki ¶¶ Abstract,[0004]-[0006],[0073],Figs. 7-8. And references like U.S. Pub. No. 2003/0007076 to Okisu (Ex. 1013) provide an example of how it was well known that camera systems could measure distance to objects to determine focus in multiple ways. *Id.*; Okisu ¶ [0093].

Thus, a POSITA seeking to improve the accuracy and speed of autofocus would combine distance-measuring autofocus as taught by *Kubo* and contrast autofocus as taught by *Shibata*. *Id.*

b) Elements [11-C] and [11-D]

Shibata teaches elements [11-C] and [11-D], both under a plain meaning construction of “within a continuous disclosure frame” and the construction proposed in Section V.D.1 above, because its lens is moved to various focus points within a single exposure, and pixels are exposed by shutter element Q only when the lens is positioned at the focus point that would cause the exposed pixels to be

in focus. *Shibata*, ¶¶[0044]-[0051], Fig. 6; Ex. 1002, ¶¶[0382-0386].

Shibata also teaches that the exposed pixels (including first and second portions) are combined into a single image, as *Shibata* teaches that after the main photography phase, “the accumulated charge of all pixels of the aforesaid CCD is read out,” resulting in a single image that combines each portion separately exposed during main photography. *Id.*, ¶[0053].

2. Claim 12

Claim 12 depends from Claim 11 and requires that the single image is displayed on a digital GUI.

Shibata and *Kubo* combined with *Kondo* renders Claim 12 obvious. Ex. 1002, ¶¶[0387-0391].

Shibata discloses a digital camera but does not explicitly disclose a display that displays the captured images. *Shibata*, ¶[0001]. However, by June 2005, digital cameras were ubiquitous, and it was well known to use a digital camera’s display show the final captured images. Ex. 1002, ¶¶[0389]. Moreover, *Kondo* expressly discloses that display unit 102 can display final images as they are taken. *Kondo*, ¶[0042]. Because instantly previewing final images was a key and heavily desired feature of digital cameras, a POSITA would expect *Shibata*’s camera to include a display to output captured images, as the combined discussed above for Claim 11, or at least find it obvious to modify *Shibata* in light of *Kondo*’s

disclosure to include that feature. Ex. 1002, ¶¶[0390-0391].

3. Claim 13

Claim 13 effectively adds the same requirement set forth in Element [3-B].

Shibata teaches Claim 13 for the same reasons set forth above for Element [3-B] in Ground 4.

4. Claim 14

Claim 14 effectively adds the same requirement set forth in Element [1-B].

Shibata and *Kubo* combined with *Kondo* renders Claim 13 obvious for the same reasons set forth above for Element [1-B] in Ground 4.

5. Claim 6

Claim 6 depends from Claim 4 and requires “wherein exposing different portions of the image sensing surface comprises adaptively exposing said portions based on at least a detected first and second object distance,” a subset of the elements of Claim 11.

Shibata discloses the limitations of independent Claim 4 for the same reasons explained above in Ground 4 for Claim 4. Further, *Shibata* combined with *Kondo* and *Kubo* renders the dependent limitations of Claim 6 obvious for the same reasons explained above for Claim 11.

6. Claim 17

Claim 17 depends from Claim 15 and adds the same requirement set forth in

Claim 6, and so is taught by *Shibata* for the same reasons set forth above for Claims 15 and 11.

VIII. SECONDARY CONSIDERATIONS

Petitioners are not aware of any secondary considerations that would overcome the strong showing of obviousness provided by the Petition. Further, any attempt by Patent Owner to rely on alleged secondary considerations cannot overcome the showing of obviousness detailed above. *Tokai Corp. v. Easton Enters., Inc.*, 632 F.3d 1358, 1370 (Fed. Cir. 2011).

IX. CONCLUSION

For the foregoing reasons, Petitioner respectfully requests that IPR of the '030 patent be instituted, and that Challenged Claims are cancelled.

Date: September 12, 2022

Respectfully submitted,

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CERTIFICATE OF WORD COUNT

The undersigned certifies that the foregoing PETITION FOR *INTER PARTES* REVIEW OF U.S. PATENT NO. 7,493,030 PURSUANT TO 35 U.S.C. §§ 311-319 and 37 C.F.R. § 42 complies with the type volume limitation in 37 C.F.R. § 42.24(a)(1). According to the utilized word-processing system's word count, the petition—excluding the caption, table of contents, a table of authorities, mandatory notices under § 42.8, certificate of service, certificate of word count, or listing of exhibits, and claim listing—contains 13,975 words.

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