UNITED STATES PATENT AND TRADEMARK OFFICE

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BEFORE THE PATENT TRIAL AND APPEAL BOARD

_____

SONY CORPORATION,
Petitioner,

v.

OPTIMUM IMAGING TECHNOLOGIES, LLC,
Patent Owner.

_____

Case No. IPR2024-00925
Patent No. 8,451,339

_____

PETITION FOR INTER PARTES REVIEW
UNDER 35 U.S.C. §§ 311-319 AND 37 C.F.R. § 42.1 et seq

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35 U.S.C. § 102(e) 3

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Other Authorities

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APPENDIX LISTING OF EXHIBITS

Exhibit	Description
1001	U.S. Patent No. 8,451,339
1002	Prosecution History of U.S. Patent No. 8,451,339
1003	Declaration of Leonard Laub
1004	Curriculum Vitae of Leonard Laub
1005	U.S. Patent Publication No. 2005/0280877 ("Watanabe")
1006	Certified Translation Of Japanese Patent Application No. JP2004-233872 ("JP-872")
1007	Certified Translation Of Japanese Patent No. JPA 2004-343358 ("Kishida")
1008	Certified Translation Of Japanese Patent Application Publication JP 2004-328506A ("Kita")
1009	U.S. Patent Publication No. 2003/0223007 A1 ("Takane")
1010	RESERVED
1011	RESERVED
1012	RESERVED
1013	RESERVED
1014	RESERVED
1015	RESERVED
1016	RESERVED
1017	RESERVED
1018	PCT Publication No. WO 2004/093438 A1 ("Dutta")
1019	Texas Instruments, TMS320C8x System-Level Synopsis (Sep. 1995)
1020	RESERVED
1021	RESERVED
1022	U.S. Patent No. 9,063,982 ("Bestgen")
1023	U.S. Patent No. 6,920,443 ("Cesare")
1024	U.S. Patent Publication No. 2006/0268357 A1 ("Vook")
1025	U.S. Patent No. 5,739,691 ("Hoenninger")
1026	[Reserved]
1027	Dkt. No. 88, Claim Construction Memorandum Opinion and Order, *Optimum Imaging Technologies LLC v. Canon Inc.*, No. 2:19-cv-00246 (E.D. Tex. June 11, 2020)
1028	*digital filter*, Comprehensive Dictionary of Electrical Engineering (2d ed. CRC Press 2005)
1029	*database management system*, Newton's Telecom Dictionary (CMP Books, 2005)

Exhibit	Description
1030	*Canon Inc. v. Optimum Imaging Technologies LLC*, IPR2020-1322, Paper 1 (Jul. 20, 2020) ("-01322 Petition")
1031	*Canon Inc. v. Optimum Imaging Technologies LLC* IPR2020-1322, Paper 9 (Mar. 1, 2021) ("-01322 D.I.")
1032	*Canon Inc. v. Optimum Imaging Technologies LLC*, IPR2020-1321, Paper 1 (Jul. 20, 2020) ("-01321 Petition")
1033	*Canon Inc. v. Optimum Imaging Technologies LLC*, IPR2020-1321, Paper 10 (Mar. 1, 2021) ("-01321 D.I.")
1034	RESERVED
1035	RESERVED
1036	RESERVED
1037	Dkt. No. 1, Complaint, *Optimum Imaging Technologies LLC v. Sony Corp.*, No. 4:23-cv-00928 (E.D. Tex. Oct. 18, 2023)
1038	Docket report in Optimum Imaging Technologies LLC v. Sony Corp., No. 4:23-cv-00928 (E.D. Tex. Oct. 18, 2023) as of May 13, 2024
1039	Eastern District of Texas, U.S. District Court—Judicial Caseload Profile, as of May 13, 2024
1040	RESERVED
1041	RESERVED
1042	RESERVED
1043	U.S. Patent No. 7,245,319 ("Enomoto")
1044	Certified Translation Of Japanese Patent No. JPH (1999)-313250 ("Yamagata")
1045	U.S. Patent No. 5,905,530 ("Yokota")
1046	U.S. Pat. App. No. 2004/0150732 ("Yamanaka II")
1047	GUAN et al., *Digital Image Correcting Method for Digital Camera* (December 2005) ("Ricoh")
1048	U.S. Patent No. 5,999,330 ("Goosey")
1049	U.S. Patent No. 7,738,015 ("Steinberg I")
1050	U.S. Patent No. 7,590,305 ("Steinberg II")
1051	Certified Translation Of Japanese Patent No. JPA 2002-190979 ("Kuniba")
1052	Certified Translation Of Japanese Patent No. JPA 2000-184247 ("Imai")
1053	GONZALEZ &WOODS, DIGITAL IMAGE PROCESSING, (Prentice Hall, 2d ed. 2002) ("Gonzalez")
1054	JOHN C. RUSS, THE IMAGE PROCESSING HANDBOOK (CRC Press, 4th ed. 2002) ("Russ").
1055	U.S. Patent No. 7,609,297 ("Master")

Exhibit	Description
1056	U.S. Pat. App. No. 2007/0080280 (“Havens”)
1057	U.S. Patent No. 7,936,392 (“Ng”)
1058	PCT Publication No. WO 2002/069214 (“Takae”)
1059	U.S. Patent No. 6,279,004 (“Lee”)
1060	Certified Translation Of Japanese Patent Application Publication No. JP 2001-251546A (“Iida”)
1061	U.S. Patent No. 5,818,524 (“Juen”)
1062	RESERVED
1063	U.S. Patent Publication No. 2002/0135688 (“Niikawa”)
1064	U.S. Patent No. 4,903,204 (“Dobbins”)
1065	U.S. Patent No. 5,414,782 (“Carasso”)
1066	Certified Translation of Japanese Patent No. JPA 2006-72660 (“Yamazaki”)
1067	U.S. Patent Publication No. 2003/0095197 (“Wheeler”)
1068	RESERVED
1069	U.S. Patent No. 5,630,153 (“Intrater”)
1070	U.S. Patent No. 5,864,409 (“Kashida-409”)
1071	PCT Publication No. WO 1993-020536 A1 (“Reddig”)
1072	U.S. Patent No. 5,475,420 (“Buchin”)
1073	RESERVED
1074	RESERVED
1075	RESERVED
1076	P. Strumiłło and M. Strzelecki, Fourier Transform of Images, available at http://mstrzel.eletel.p.lodz.pl/mstrzel/pattern_rec/fft_ang.pdf (visited May 10, 2024).
1077	U.S. Patent No. 4,841,322 (“Kawasaki”)

MANDATORY NOTICES

A. Real Party-In-Interest

Sony Corporation ("Sony" or "Petitioner") is the Real Party-in-Interest.

B. Related Matters

A decision in this proceeding could affect or be affected by the following:

1. United States Patent & Trademark Office

The application from which U.S. Patent No. 8,451,339 issued is a Continuation of U.S. Patent Application No. 11/825,521 (U.S. Patent No. 7,612,805), which claims priority from provisional application 60/807,065.

The following U.S. patent applications claim the benefit of priority to U.S. Patent No. 8,451,339:

(i) U.S. Patent Application No. 13/691,805 (U.S. Patent No. 10,873,685), filed December 2, 2012; (ii) U.S. Patent Application No. 16/692,939 (U.S. Patent No. 11,106,032), filed November 22, 2019; (iii) U.S. Patent Application No. 16/692,972 (U.S. Patent No. 10,877,266), filed November 22, 2019; (iv) U.S. Patent Application No. 16/694,850 (U.S. Patent No. 10,877,267), filed November 25, 2019; (v) U.S. Patent Application No. 16/694,838, filed November 25, 2019; (vi) U.S. Patent Application No. 17/383,602 (U.S. Patent No. 11,774,751), July 23, 2021; (vii) U.S. Patent Application No. 18/454,196, filed August 23, 2023.

2. U.S. District Court for the Eastern District of Texas

The following district court actions involve the '339 patent.

(i) *Optimum Imaging Technologies LLC v. FUJIFILM Corporation*, Case No. 4-23-cv-00922; (ii) *Optimum Imaging Technologies LLC v. Nikon Corporation*, Case No. 4-23-cv-00923; (iii) *Optimum Imaging Technologies LLC v. Olympus Corporation*, et al., Case No. 4-23-cv-00924; (iv) *Optimum Imaging Technologies LLC v. Panasonic Corporation*, Case No. 4-23-cv-00926; (v) *Optimum Imaging Technologies LLC v. Sony Corporation*, Case No. 4-23-cv-00928 ("the Litigation").

3. U.S. District Court for the Western District of Texas

Canon Inc. v. Optimum Imaging Technologies LLC, Case No. 1-20-cv-01238 (Terminated April 28, 2021).

C. Counsel and Service Information - § 42.8(b)(3) and (4)

Lead Counsel	Scott A. McKeown, Reg. No. 42,866
Backup Counsel	Adam R. Wichman, Reg. No. 43,988 Randy J. Pritzker, Reg. No. 35,986
Service Information	E-mail: SMcKeown-PTAB@WolfGreenfield.com AWichman-PTAB@WolfGreenfield.com RPritzker-PTAB@WolfGreenfield.com Post and hand delivery: Wolf, Greenfield & Sacks, P.C. 600 Atlantic Avenue Boston, MA 02210-2206 Telephone: 617-646-8000 Facsimile: 617-646-8646

A power of attorney is submitted with the Petition. Counsel for Petitioner consents to service of all documents via electronic mail.

Sony Corporation ("Sony" or "Petitioner") requests *inter partes* review and cancellation of U.S. Patent No. 8,451,339 (EX1001, "the '339 patent") claims 1-5 and 14-18 (the "Challenged Claims").

I. INTRODUCTION

The '339 patent is directed to automated correction of imaging distortions in digital camera systems. The distortions are classified as "optical aberrations" from the physical optics components or "digital aberrations" from other imaging components or processes. A processing platform of the camera system identifies a corresponding one of a plurality of optical image aberration corrections in a database for correcting aberrations of a given lens, component, or process prior to final storage of the captured image in memory. (EX1001, 7:22-29; 8:3-8; Fig.1)

During prosecution the examiner issued a solitary action citing only two references even though such well-worn imaging system concepts were known in the art. Indeed, it was well-known at the time of filing the '339 patent to automate the correction of digitally captured image data such as video to account for optical and digital aberrations prior to final storage of the captured image data.

For example, as explained herein, Watanabe (EX1005) is a 2005 patent publication assigned to Ricoh, which manufactures digital cameras. Watanabe provides a digital signal processing circuit that performs automated processing of captured image data to account for optical and image aberrations. Watanabe

identifies distortion aberration and peripheral light intensity corrections from memory for application to captured image data prior to final storage of the image in a memory; Watanabe, [0047]) and processes the digitized video to apply the corrections; Watanabe, [0032], [0048]-[0064]). **Grounds 1-3** shows that Watanabe in combination with other references of record renders claims 1-5 and 14-18 obvious.

Further, Takane is a 2003 patent publication assigned to Fuji Photo Film, which manufactures digital cameras (EX1009). Takane describes a digital imaging system that captures image data and provides image processing that corrects aberrations therein. Takane's digital camera includes a memory in which various parameters are identified and stored in advance to provide for automated processing of captured image data to remove such aberrations. Takane, [0033], Figs. 1, 2. **Grounds 4-6** shows that Takane, applying Watanabe's teaching of software accessing a database, renders obvious claims 1-5 and 14-18 obvious.

Accordingly, Petitioner respectfully requests that inter partes review of the '339 petition be ordered and claims 1-5 and 14-18 cancelled.

II. STANDING CERTIFICATION

The '339 patent is available for IPR. Sony is neither barred nor estopped from requesting IPR. 37 C.F.R. § 42.104(a).

III. UNPATENTABILITY GROUNDS

Pre-AIA law applies because the '339 patent was filed before March 16, 2013. EX1001, code (22).

Ground	Reference(s)	Claim(s)	Basis
1	Watanabe	1-2, 5, 14-15, and 17	§103(a)
2	Watanabe+Kishida	3, 18	§103(a)
3	Watanabe+Kita	4, and 16	§103(a)
4	Takane+Watanabe	1-2, 5, 14-15, and 17	§103(a)
5	Takane+Watanabe+Kishida	3, 18	§103(a)
6	Takane+Watanabe+Kita	4, and 16	§103(a)

The '339 patent issued from an application filed September 18, 2009. EX1001, code (22). The Patent Owner ("PO") bears the burden to show that any claim is entitled to an earlier effective-filing date. *Dynamic Drinkware v. National Graphics*, 800 F.3d 1375, 1380 (Fed. Cir. 2015). The identified references are pre-AIA prior art to every Challenged Claim based on their priority and publication dates:

Reference	Priority	Publication	Basis
Watanabe (EX1005)	2005-06-07	2005-12-22	§§102(a), (b), (e)
Kishida (EX1007)		2004-02-12	§§102(a), (b)
Kita (EX1008)	2003-04-25	2004-11-18	§§102(a), (b)
Takane (EX1009)	2003-06-03	2003-12-04	§§102(a), (b), (e)

IV. ’339 PATENT[1]

The ’339 patent is directed to systems and methods for correcting known optical aberrations in digital images using a database with lens-specific aberration correction information. “The invention applies to any imaging system that includes interactions between optics, digital image sensors, post-capture integrated circuits [“ICs”] and digital storage components.” 1:22-25. The specification describes well-known optical aberrations (3:40-43) and “optical vignetting” that affects “peripheral illumination” (3:45-53) that are “characterized by lens type” (3:25-27). The ’339 patent replaces optical filters correcting these lens aberrations with “in-camera digital filters” that correct aberrations using “in-camera digital filtration,” e.g., digital signal processing. 7:22-29; 8:3-8; Fig.1.

The imaging system connects a sensor to an application specific integrated circuit (“ASIC”), a digital signal processor (“DSP”), a database, and a microprocessor. 30:39-55, Fig. 1. The image sensors are photoelectric sensors including a charge coupled device (“CCD”) or CMOS focal plane array. 3:38-51, 17:47-18:5, Fig. 17. The system identifies a specific lens type associated with an optical aberration and applies a digital filter to the correct the aberration. 31:31-64,

[1] Unless otherwise noted, Section IV citations reference EX1001. All emphasis in the Petition is added unless otherwise noted.

Figs. 5-7*, See also* Laub, ¶¶ 71-97. Thereafter, the revised image is stored in memory. *Id.*

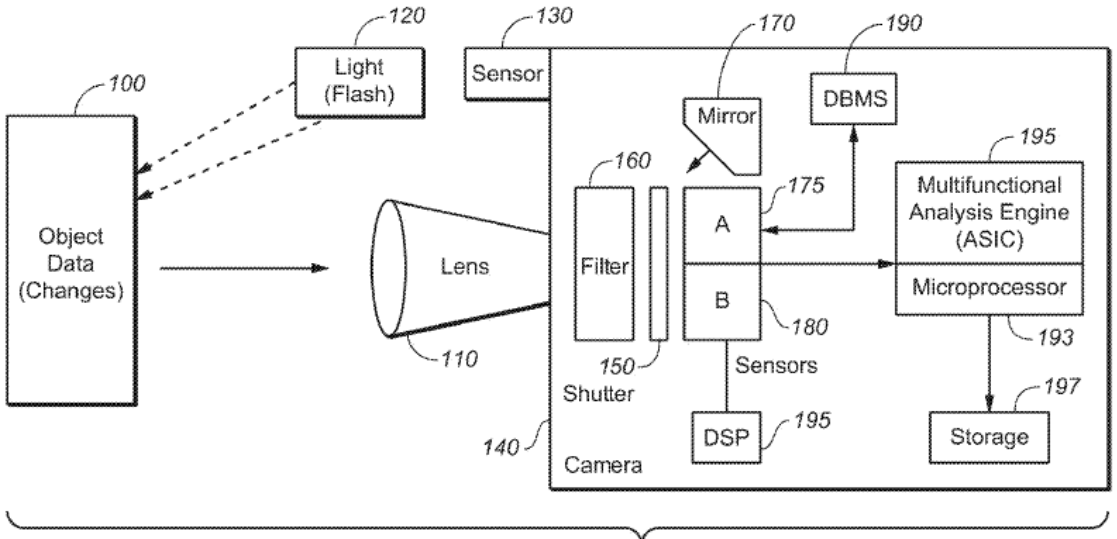


FIG. 1

A. Challenged Claims

The claim list (Appendix A) reproduces claims 1-5 and 14-18. All claims recite a "digital imaging system" comprising conventional components and describe how the system "uses" the components. Independent claim 1 is representative:

1.PRE	A digital imaging system for correcting optical image aberrations comprising:
1.a	a digital camera mechanism, an optical lens mechanism, a digital sensor, a microprocessor, a digital signal processor, system software, a database management system and a memory storage sub-system;
1.b	wherein the optical lens mechanism is a fixed focal length lens;

1.c	wherein a microprocessor uses system software to identify at least one optical aberration by accessing the database;
1.d	wherein the microprocessor uses the database to identify at least one algorithm to use to correct the at least one optical aberration;
1.e	wherein when the image file is captured by the digital sensor the digital file is forwarded to the digital signal processor;
1.f	wherein the image file with the at least one optical aberration is corrected by applying digital filtration by using at least one algorithm in the digital signal processor; and
1.g	wherein the modified digital file consisting of the digital data optimized from the at least one optical aberration that are corrected from the original optical image is stored in memory.

Independent claim 14 repeats the limitations in claim 1 with minor differences, such as a "zoom lens" instead of a "fixed focal length lens."

Dependent claims add limitations concerning particular known aberrations (claims 2-3, 15, and 18), using well-known fast Fourier transform algorithms (claims 4 and 16), database contents (claim 5), and obvious variations on independent claim limitations (claim 17).

B. Prosecution History

The '339 patent issued from Application No. 12/586,221, a continuation of the application that issued as U.S. Patent No. 7,612,805 (whose claims Sony challenges in a co-pending IPR).

The Examiner rejected the application-claims for obviousness-type double patenting over the parent '805 claims, with various claims being rejected as anticipated by U.S. Pat. App. No. 2007/0236574, obvious over the '574 publication in view of U.S. Pat. App. No. 2007/0080280 and/or Official Notice and lacking written description or definiteness. EX1002, 113-125. In prosecution, PO concedes that the hardware components of the claims are known to be used in cameras for image processing, stating that "it is acknowledged that microprocessors and ASICS are used in digital cameras," where "[t]he microprocessor is a CPU that controls the computing functions of the camera," and that "it is recognized that a digital signal processor (DSP)" or "an application specific integrated circuit (ASIC), is used to process a digital image file." EX1002, 154-155. Following an Interview dated August 21, 2012, PO thereafter made various amendments to the claims and filed a terminal disclaimer over the '805 claims. EX1002, 132-158. The Examiner then allowed the claims without meaningful explanation. EX1002, 162-170.

C. Canon IPRs

The '339 patent was challenged in IPR2020-01322 (EX1030) along with the related '805 patent in IPR2020-01321 (EX1032). The Board discretionarily denied both petitions under *Fintiv*. EX1033, 12 (-01321 denial); EX1031, 12 (-01322 denial). The Board never considered the merits of any ground in either

petition and performed no compelling merits assessment per current 314(a) practices.

D. POSA

A POSA would have had a bachelor's degree in electrical engineering, physics, or a related field, with at least two years of industry experience and/or research, both concerning digital camera system design and image processing. Laub, ¶¶49-58.

V. CLAIM INTERPRETATION

The Board construes claim terms using ordinary meaning in light of the specification and prosecution history. 37 C.F.R. § 42.100(b). The Board need only construe terms to the extent needed to resolve disputes. *Nidec v. Zhongshan*, 868 F.3d 1013, 1017 (Fed. Cir. 2017); 83 Fed. Reg. 51,340 at 51,353.

A. Infringement Contentions

1. "uses system software to identify at least one optical aberration."

Independent claims 1 and 14 each recite a version of a "microprocessor uses system software to identify at least one optical aberration." [1.c]. [14.e] ("the microprocessor uses system software… to identify at least one optical aberration").

In the Litigation, PO contends that [1.c] is met by software that corrects aberrations based on the optical system configuration. EX1037 ("Compl."), ¶57 (citing "a 'lens compensation' function that corrects multiple types of optical

aberrations" such as shading, chromatic aberration, and "distortion" compensation), ¶79 (accused product "contains photo shooting functionality ***that automatically corrects optical aberrations based on the lens being used***"), *id.* (accused product "system software" is used to "automatically compensate for these optical aberrations").

Thus, as PO urges applying the claim language in litigation, "using software to identify an optical image aberration" is met by using software that corrects an optical aberration based on information about the optical system like the lens or focal length. *10X Genomics v. Bio-Rad Labs.*, IPR2020-00086, Paper 8, 17-19 (April 27, 2020) (claim constructions based on patent owner's infringement contentions comply with 37 C.F.R. §42.104(b)(3)). In [14.e], this is met by software accessing a database to obtain correction parameters based on particular optical system parameters like the lens and focal length. *See also* EX1001, Fig. 5; 11:14-16 ("[E]ach lens… will have specific aberrations, the corrections for which will be accessible in a database.").

B. Ordinary Meaning

For clarity the Petition identifies the ordinary meaning of these particular terms to a POSA, as confirmed by the '339 patent's usage.

1. "vignetting"

Claims 3, 15, and 18 recite "vignetting." In prior litigation the district court construed "vignetting" this patent as "an effect in which the edges of an image are darker than the image's center." EX1027, 9-10. The Board should apply this construction, which is consistent with the '339 specification. EX1001, 3:45-46 ("[V]ignetting affects peripheral illumination."), 31:16-17 ("In vignetting, the lens (300) makes the edges of the image significantly darker as the light falls off[.]").

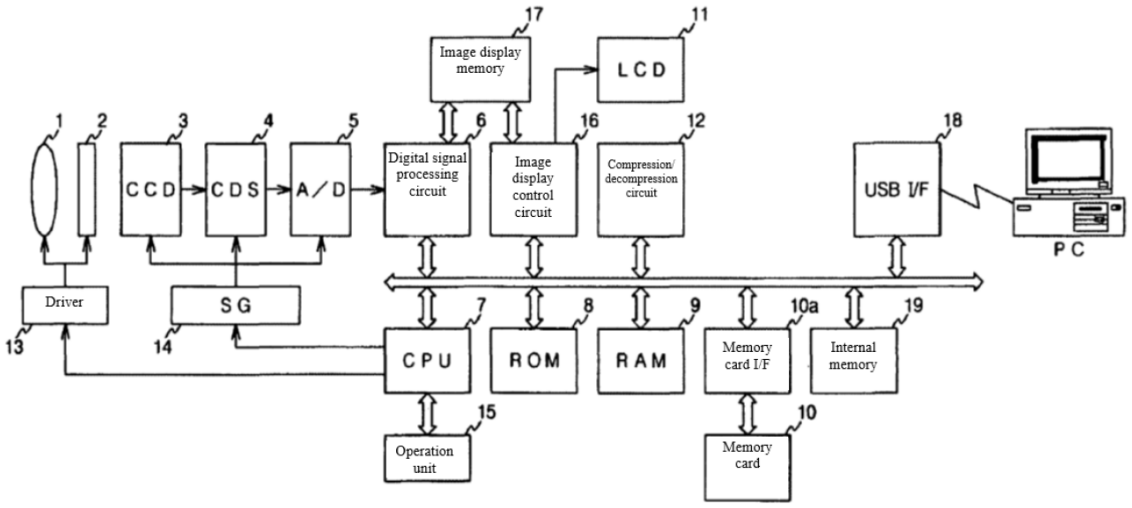
All other terms should be given their ordinary meaning to a POSA.

VI. GROUND 1: WATANABE RENDERS OBVIOUS CLAIMS 1-2, 5, 14-15, AND 17

A. Watanabe

Watanabe, a U.S. Patent Publication entitled "Image Recording Apparatus and Image Processing System," incorporates JP2004-233872 (EX1006, "JP-872"). Watanabe, code (54), [0015]; *Advanced Display Sys., Inc. v. Kent State Univ.*, 212 F.3d 1272, 1282 (Fed. Cir. 2000) (incorporated material "is effectively part of the host document as if it were explicitly contained therein.").

Watanabe describes an image processing system for a digital camera that uses CCD sensors to capture images as well as video (through its incorporation of JP-872). JP-872, [0006]-[0007], Fig. 1; Watanabe, [0035] (digital camera 100 with CCD 53); Laub, ¶¶113-120.



JP-872, Fig. 1.

Watanabe adds "information related to lens characteristics" including "lens type… focal length at the time of shooting… and the zoom position" to image data and identifies "distortion aberration correction" and "peripheral light intensity corrections" based on "focal length and zoom position for each lens." JP-872, [0007]; Watanabe, [0046]-[0047]; Laub, ¶¶121-122.

A "digital signal processing circuit 6… performs various processing" and "correction" to images that have been digitized by A/D converter 5. JP-872, [0006]; *see also* Watanabe, [0038] ("digital signal processing circuit 56… executes various processes" and "correction" to digitized images). Watanabe identifies distortion aberration and peripheral light intensity corrections (JP-872, [0007]; Watanabe, [0047]) and processes the digitized images to apply the corrections (JP-872, [0006]-[0008]; Watanabe, [0032], [0048]-[0064]). Laub, ¶120.

B. Claim 1

1. Limitation [1.PRE]

1.PRE	A digital imaging system for correcting optical image aberrations comprising:

If [1.PRE] is limiting Watanabe meets it by describing a digital imaging system. JP-872, [0006]-[0008]; Watanabe, [0002] (describing "an image recording apparatus and an image processing system" that performs "distortion aberration correction"), [0032], [0035]. Watanabe corrects optical image aberrations in digital images as explained *infra* §§VI.B.2-VI.B.7 (limitations [1.a]-[1.g]). Laub, ¶¶ 71-97 and 130-131

2. Limitation [1.a]

1.a	a digital camera mechanism, an optical lens mechanism, a digital sensor, a microprocessor, a [DSP], system software, a [DBMS] and a memory storage sub-system;

Watanabe meets [1.a] as shown below.

a. "digital camera mechanism"

Watanabe describes a "digital camera" (JP-872, [0006], Fig. 1; Watanabe, [0035], Figs. 1A-1B. Watanabe discloses a CCD that captures images, which are digitized. JP-872, [0006] (CCD 3, A/D converter 5), Fig. 1; Watanabe, [0035] (CCD 53, A/D converter 55), [0037] ("A/D converter converts analogue image data… to digital image data"), Fig. 1A; Laub, ¶¶106-110; and 132-133.

b. "optical lens mechanism"

Watanabe discloses a lens and lens mechanism because it describes "zoom position" and correcting distortion "based on… zoom position for each lens." JP-872, [0007]; Watanabe, [0047], [0049], Fig. 3; Laub, ¶¶123-125. A "mechanical mechanism including an autofocus" moves the lens. JP-872, [0006], Fig. 1 (lens 1, "mechanical mechanism 2"); Watanabe, [0035] ("lens 51" and "mechanical structure 52" with autofocus), [0036] (lens unit), Fig. 1A (51, 52); Laub, ¶¶134-135.

c. "digital sensor"

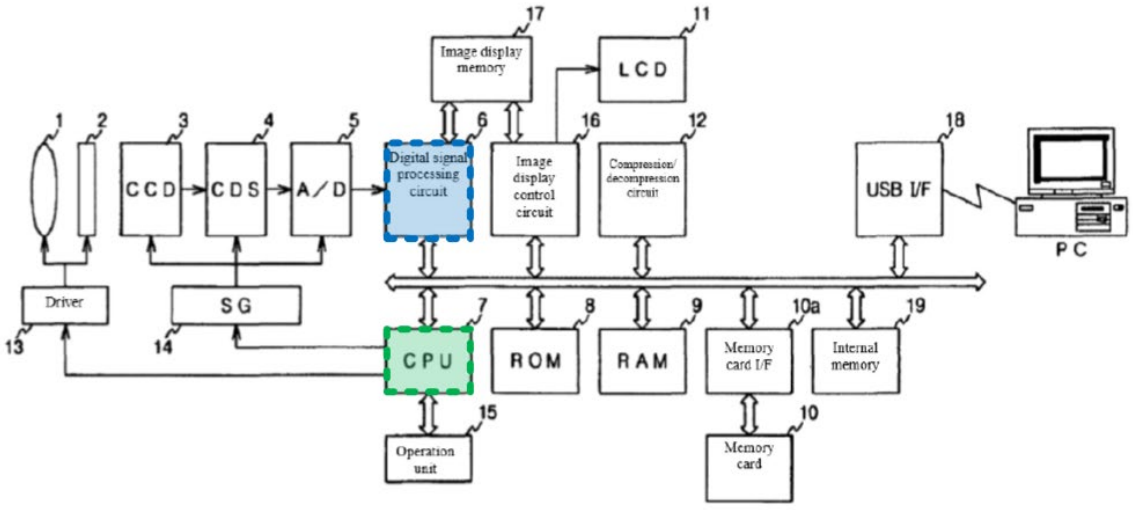
Notwithstanding that a CCD provides an analog signal that requires digitization, the '339 specification identifies a CCD as a "***digital*** sensor[]" in which "photons are recorded by electrically charged pixels." EX1001, 14:1-3; *id.*, 2:43-51, 17:47-50; see also id., 31:10-12 (analog-to-digital converter ("ADC") 210 digitizes analog signal from CCD), 8:43 (describing analog-to-digital ("A/D") conversion process), 29:39 (same), Fig. 2 (ADC 210). A CCD is a digital sensor. JP-872, [0006] ("digital camera" comprising "CCD 3"), Fig. 1; Watanabe, Abstract, [0002], [0009], [0034], [0035] ("digital camera 100" with CCD 53), Fig. 1A (100) ; Laub, ¶¶117-119. Watanabe discloses a CCD that captures digital images. JP-872, [0006] (CCD 3, A/D converter 5), Fig. 1; Watanabe, [0035] (CCD

53, A/D converter 55), [0037] ("A/D converter converts analogue image data… to digital image data"), Fig. 1A; *supra* §VI.B.2.a; Laub, ¶136.

d. "a microprocessor, a [DSP]"

Watanabe's digital camera includes a CPU and digital signal processing circuit. JP-872, [0006] (CPU 7, circuit 6), Fig. 1; *see also* Watanabe, [0035], [0038], Fig. 1B (CPU 57, circuit 56). As discussed supra §IV.B, PO concedes that "a microprocessor is a CPU that controls the computing functions of the camera." EX1026, 154-155. Watanabe describes a CPU that controls computing functions of its camera. See Watanabe, [0042] ("CPU 57 controls operation of each part of the digital still camera"). Therefore, Watanabe describes a microprocessor. Furthermore, a microprocessor is an obvious implementation of a CPU. Laub, ¶¶137, 143. A DSP is a digital signal processing circuit. EX1002, 16; Laub, ¶¶138-143.

Watanabe leaves CPU and DSP implementation details to the POSA because it does not describe whether they are provided as discrete components or integrated in a system-on-chip ("SoC"). E.g., JP-872, Fig. 1 (functional block diagram showing DSP and CPU); Watanabe, Fig. 1B, Laub, ¶¶144-153.



JP-872, Fig. 1 (annotated).

e. "system software"

The specification describes "processing software" as "stored in either a microprocessor or an ASIC." EX1001, 21:67:22:1. POSAs would have understood the '339 patent as describing all processing intelligence in the claimed system as software, from software "stored in" a microprocessor or ASIC (*id.*; limitation [1.c] ("microprocessor uses system software")) to application layer programs (*id.*, 6:31-36, describing "Adobe Photoshop"). Laub, ¶¶154-156. POSAs would also have understood the '339 patent's reference to software as encompassing all layers of the Open Systems Interconnection ("OSI") stack because the '339 patent describes network and communication applications whose functionality is provided by software represented in the OSI stack. E.g., EX1001, Fig. 33, Fig. 35 ("DBMS in Distributed Network"), 6:62-7:9, 8:25-38, 24:37-40, 30:63-31:9; Laub, ¶157. Watanabe's image recording apparatus includes "in-

camera software" because it "stores programs" in read-only memory ("ROM"). JP-872, [0006], Fig. 1 (ROM8); Watanabe, [0039] ("ROM 58 stores programs"), [0042] ("control program stored in ROM 58"), Fig. 1B (ROM 58), Fig. 3 (image processing program 71); Laub, ¶158.

f. "a [DBMS]"

Watanabe describes a DBMS.

First, Watanabe describes using a database. It describes "tables 70 including distortion aberration correction values and peripheral light intensity correction values in accordance with focusing points and zoom positions" that "are prepared in advance on a lens-to-lens basis[.]" Watanabe, [0047], Fig. 3 ("correction value table 70"). Watanabe's "value table 20" is also "prepared" to correct distortion aberration and peripheral lighting "based on the focal length and zoom position for each lens[.]" JP-872, [0007]; Laub, ¶159. Watanabe's tables comprise a database. EX1022 ("Bestgen"), 2:8-12 ("a database may be viewed as one or more tables of information"); EX1023 ("Cesare"), 1:36-39 ("Data records in a computer database are maintained in tables, which are a collection of rows all having the same columns."); Laub, ¶¶159-163.

Second, Watanabe discloses "a control program stored in the ROM 58" that CPU 57 uses "to control each part" of the camera including "a correction process on image data." Watanabe, [0042]; *id.*, [0048] ("distortion aberration correction

process is executed according to distortion aberration information"), [0059] ("CPU 57… control[s] each part of the apparatus according to the image processing program"), Fig. 4 (step S104 image processing); Laub, ¶164. The "control program" comprises a DBMS at least because it is software that retrieves image correction data associated with lens-specific focusing points and zoom positions from the database (tables 70, table 20). Watanabe, [0042], [0047], [0049] ("a distortion aberration correction process is executed according to a lens type, a focusing point, and a zoom position"), Fig. 3; JP-872, [0007] ("image correction processing program 21 will cause… CPU 7 to determine the correction value table based on the lens type and adjust zoom position"); Laub, ¶165.

Regardless, POSAs would have understood the teaching of a DBMS as noted above to access the correction data in Watanabe's tables because such was routine for accessing a database and managing the manipulation/use of its contents. Laub, ¶166.

g. "memory storage sub-system"

Watanabe discloses a "memory storage sub-system." Read only memory ("ROM") 8 "stores programs and data," random access memory ("RAM") 9 "temporarily stores data," and "memory card 10 and built-in memory 19" store image data in "an image data file." JP-872, [0006], Fig. 1; *see also* Watanabe, [0035] (memory card 60, memory card interface 60a), [0042]; Laub, ¶¶167-168.

3. Limitation [1.b]

1.b	wherein the optical lens mechanism is a fixed focal length lens;

Limitation [1.b] further defines the "optical lens mechanism" as "a fixed focal length lens." Watanabe discloses or suggests [1.b] because fixed focal length lenses were well-known as interchangeable with zoom lenses as dictated by imaging conditions. A POSITA would recognize that cameras often substitute one lens assembly for another zoom to fixed, or vice versa, as conditions demand. Laub, ¶¶92-97; and ¶169(citing Exhibit 1077).

4. Limitations [1.c] and [1.d]

1.c	wherein a microprocessor uses system software to identify at least one optical aberration by accessing the database;
1.d	wherein the microprocessor uses the database to identify at least one algorithm to use to correct the at least one optical aberration;

In [1.c] "the database" has no antecedent basis. Limitation [1.a] recites a DBMS. The DBMS is software interfacing between an application and a database but is not itself a database. *Supra* §VI.B.2 ([1.a]). Regardless, Watanabe discloses a database (*id.*) and meets [1.c]-[1.d] as explained below.

Watanabe meets [1.c] and [1.d] because Watanabe's in-camera software adds "information relative to distortion aberration" and "peripheral light intensity"

(e.g., "at least one optical image aberration") to image data based on the lens used to capture the image. JP-872, [0007]; Watanabe, [0046]; Laub, ¶¶170-171.

Watanabe's CPU (*supra* §VI.B.2.d) runs software (*supra* §§,VI.B.2.e VI.E.2.f) that identifies an optical image aberration including a corresponding correction algorithm as in [1.d]. Laub, ¶ 171

A POSA would have understood that an "algorithm to use to correct the at least one optical aberration" includes a "specific sequence of operations" applied by the DSP. E.g., EX1069 ("Intratater"), 6:37-40; Laub, ¶¶172-176. Watanabe does not explain where the algorithms that its DSP applies are stored, leaving this detail to a POSITA.

A POSA would have understood that there were two known alternatives: (1) storing the algorithm(s)—as executable code—in the DSP, or (2) storing them in other memory or computer-readable medium and loading them into the DSP as needed. Laub, ¶174. It was known to select and load algorithms from memory to provide particular signal processing ("filtration") at the DSP. Laub, ¶172, 175 (discussing EX1069, EX1070 ("Kashida"), EX1072 ("Buchin"), EX1071 ("Reddig")). A design choice between two known implementations is obvious. *ACCO Brands Corp. v. Fellowes, Inc.*, 813 F.3d 1361, 1367 (Fed. Cir. 2016) (where POSA "would... be left with two design choices... [e]ach of these two design choices is an obvious combination").

A POSA would have understood to store or—at a minimum—identify the DSP filtration algorithm for a particular aberration correction in Watanabe's database in order to employ the stored parameters (for example as memory offset or look-up address in the database to the algorithm memory location). Laub, ¶¶175-176. Thus, Watanabe's IC would "obtain" the correction algorithm by accessing the database for information identifying the algorithm (or the algorithm itself) then "forward" the algorithm to the DSP so that it could apply the filter and correct the aberration. Laub, ¶176. The retrieval option frees the DSP from having to store every aberration correction algorithm used by the system in advance by loading them on an as-needed basis.

Because Watanabe's CPU identifies an optical image aberration including a corresponding correction algorithm as in [1.d], Watanabe therefore also identifies "at least one optical image aberration" as in [1.c]—by database lookup based on the lens type, focal length, and zoom position corresponding to the parameters when the image was taken. Watanabe, [0047] ("CPU determines a table according to a lens type and determines correction values according to a focusing point and a zoom position"); JP-872, [0007] ("image correction program 21 will cause CPU 7 to determine the correction value table based on the lens type and [] zoom position.… A correction value is determined based on the focal length[.]"); *supra*

§VI.B.2.f (discussing Watanabe's database); Laub, ¶¶170-171. This meets [1.c] and [1.d]. Laub, ¶¶170-171.

Watanabe's image processing program uses the identified corrections to correct the aberration by applying the correction values in accordance with a digital filtration algorithm. JP-872, [0007] ("[C]orrected image data 22 is obtained according to the correction value."); Watanabe, [0048] (similar); *infra* §VI.B.6.

5. Limitation [1.e]

1.e	wherein when the image file is captured by the digital sensor the digital file is forwarded to the [DSP];

Watanabe meets [1.e] because Watanabe's CCD captures images and forwards them to the DSP. JP-872, Fig. 1, [0006] (A/D converter 5 digitizes CCD image capture and passes signal to DSP circuit 6); Watanabe, Figs. 1A-1B, [0037]-[0038], [0061]-[0062] (steps 103, 203); *supra* §VI.B.2.c (CCD is "digital sensor"); Laub, ¶¶177-178.

6. Limitation [1.f]

1.f	wherein the image file with the at least one optical aberration is corrected by applying digital filtration by using at least one algorithm in the [DSP]; and

The term "image file" has no antecedent basis in claim 1. Irrespective, Watanabe's DSP corrects image files as described below. Watanabe applies "a correction process on image data" recorded in "an image data file" in memory.

Watanabe, [0042]; cf. id., [0039] (compressed image data stored as "image data files"). For example, as described *supra* §VI.B.5 with respect to limitation [1.e], Watanabe describes that when an image file captured by the digital sensor, a digital file is forwarded to the DSP.

Watanabe meets [1.f] because Watanabe's DSP corrects optical image aberrations in digital images by applying corrections from the database. JP-872, [0006] (DSP "performs various processing" on digitized input), [0007] (describing "distortion correction processing" and obtaining "corrected image data" for digital images "according to correction values" based on lens type, focal length, and zoom position), [0008], Fig. 4 (step 104); Watanabe, [0038] (DSP circuit 56 "executes various processes" including "correction" to "image data"), Figs. 1A-1B (DSP receives digitized image data under CPU 57 control), [0049] ("distortion aberration correction process is executed"), [0061]-[0062] (steps 103 and 203); Laub, ¶¶179-183. Watanabe's DSP processes the captured images and corrects distortion aberrations and peripheral light intensity, under CPU control in accordance with a correction process/algorithm. (Watanabe, [0042], [0059]-[0060], Figs. 1A-1B), using the correction data from the database table 70 as shown in Fig. 3. Laub, ¶184.

Watanabe teaches an "algorithm," as explained above for [1.d] *supra* §VI.B.4. The corrections that the DSP applies are "digital filtration" because they

numerically process the image data. EX1028, 193 ("digital filter" is "the computational process or algorithm by which a sampled signal or sequence of numbers (acting as an input) is transformed into a second sequence of numbers termed the output signal."); EX1001, 14:60, 15:8-10 (describing data interpolation as example of "digital filtration"), 31:55-32:11 (citing fast Fourier transform as an example of a "digital filtration process"); JP-872, [0008] ("image processing program… performs image processing on the image data"); Watanabe, [0048]-[0049], [0062]-[0063]; Laub, ¶¶98-105 and 185-187.

7. Limitation [1.g]

1.g	wherein the modified digital file consisting of the digital data optimized from the at least one optical aberration that are corrected from the original optical image is stored in memory.

Watanabe meets [1.g] because it discloses memory card 10 and memory card interface 10a storing processed image data ("modified digital file"). JP-872, [0006] ("CPU 7 controls the recording operation of image data to the memory card 10"), [0007] ("it is possible to record data that has been subjected to distortion aberration correction"), [0008] (step 206)]; *see also* Watanabe, Fig. 1B (memory card 60), Fig. 3 (corrected image data 72), [0058] (corrected image data "is recorded on the memory card 60"), [0063] (step 206); Laub, ¶188.

C. Claim 2

2.PRE	The system of claim 1:
2.a	wherein the optical aberrations include at least one of spherical, comatic, lens distortion, astigmatism, curvature of field, pin cushion, barrel distortion, chromatic aberrations, scattered light, red eye, dust and/or flare types of optical aberrations.

Watanabe meets [2.PRE] because it meets claim 1 as shown *supra* §VI.B.

Limitation [2.a] recites "optical aberrations include at least one of" particular aberrations joined by "and/or." The plural "optical aberration**s**" has no antecedent basis in claim 1, which recites a singular "optical image aberration" in [1.c], [1.d], [1.f], and [1.g]. A single aberration in claim 1 is consistent with a single aberration ("at least one") from the list in claim 2. Accordingly, a single "optical image aberration" from the list meets [2.a].

Watanabe meets [2.a] because it describes correcting "curvature aberration" (JP-872, [0007]) and lens distortion. Watanabe, [0006] (in "table look-up method… a ***lens distortion aberration rate*** is predetermined at each focusing point and zoom position"), [0049] (distortion aberration corrected for each lens type, focusing point, and zoom position); JP-872, [0002] ("lens distortion rate"), [0004] ("[d]istortion aberration correction processing based on lens type, focal length, and zoom position"); Laub, ¶¶191-192. Furthermore, it was known that "pin-cushion distortion" and "barrel distortion" are multiple types of optical distortions of lenses, Takane, [0005]; Laub, ¶361.

D. Claim 5

1. Limitations [5.PRE] and [5.a]

5.PRE	The system of claim 1:
5.a	wherein each lens type is registered in the camera database;

Watanabe meets claim 1 as shown *supra* §VI.B. POSAs would have understood that "registered in the camera database" meant that a database associated correction data ([5.c] "filtration solutions") with "each lens type." Laub, ¶¶193-197 (citing EX1058, Abstract; EX1023, 1:36-39). Watanabe meets [5.a] because its tables ("camera database") associate each lens type with correction data for a given focal length and zoom position. Watanabe, [0047] (tables 70); JP-872, [0007] (table 20); *supra* §VI.B.2 (limitation [1.a]); Laub, ¶199-201.

2. Limitation [5.b]

5.b	wherein the multiple optical aberrations of each lens is listed in the database;

Watanabe meets [5.b] because its tables ("the database") store corrections for curvature aberration, lens distortion, and vignetting ("multiple optical aberrations") for each lens used in the imaging system. *Supra* §VI.C (curvature aberration, lens distortion), *infra* §VII.C.1 (vignetting); Laub, ¶202. Furthermore,

it was known that "pin-cushion distortion" and "barrel distortion" are multiple types of optical distortions of lenses, Takane, [0005]; Laub, ¶361.

3. Limitation [5.c]

5.c	wherein the filtration solutions to the lens optical aberrations are listed in the database;

The "filtration solutions" are parameters for implementing the digital filter providing aberration correction in [1.d] and [1.f]. *Supra* §§VI.B.4 ([1.d]), VI.B.6 ([1.f]); Laub, ¶203-204. Watanabe meets [5.c] because its tables ("the database") store the corrections ("filtration solutions") for the lens optical aberrations. *Supra* §§VI.B.2 ([1.a]), VI.B.6 ([1.f]); Bestgen, 2:8-12 ("a database may be viewed as one or more tables of information"); Laub, ¶205. POSAs would also have understood that listing filter solutions to correct lens aberrations was a conventional use of a database for correcting lens optical aberrations. E.g., Vook,

[0023], [0035]; EX1025 ("Hoenninger"), 4:11-14 (database stores filter coefficients); Laub, ¶206.

4. Limitation [5.d]

5.d	wherein the filtration of each lens optical aberration is applied by the [DSP]; and

Watanabe meets [5.d] because its DSP applies corrections ("the filtration") for "each lens optical aberration." *Supra* §VI.B.6 (limitation [1.f]); Laub, ¶207.

5. Limitation [5.e]

5.e	wherein after the [DSP] applies the filtration to correct the optical aberrations the corrected digital file is forwarded to storage in memory.

Watanabe meets [5.e] for the same reason it meets limitation [1.g] *supra* §VI.B.7. Laub, ¶208.

E. Claim 14

1. Limitations [14.PRE] and [14.a]

Watanabe meets [14.PRE] and [14.a] for the same reasons Watanabe meets the corresponding limitations in claim 1. Laub, ¶¶ 71-97 and 210.

Limitation	Corresponding Limitation	Discussion
[14.PRE]	[1.PRE]	§VI.B.1
[14.a]	[1.a]	§VI.B.2

Watanabe meets the remaining limitations in claim 14 as follows.

2. Limitation [14.b]

14.b	wherein the optical lens mechanism is a zoom lens;

Watanabe discloses a zoom lens because it describes "zoom position" and correcting distortion "based on… zoom position for each lens." JP-872, [0007]; Watanabe, [0047], [0049], Fig. 3; Laub, ¶211. A "mechanical mechanism including an autofocus" moves the lens. JP-872, [0006], Fig. 1 (lens 1, "mechanical mechanism 2"); Watanabe, [0035] ("lens 51" and "mechanical structure 52" with autofocus), [0036] (lens unit), Fig. 1A (51, 52); Laub, ¶212. Therefore, Watanabe meets [1.b].

3. Limitation [14.c]

14.c	wherein the zoom lens changes focal length positions;

Watanabe meets [14.c] because it describes a zoom lens configured to change focal length position and teaches a zoom lens and a "mechanical mechanism including an autofocus" that moves the lens as explained for limitations [1.a] and [14.b]. *Supra* §§VI.B.2.b, VI.E.2; JP-872, [0007] (correcting distortion aberration and peripheral light intensity based on "focal length and zoom position for each lens"); Watanabe, [0049] (same for "focusing point and a zoom position"); Laub, ¶214-219.

4. Limitation [14.d]

14.d	wherein when the image file is captured by the digital sensor the file is forwarded to the [DSP] and to memory;

Watanabe meets [14.d] for the same reasons it meets [1.e]. *Supra* §VI.B.5; Laub, ¶¶220-231.

5. Limitation [14.e]

14.e	wherein the microprocessor uses system software to access the database to identify at least one optical aberration in the image file at any focal length of a zoom lens configuration;

Watanabe meets [14.e] because the in-camera software ("system software") accesses the database and identifying at least one optical aberration in an image based on lens, focal length, and zoom position as explained for limitations [1.c]-[1.d]. *Supra* §VI.B.4; Laub, ¶232. Watanabe discloses distortion aberration and peripheral light intensity corrections for different focal lengths of its zoom lens. JP-872, [0007] (correcting distortion aberration and peripheral light intensity based on "focal length and zoom position for each lens"); Watanabe, [0049] (same for "focusing point and a zoom position"); Laub, ¶¶233-234.

6. Limitation [14.f]

14.f	wherein the microprocessor accesses the database to obtain at least one filtration correction algorithm to the optical aberrations[2] and forwards the at least one filtration algorithms to the [DSP];

Watanabe meets "obtain at least one filtration correction algorithm" as in [14.f].

A POSA would have understood that a "filtration correction algorithm" includes a "specific sequence of operations" applied by the DSP. E.g., EX1069 ("Intratater"), 6:37-40; Laub, ¶¶235-239. Watanabe does not explain where the algorithms that its DSP applies are stored, leaving this detail to a POSITA.

A POSA would have understood that there were two known alternatives: (1) storing the algorithm(s)—as executable code—in the DSP, or (2) storing them in other memory or computer-readable medium and loading them into the DSP as needed. Laub, ¶174. It was known to select and load algorithms from memory to provide particular signal processing ("filtration") at the DSP. Laub, ¶172, 175 (discussing EX1069, EX1070 ("Kashida"), EX1072 ("Buchin"), EX1071 ("Reddig")). A design choice between two known implementations is obvious. *ACCO Brands Corp. v. Fellowes, Inc.*, 813 F.3d 1361, 1367 (Fed. Cir. 2016)

[2] "aberrations" (plural) has no antecedent basis in the claim.

(where POSA "would... be left with two design choices... [e]ach of these two design choices is an obvious combination").

A POSA would have understood to store or—at a minimum—identify the DSP filtration algorithm for a particular aberration correction in Watanabe's database in order to employ the stored parameters (for example as memory offset or look-up address in the database to the algorithm memory location). Laub, ¶235. Thus, Watanabe's IC would "obtain" the correction algorithm by accessing the database for information identifying the algorithm (or the algorithm itself) then "forward" the algorithm to the DSP so that it could apply the filter and correct the aberration. Laub, ¶235. The retrieval option frees the DSP from having to store every aberration correction algorithm used by the system in advance by loading them on an as-needed basis.

Watanabe further meets [14.f] because its CPU accesses tables 20 or 70 ("the database") to obtain distortion aberration and peripheral light intensity corrections for each lens, focal length, and zoom position ("at least one filtration correction algorithm to an optical image aberration") as explained *supra* §§ VI.B.2.f ([1.a]), VI.B.4([1.c]-[1.d]). Watanabe corrects distortion aberration or peripheral light intensity in digital images as explained *supra* §§VI.B.4 ([1.d]). Watanabe forwards the correction—including the "at least one filtration

algorithm[]" as explained above—to the DSP as explained *supra* §VI.B.4 ([1.d] DSP applies "digital filtration" based on corrections from database). Laub, ¶239.

7. Limitation [14.g]

14.g	wherein the image file is forwarded to the [DSP] which applies at least one filtration algorithm to optimize the image and corrects the at least one optical aberration at the specific focal length in the zoom lens configuration; and

Watanabe meets [14.g] because it teaches forwarding images to the DSP as explained for [1.e] *supra* §VI.B.5. Laub, ¶240.

Watanabe's DSP applies the distortion aberration and peripheral light intensity corrections to image files using "digital filtration" as explained *supra* §VI.B.6 (limitation [1.f]). Laub, ¶241. The DSP correction applies a "filtration algorithm" because Watanabe teaches a "filtration correction algorithm to the optical aberrations," as explained above for [14.f] *supra* §VI.E.6. Laub, ¶172, 238. The corrections are "at the specific focal length in the zoom lens configuration" because Watanabe describes selecting corrections based on lens, focal length, and zoom position. JP-872, [0007]; Watanabe, [0049]; Laub, ¶242.

8. Limitation [14.h]

14.h	wherein the modified image file consisting of the digital data optimized from the at least one optical aberration of a specific focal length of the zoom lens that are corrected from the original optical image is stored in memory.

Watanabe meets "wherein the modified image file consisting of the digital data optimized from the at least one optical aberration… that are corrected from the original optical image is stored in memory" for the same reasons it meets [1.g]. *Supra* §VI.B.7; Laub, ¶¶244-245. Watanabe's digital file is a digital image file. Watanabe, [0037]. The corrections are "at the specific focal length in the zoom lens configuration" because Watanabe describes selecting corrections based on lens, focal length, and zoom position. JP-872, [0007]; Watanabe, [0049]; Laub, ¶245. Therefore, Watanabe meets [14.h].

F. Claim 15

15.PRE	The system of claim 14:
15.a	wherein the optical aberrations include vignetting, spherical, comatic, lens distortion, chromatic aberrations, curvature of field, pin cushion, barrel distortion, scattered light, red eye, dust and/or flare types of optical aberrations.

Watanabe meets claim 14. *Supra* §VI.E. Watanabe meets [15.a] for the same reasons it meets [2.a] as explained *supra* §VI.C; Laub, ¶¶246-248. Watanabe further describes correcting "vignetting" [15.a] because Watanabe describes correcting peripheral light intensity (Watanabe, [0032], [0048]-[0049], Fig. 8), e.g.,

"correcting brightness of a peripheral portion of an image" (Watanabe, [0056]), which corrects vignetting. *Supra* §V.B.1 (claim construction); Laub, ¶249.

G. Claim 17

17.PRE	The system of claim 14:
17.a	wherein each focal length of a zoom lens is analyzed for a different set of optical aberrations.

Watanabe meets claim 14 (*supra* §VI.E). Limitation [17.a] recites "***each focal length of a zoom lens*** is analyzed for ***a different set of optical aberrations***." Aberrations associated with each focal length for a given zoom lens are a "different set of optical aberrations" because each focal length is associated with one or more aberrations. Laub, ¶252. Watanabe meets [17.a] because tables 20 and 70 (the database) contain correction data for optical aberrations at each focal length and zoom position for each lens type. *Supra* §§VI.B.2.f (limitation [1.a]), VI.I.5(limitation [14.e]); JP-872, [0007]; Watanabe, [0046]-[0049]; Laub, ¶¶251-253.

VII. GROUND 2: WATANABE IN VIEW OF KISHIDA RENDERS OBVIOUS CLAIMS 3, AND 18

A. Kishida

Kishida describes software for image processing to "[p]rovide an appropriate image by achieving both shading… and exposure correction[.]" Kishida, Abstract, [0020] (image processing techniques embodied in computer software). This solves

a problem with prior art methods that required "a huge amount of processing" to correcting image exposure after correcting shading. Kishida, [0008]; Laub, ¶¶254-260. Kishida describes an imaging system that optimizes exposure based on a prediction of shading that will occur in an image. Kishida, [0011]. Kishida's methodology reduces processing power requirements for exposure and shading correction. Kishida, [0012].

B. Watanabe in View of Kishida

Watanabe describes correcting peripheral lighting (e.g., shading or vignetting) in digital images but does not describe optimizing exposures, alone or in cooperation with shading corrections.

POSAs would have had reasons to use Kishida's exposure and shading correction teachings with Watanabe to improve Watanabe's image processing with autoexposure functionality. Laub, ¶¶261-263. Exposure optimization was a known imaging problem regardless of vignetting. Using Kishida's teachings in Watanabe would provide an imaging system that could correct exposure and vignetting problems while avoiding the known problems with processing requirements for prior approaches. Laub, ¶263.

POSAs would have had a reasonable expectation of success because Kishida implemented its techniques in software, [0020], which could be implemented in Watanabe's control program running on Watanabe's IC. The programming

implementing Kishida's teachings in Watanabe was within the POSA's ordinary skill and would produce predictable results. Laub, ¶¶264-265.

C. Claim 3

1. Limitations [3.PRE] and [3.a]

3.PRE	The system of claim 1:
3.a	wherein the optical aberration is vignetting;

Watanabe in View of Kishida meets claim 1 for the reasons Watanabe meets claim 1 (*supra* §VI.B). Watanabe+ Kishida meets [3.a] because Watanabe describes correcting peripheral light intensity (Watanabe, [0032], [0048]-[0049], Fig. 8), e.g., "correcting brightness of a peripheral portion of an image" (Watanabe, [0056]), which corrects vignetting. *Supra* §V.B.1 (claim construction); Laub, ¶¶267-268.

2. Limitation [3.b]

3.b	wherein the [DSP] applies neutral density filtration from one third of a stop to three stops in the center of the image and/or wherein the [DSP] applies an algorithm to lighten the corners of the image or the [DSP] applies both neutral density filtration in the image center and/or an algorithm to lighten the corners of the image; and

Watanabe+Kishida meets [3.b] because Watanabe's DSP "applies an algorithm to lighten the corners of images as follows. Watanabe explains that image brightness decreases from the center to a peripheral portion. Watanabe, [0024] ("Fig. 8… show[s] degradation of light intensity or a peripheral portion"),

[0054], Fig. 8; Laub, ¶¶269-274. Watanabe corrects "the light intensity of a peripheral portion of the image" by "correcting brightness… according to the cosine fourth law [a peripheral portion] so that may be substantially the same brightness of the center portion[.]" Watanabe, [0056]; Laub, ¶273. This applies an algorithm (the "cosine fourth law") to "lighten" the image's "peripheral portion," which includes "corners." Laub, ¶274.

3. Limitation [3.c]

3.c	wherein the image exposure is optimized to correct the vignetting.

Watanabe+Kishida meets [3.c] because Kishida describes "exposure correction control based on shading prediction." Kishida, [0010]; *id.*, [0015]; Laub, ¶¶275-277. Kishida's shading phenomenon is vignetting. Kishida, [0002]-[0003], [0017], [0070]; Laub, ¶256. Kishida's coordinated vignetting and exposure control optimizes the image exposure to correct vignetting. Laub, ¶277.

D. Claim 18

Watanabe in View of Kishida meets limitation [18.PRE] for the same reasons that Watanabe meets claim 14 (*supra* §VI.E). Watanabe+Kishida meets the remaining claim 18 limitations for the same reasons it meets the corresponding limitations in claim 3. Laub, ¶¶278-280.

Limitation	Corresponding Limitation	Discussion
[18.a]	[3.a]	§VII.C.1
[18.b]	[3.b]	§VII.C.2
[18.c]	[3.c]	§VII.C.3

VIII. GROUND 3: WATANABE IN VIEW OF KITA RENDERS OBVIOUS CLAIMS 4 AND 16

A. Kita

Kita describes correcting image aberrations from a lens by filtering in the spatial frequency domain, then recovering the image by transforming back to image space. Kita, Abstract, [0008]-[0010]; Laub, ¶281. Kita transforms images between image space and spatial frequency space using a fast Fourier transform (FFT) and its inverse. Kita, [0026]; Laub, ¶¶98-105 and 281-287. Kita restores the image (removes optical aberrations) by applying a filter representing the inverse of the lens modulation transfer function ("MTF"), which represents the filtering effect of the lens on a captured image. Kita, [0008]-[0010], [0012], [0027], [0041]; Laub, ¶286. The inverse MTF filter changes with the lens and optical system characteristics like zoom value, focus value, and iris value when the image is taken. Kita, [0011], [0014], [0016]-[0017], [0021], [0059], [0078]; Laub, ¶287.

B. Watanabe in View of Kita

Watanabe does not describe a detailed methodology for correcting optical aberrations other than vignetting. Kita provides detailed explanations for correcting optical aberrations using principles and techniques based on Fourier optics and inverse MTF filters for a lens under different "optical adjustment values" including zoom lens position and focus. Kita, [0059]; Laub, ¶¶98-105 and 288-289.

POSAs would have had reasons to apply Kita's filtering and image restoration teachings in Watanabe's system to implement Watanabe's aberration corrections (a detail left to POSITAs. Laub, ¶290. This combination would combine familiar techniques and components (Kita's image restoration with Watanabe's imaging and image processing system) yielding predictable results. Laub, ¶291; *KSR*, 550 U.S. at 416. POSAs would have had a reasonable expectation of success because Kita's techniques used software that could be implemented in Watanabe's system, and doing so was within the POSA's ordinary skill. Laub, ¶¶291-292. POSAs would have known that Kita's technique applied to Watanabe's digital image captures because Kita's technique applied to images. *Supra* §VI.B.4 ([1.c], [1.d]); Laub, ¶291.

C. Claims 4 and 16.

Watanabe+Kita meets the following limitations of claims 4 and 16 for the same reasons that Watanabe meets the independent claims:

Limitation	Independent Claim	Discussion
[4.PRE]	1	§VI.B
[16.PRE]	14	§VI.I

1. Limitations [4.a] and [16.a]

4.a	wherein the digital signal processor applies at least one fast Fourier transform (FFT) algorithm to correct the at least one optical aberration.

16.a	wherein the digital signal processor applies a fast Fourier transform (FFT) algorithm to correct optical and/or digital aberrations.

Limitations [4.a] recites the DSP "wherein the [DSP] applies at least one fast Fourier transform (FFT) algorithm" to correct "at least one optical aberration," while [16.a] recites an FFT to correct "optical and/or digital aberrations."

Watanabe+Kita meets [4.a] and [16.a] because Kita describes correcting optical image aberrations by transforming an image using FFT, applying an "MTF filter" comprising the inverse of the lens MTF, then recovering the original image—corrected for lens aberrations—by inverse FFT. Kita, [0027]; Laub, ¶¶98-105 and 293-297. The "MTF correction filtering" is performed "through an MTF inverse function table 87" with parameters determined from optical system settings

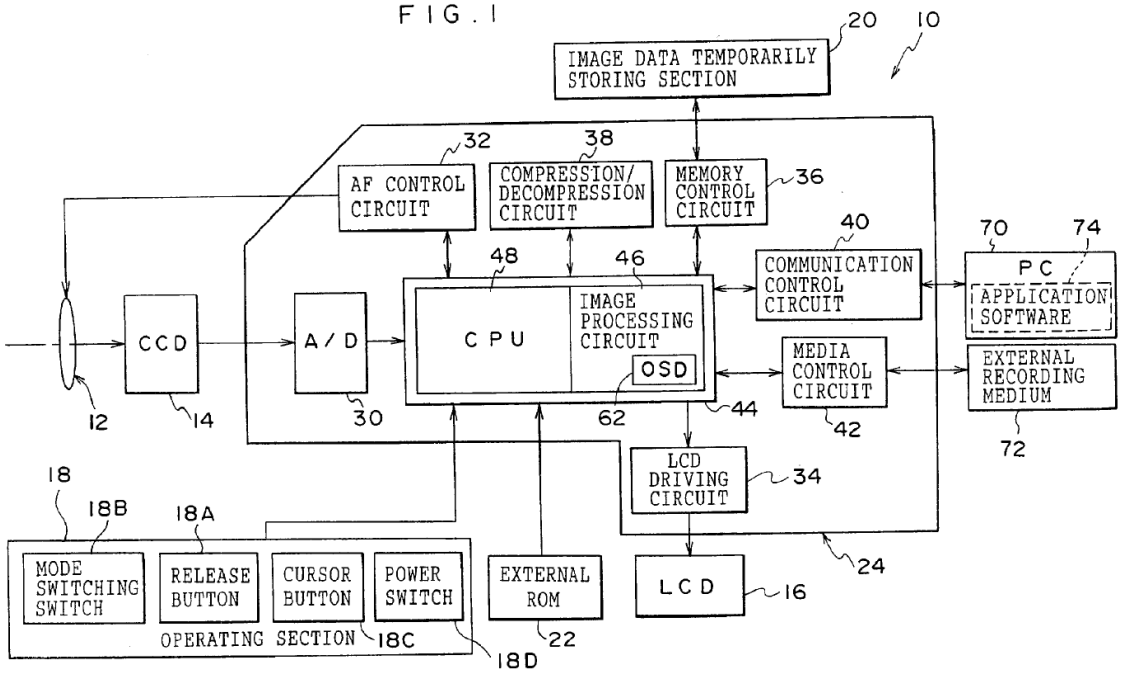
including zoom value, defocusing value, and iris parameters. Kita, [0059]-[0061]; Laub, ¶298. The MTF filter corrects for the optical aberrations introduced by the lens. Kita, Abstract (inverse function for MTF restores "original image"), [0011] ("restoration filtering" uses "a filter of the curve of the inverse function of the… transfer function depending on the optical adjustment values for the optics system."), [0027]; Laub, ¶299.

IX. GROUND 4: TAKANE IN VIEW OF WATANABE RENDERS OBVIOUS CLAIMS 1-2, 5, 14-15, AND 17

A. Takane in View of Watanabe

Takane describes a digital imaging system that captures images and provides image processing that corrects distortion. Takane, Abstract; Laub, ¶300-305. Takane's digital camera includes "external ROM 22 in which various programs, parameters, conversion tables and the like are stored in advance[.]" Takane, [0033], Figs. 1, 2.

Takane describes storing polynomial coefficients (hereinafter "correction parameters") that "approximate[] the amount of displacement of the optical distortion… in advance" in distortion correction circuits 56 and 58 of image processing circuit 46 (Fig. 1, below), which "correct the optical distortion" in image data "using these parameters." Takane, [0054]; (known to use optical distortion displacement polynomial inverse "as a correction formula"). Takane also stores correction parameters based on "image size." Takane, [0060].



While Takane explains that it was known to store parameters "for each focal length" of different lenses and to "carry[] out correction by selecting the parameters in accordance with the focal length at the time of photographing," Takane, [0008], Takane leaves the camera's data storage and retrieval techniques to the POSA. Laub, ¶¶306-307.

Watanabe discloses storing optical distortion correction parameters by lens, focal length, and zoom position in tables as explained *supra* §§VI.B.2.f ([1.a]), VI.B.4 ([1.d]). Watanabe's tables comprise a database. *Supra* §VI.B.2.f ([1.a]); Bestgen, 2:8-12; Cesare, 1:36-39; Laub, ¶308. Watanabe's control program retrieves image correction data associated with lens-specific focusing points and zoom positions from the database (tables 70, table 20), thus comprising a DBMS.

Supra §VI.B.2.f ([1.a]); Laub, ¶309. Watanabe's software provides the distortion correction parameters to the DSP to correct image distortions. *Supra* §VI.B.2.f ([1.a]); Laub, ¶309.

POSAs would have had several reasons to use Watanabe's database and DBMS teachings in order to achieve Takane's system by organizing distortion correction parameters by image size, lens, focal length, and zoom position in tables comprising a database, then identifying and retrieving parameters, and providing them to Takane's distortion correction circuits to correct distortion, because Watanabe demonstrates these techniques were conventional. Laub, ¶310. POSAs would have known that Watanabe's database techniques were compatible with Takane's description of storing correction parameters for each focal length (Takane, [0008]) and selecting parameters based on focal length at the time of image capture (Takane, [0060]). Laub, ¶311. Takane's criticism of tables storing corrections for each pixel or "coordinate" (Takane, [0007]) does not apply since this combination uses tables to store correction parameters rather than correction values for each pixel. Laub, ¶312.

Using Watanabe's database and DBMS teaching was within the POSA's ordinary skill and would have benefited Takane in the same manner as Watanabe. Laub, ¶¶313-314; *KSR*, 550 U.S. at 417. POSAs would have had a reasonable expectation of success because Watanabe demonstrates that storing correction

parameters in a database and DBMS software retrieving parameters from the database were conventional. Laub, ¶315.

In Takane+Watanabe, Takane is modified with the table teachings of Watanabe (database) to organize and store parameters for optical distortion correction for each image size, lens, focal length, and zoom position in Takane's ROM 22 for simplified and streamlined access. Laub, ¶316. Takane's software—a "control routine" (Takane, [0028]) and a "dynamic image photographing processing… sub-routine" (Takane, [0030])—retrieves parameters from the database and loads them into the distortion correction circuits based on the image size, lens, focal length, and zoom position at the time of image capture. Laub, ¶¶317-318.

B. Claim 1

1. Limitation [1.PRE]

1.PRE	A digital imaging system for correcting optical image aberrations comprising:

If [1.PRE] is limiting Takane+Watanabe meets it because Takane describes a digital photographing device that corrects optical distortion by digital signal processing on images captured by "dynamic image photographing in which continuous results of photographing by the CCD… are outputted." Takane, [0041]; *id.*, [0006], [0011], [0014], [0017]; Laub, ¶¶71-97 and 319-322. Takane corrects

optical image aberrations in a digital images as explained *infra* §§IX.B.2-IX.B.7 (limitations [1.a]-[1.g]).

2. Limitation [1.a]

1.a	a digital camera mechanism, an optical lens mechanism, a digital sensor, a microprocessor, a [DSP], system software, a [DBMS] and a memory storage sub-system;

Takane+Watanabe meets [1.a] as shown below.

a. "digital camera mechanism"

Takane describes a "digital camera mechanism" because it describes a "digital photographing device" that includes a "digital video camera." Takane, [0006], [0015], [0041]-[0042]; Laub, ¶¶323-325.

b. "optical lens mechanism"

Takane describes an "optical unit 12" that "is structured as a zoom lens whose focal length can be changed[.]" Takane, [0038]; limitation [1.b]; Laub, ¶¶326-328.

c. "digital sensor"

Takane captures images using a CCD, which it digitizes to provide digital image data. Takane, [0033], [0035], [0039], [0041]-[0042], [0044], Fig. 1 (CCD 14, A/D 30); EX1001, 2:43-52 (CCD is digital sensor); Laub, ¶329.

d. "a microprocessor, a [DSP]"

Takane's "main controlling section 24" is "structured as a one-chip LSI (large scale [IC])" that includes CPU 48 and image processing circuit 46, which further includes signal processing circuits 50, 52, 54 and distortion correction circuits 56, 58. Takane, [0036]; *id.*, [0035], Figs. 1 (control section 24, CPU 48, image processing circuit 46), Fig. 2 (image processing circuit 46 detail); Laub, ¶¶331-336. As discussed supra §IV.B, PO concedes that "a microprocessor is a CPU that controls the computing functions of the camera." EX1026, 154-155. Takane describes a CPU that controls functions of its digital camera. See, e.g., Takane [0028] ("a CPU of the digital camera"), [0035] ("CPU 48 serving as a control section"), [0072] ("CPU 48 governs the operations"). Therefore, Takane describes a microprocessor. Furthermore, a microprocessor is an obvious implementation of Takane's "main controlling section 24". Laub, ¶331, 336.

A DSP is a signal processing circuit. *Supra* §VI.B.2.d (Ground 1 limitation [1.a]); Laub, ¶332. Takane does not describe how distortion correction circuits 56 or 58 are implemented, leaving the decision to the POSA. Laub, ¶337. POSAs would have had reasons to use a DSP to implement circuits 50, 52, 54, 56, and 58, with a reasonable expectation of success, because DSPs were designed and routinely used for digital signal processing—including image processing—and Takane describes circuits 50, 52, 54, 56, and 58 as providing digital signal

processing. *Supra* §VI.B.2.d (Ground 1, [1.a], discussing DSP); Takane, [0043]-[0047], [0050], [0054]-[0059], [0078]; Laub, ¶¶338-339. POSAs would have understood that using a DSP for distortion correction in circuits 56 and 58 would at least advantageously provide greater flexibility for functions that are not repetitive and labor intensive (suggesting an ASIC). Thus, at least some functionality would be implemented as a DSP to leverage the programmability of the DSP to apply different signal processing. Laub, ¶¶339-344.

Thus, Takane's control section 24 and one or more DSPs implementing image processing circuit 46 meet the limitations reciting by [1.a]. Laub, ¶344.

e. "system software"

Takane's digital camera includes external ROM 22 that stores "programs… in advance[.]" Takane, [0033]. Takane's device executes a "control routine" that includes dynamic image (video) processing. Takane, [0028], [0030], [0073], [0100]-[0111], Fig. 3 (step 106), Fig. 5. The stored programs and the routines that Takane's camera executes are "system software" meeting [1.a]. Laub, ¶¶345-347.

f. "a [DBMS]"

In Takane+Watanabe, Takane's microprocessor executes software that accesses a database comprising tables with correction parameters that it provides to the DSP comprising distortion correction circuit 56. *Supra* §IX.A (discussing combination). The software accessing the database is a DBMS. *Id.*; *supra*

§VI.B.2.f (discussing DBMS); Laub, ¶351. The database contains parameters for correcting optical distortion. *Supra* §IX.A; *infra* §IX.B.4 ([1.d]); Laub, ¶352. Thus, Takane+Watanabe provides a "[DBMS]." Laub, ¶¶349-353.

g. "memory storage sub-system"

Takane describes "storing section 20" comprising SRAM or SDRAM, under control of memory control circuit 36. Takane, [0033], [0065], Figs. 1, 2; *see also id*., [0066] (media control circuit 42, external recording medium 72); Laub, ¶¶354-355.

3. Limitation [1.b]

1.b	wherein the optical lens mechanism is a fixed focal length lens;

Takane meets [1.b] because fixed focal length lenses were known as interchangeable with zoom lenses as dictated by imaging conditions. Laub, ¶356.

4. Limitations [1.c] and [1.d]

1.c	wherein a microprocessor uses system software to identify at least one optical aberration by accessing the database;
1.d	wherein the microprocessor uses the database to identify at least one algorithm to use to correct the at least one optical aberration;

Takane+Watanabe meets [1.c] and [1.d] because Takane's "main controlling section 24" is the microprocessor that includes CPU 48 and image processing circuit 46, with first distortion correction circuit 56. *Supra* §IX.B.2.d. Takane's microprocessor executes software (*supra* §IX.B.2.e ([1.a] "system software")) that

identifies "parameters which are peculiar to the predetermined image size… at the time of dynamic image photographing" that have been "stored for each of a plurality of predetermined focal distances." Takane, [0060]; *supra* §X.A (describing combination); Laub, ¶¶357-359. Takane's software selects "optimal parameters" for the focal length and lens at the time video is captured, then applies image processing to correct the optical distortion associated with the lens and focal length. Takane, [0060]; Laub, ¶¶360-361. This meets [1.c] because it identifies "at least one optical image aberration," e.g., the "pin-cushion" or "barrel" distortion that Takane describes as known to be correctable with its method (Takane, [0005], [0054]-[0059]), for the lens and focal length at video capture. Laub, ¶362.

Takane's image processing circuit 46, and first distortion correction circuit 56, "carries out predetermined digital signal processing" and corrects optical distortion on dynamic images, and thus on successive frames and "at least one frame" of the digital video comprising "dynamic images." Takane, [0043], [0100]-[0102], Fig. 3 (step 106), Fig. 5 (step 142); Laub, ¶363. Takane stores correction parameters "in advance" in first distortion correction circuit 56 based on the lens and focal length, then corrects optical distortion in digital video using the correction parameters, and therefore Takane's microprocessor also identifies "at

least one algorithm to use to correct the at least one optical aberration." Takane, [0054]; Laub, ¶¶364-374. This meets [1.d]. Laub, ¶374.

5. Limitation [1.e]

1.e	wherein when the image file is captured by the digital sensor the digital file is forwarded to the [DSP];

Takane+Watanabe meets [1.e] because Takane's CCD captures images. Takane, [0041]; Laub, ¶375. Takane's A/D converter digitizes the video and sends it to signal processing circuit 50, dynamic image signal processing circuit 52, and first distortion correction circuit 56, which comprise a DSP. *Supra* §IX.B.2.d ([1.a]), Takane, [0042]-[0045], [0053]. Figs. 1, 2; Laub, ¶375. This meets [1.e]. Laub, ¶376.

6. Limitation [1.f]

1.f	wherein the image file with the at least one optical aberration is corrected by applying digital filtration by using at least one algorithm in the [DSP]; and

Takane+Watanabe meets [1.f] because Takane's first distortion correction circuit 56 comprising a DSP (*supra* §IX.B.2.d ([1.a])) corrects optical distortion in the image data using the polynomial parameters (algorithm)relating to distortion based on the lens and focal length. Takane, [0054]-[0062], [0100]-[0102]; *supra* §IX.A (discussing combination); Laub, ¶377. Takane describes determining the image before correction using nearest-neighbor or bi-linear interpolation and a

multidimensional function parameterized by the coefficients associated with the lens focal length (Takane, [0056]-[0057]), then correcting optical distortion by "making the pixel data… into pixel data of the coordinates (x, y) in the image after correction." Takane, [0058]; Laub, ¶378. This process applies "digital filtration" meeting [1.f]. Laub, ¶¶379-381.

7. Limitation [1.g]

1.g	wherein the modified digital file consisting of the digital data optimized from the at least one optical aberration that are corrected from the original optical image is stored in memory.

Takane+Watanabe meets [1.g] because Takane stores corrected image data in storing section 20. Takane, [0065], [0102]; Laub, ¶382.

C. Claim 2

2.PRE	The system of claim 1:
2.a	wherein the optical aberrations include at least one of spherical, comatic, lens distortion, astigmatism, curvature of field, pin cushion, barrel distortion, chromatic aberrations, scattered light, red eye, dust and/or flare types of optical aberrations.

Takane+Watanabe meets claim 2 because Takane describes that the amount of pin-cushion and barrel distortion from lens refraction "is determined in accordance with a distance from the optical center." Takane, [0005]; Laub, ¶¶384-388. Takane corrects optical distortion based on "a polynomial which approximates the amount of displacement of the optical distortion." Takane,

[0054]-[0059]; Laub, ¶386. POSAs would have understood that Takane's optical distortion correction applies to pin-cushion and barrel distortion. Laub, ¶387.

D. Claim 5

1. Limitations [5.PRE] and [5.a]

5.PRE	The system of claim 1:
5.a	wherein each lens type is registered in the camera database;

Takane+Watanabe meets claim 1 as shown *supra* §IX.B. POSAs would have understood that "registered in the camera database" meant that a database associated correction data ([5.c] "filtration solutions") with "each lens type." Laub, ¶¶195-197 (citing EX1058, Abstract; EX1023, 1:36-39). Takane+Watanabe meets [5.a] because Watanabe's tables ("camera database") associate each lens type with correction data for a given focal length and zoom position. Watanabe, [0047] (tables 70); JP-872, [0007] (table 20); *supra* §IX.B.2 (limitation [1.a]); Laub, ¶¶390-391.

2. Limitation [5.b]

5.b	wherein the multiple optical aberrations of each lens is listed in the database;

Takane+Watanabe meets [5.b] because Watanabe's tables ("the database") store corrections for curvature aberration, lens distortion, and vignetting ("multiple

optical aberrations") for each lens used in the imaging system. *Supra* §IX.C (curvature aberration, lens distortion), *infra* §X.B.1 (vignetting); Laub, ¶392.

3. Limitation [5.c]

5.c	wherein the filtration solutions to the lens optical aberrations are listed in the database;

The "filtration solutions" are parameters for implementing the digital filter providing aberration correction in [1.d] and [1.f]. *Supra* §§VI.B.4 ([1.d]), VI.B.6 ([1.f]); Laub, ¶¶203-204. Takane+Watanabe meets [5.c] because its tables ("the database") store the corrections ("filtration solutions") for the lens optical aberrations. *Supra* §§VI.B.2 ([1.a]), VI.B.6 ([1.f]); Bestgen, 2:8-12 ("a database may be viewed as one or more tables of information"); Laub, ¶¶393. POSAs would also have understood that listing filter solutions to correct lens aberrations was a conventional use of a database for correcting lens optical aberrations. E.g., Vook, [0023], [0035]; EX1025 ("Hoenninger"), 4:11-14 (database stores filter coefficients); Laub, ¶206.

4. Limitation [5.d]

5.d	wherein the filtration of each lens optical aberration is applied by the [DSP]; and

Takane+Watanabe meets [5.d] because Watanabes' DSP applies corrections ("the filtration") for "each lens optical aberration." *Supra* §VI.B.6 (limitation [1.f]); Laub, ¶394.

5. Limitation [5.e]

5.e	wherein after the [DSP] applies the filtration to correct the optical aberrations the corrected digital file is forwarded to storage in memory.

Takane+Watanabe meets [5.e] for the same reason it meets limitation [1.g] *supra* §IX.B.7. Laub, ¶395.

E. Claim 14

1. Limitations [14.PRE] and [14.a]

Takane+Watanabe meets the following claim 14 limitations for the same reasons it meets the corresponding limitations in claim 1. Laub, ¶397.

Limitation	Corresponding Limitation	Discussion
[14.PRE]	[1.PRE]	X.B.1
[14.a]	[1.a]	X.B.2

Takane+Watanabe meets the remaining limitations in claim 14 as follows.

2. Limitation [14.b]

14.b	wherein the optical lens mechanism is a zoom lens;

Takane describes an "optical unit 12" that "is structured as a zoom lens whose focal length can be changed[.]" Takane, [0038]; limitation [1.b]; Laub, ¶¶398-399.

3. Limitation [14.c]

14.c	wherein the zoom lens changes focal length positions;

Takane+Watanabe meets [14.c] because Takane's "optical unit 12 is structured as a zoom lens whose focal length can be changed[.]" Takane, [0038]; *supra* §IX.B.2 ([1.a]); Laub, ¶400.

4. Limitation [14.d]

14.d	wherein when the image file is captured by the digital sensor the file is forwarded to the [DSP] and to memory;

Takane+Watanabe meets [14.d] because Takane forwards images from the A/D converter to image processing circuit 46 and the DSP comprising signal processing circuit 50, dynamic image signal processing circuit 52, and first distortion correction circuit 56. Takane, [0053], Fig. 2; *supra* §IX.B.2.d ([1.a] discussing DSP); Laub, ¶¶401-402.

5. Limitation [14.e]

14.e	wherein the microprocessor uses system software to access the database to identify at least one optical aberration in the image file at any focal length of a zoom lens configuration;

Takane+Watanabe meets [14.e] because the combination uses Takane's microprocessor to execute Takane's modified software to retrieve correction parameters from the database based on, *inter alia*, the lens and focal length of the zoom lens used at the time of image capture. *Supra* §§V.A.1 (construction), XIII.A (discussing combination), XIII.B.2.d ([1.a] discussing IC), XIII.B.2.a ([1.a] "in-camera software"), XIII.B.6 ([1.f]); Takane, [0054]-[0062], [0100]-[0102]; Laub, ¶403.

6. Limitation [14.f]

14.f	wherein the microprocessor accesses the database to obtain at least one filtration correction algorithm to the optical aberrations and forwards the at least one filtration algorithms to the [DSP];

Takane+Watanabe meets [14.f] because in the combination Takane's main controlling section 24—the microprocessor (*supra* §IX.B.2.d) —uses in-camera software (*supra* §IX.B.2.e) to access a database to obtain correction parameters associated with the lens and focal length at the time of image capture, which the microprocessor provides to the distortion correction circuit. *Supra* §§IX.A (discussing combination), X.B.2 ([1.a]), X.B.6 ([1.f]); Takane, [0054]-[0062],

[0100]-[0102]; Laub, ¶404. The correction parameters "express[] a polynomial which approximates the amount of displacement of the optical distortion." Takane, [0054]. Constructing this polynomial for each image size and focal length is an algorithm, as is digital filtration that uses that polynomial to interpolate pixel positions and correct distortion. Takane, [0054]-[0060]; Laub, ¶372. Providing the parameters thus provides and enables a filtration algorithm. Laub, ¶405.

7. Limitation [14.g]

14.g	wherein the image file is forwarded to the [DSP] which applies at least one filtration algorithm to optimize the image and corrects the at least one optical aberration at the specific focal length in the zoom lens configuration; and

Takane+Watanabe meets [14.g] because Takane forwards digital video to a first distortion correction circuit that comprises a DSP as explained as explained *supra* §§IX.B.5 ([1.e]), IX.E.4 ([14.d]). The distortion correction circuit corrects optical aberrations (including at least pin-cushion and barrel distortion) in digital video based on parameters associated with Takane's zoom lens and focal length when the image was taken. *Supra* §§IX.A (discussing combination), X.B.2 ([1.a]), X.B.6 ([1.f]); Takane, [0054]-[0062], [0100]-[0102]; Laub, ¶¶407-408.

8. Limitation [14.h]

14.h	wherein the modified image file consisting of the digital data optimized from the at least one optical aberration of a specific focal length of the zoom lens that are corrected from the original optical image is stored in memory.

Takane+Watanabe meets [14.h] because Takane stores corrected image data in storing section 20. Takane, [0065], [0102]; Laub, ¶409. The corrections are "at the specific focal length in the zoom lens configuration" because the distortion correction circuit corrects optical based on parameters associated with Takane's zoom lens and focal length when the image was taken. *Supra* §§IX.A (discussing combination), X.B.2 ([1.a]), X.B.6 ([1.f]); Takane, [0054]-[0062], [0100]-[0102]; Laub, ¶410.

F. Claim 15

15.PRE	The system of claim 14:
15.a	wherein the optical aberrations include vignetting, spherical, comatic, lens distortion, chromatic aberrations, curvature of field, pin cushion, barrel distortion, scattered light, red eye, dust and/or flare types of optical aberrations.

Takane+Watanabe meets [15.PRE] because it meets claim 14 (*supra* §IX.E) and it meets [15.a] for the same reasons it meets claim 2 (*supra* §IX.C). Laub, ¶411

G. Claim 17

17.PRE	The system of claim 14:
17.a	wherein each focal length of a zoom lens is analyzed for a different set of optical aberrations.

Takane+Watanabe meets [17.PRE] because it meets claim 14 (*supra* §IX.E) and it meets [17.a] because Takane uses a zoom lens (*supra* §IX.B.2.b ([1.a])) and Takane+Watanabe stores correction parameters for each lens focal length. Takane, [0008], [0038]-[0039], [0060], [0064]; *supra* §IX.A (combination); Laub, ¶412.

X. GROUND 6: TAKANE IN VIEW OF WATANABE IN FURTHER VIEW OF KISHIDA RENDERS OBVIOUS CLAIMS 3 AND 18

A. Takane and Watanabe in Further View of Kishida

Watanabe describes correcting peripheral lighting (e.g., shading or vignetting) in digital images but does not describe optimizing exposures, alone or in cooperation with shading corrections. Laub, ¶412

POSAs would have had reasons to apply Kishida's exposure and shading correction teachings in further view of Takane + Watanabe to improve Takane's exposure control functionality. Laub, ¶¶413-414. Takane describes exposure control using "shutter speed, diaphragm, and the like." Takane [0041], [0093], [0122]. Exposure optimization was a known imaging problem regardless of vignetting. Using Kishida's techniques would provide an imaging system that could correct exposure and vignetting problems while avoiding the known

problems with processing requirements for prior approaches. Laub, ¶415. Indeed, Takane describes that after a digital image is taken, "the CPU 48 proceeds" to "optical distortion correction processing." Takane, [0122]-[0123].

POSAs would have had a reasonable expectation of success because Kishida implemented its techniques in software, [0020], which could be included in Watanabe's control program running on Watanabe's IC. The programming implementing Kishida's teachings in Watanabe was within the POSA's ordinary skill and would produce predictable results. Laub, ¶416.

B. Claim 3

1. Limitations [3.PRE] and [3.a]

3.PRE	The system of claim 1:
3.a	wherein the optical aberration is vignetting;

Takane+Watanabe+Kishida meets claim 1 for the reasons Takane+Watanabe meets claim 1 (*supra* §IX.B). Takane+Watanabe+ Kishida meets [3.a] because Watanabe describes correcting peripheral light intensity (Watanabe, [0032], [0048]-[0049], Fig. 8), e.g., "correcting brightness of a peripheral portion of an image" (Watanabe, [0056]), which corrects vignetting. Laub, ¶418.

2. Limitation [3.b]

3.b	wherein the [DSP] applies neutral density filtration from one third of a stop to three stops in the center of the image and/or wherein the [DSP]

	applies an algorithm to lighten the corners of the image or the [DSP] applies both neutral density filtration in the image center and/or an algorithm to lighten the corners of the image; and

Takane+Watanabe+Kishida meets [3.b] because Watanabe's DSP "applies an algorithm to lighten the corners of images as follows. Watanabe explains that image brightness decreases from the center to a peripheral portion. Watanabe, [0024] ("Fig. 8… show[s] degradation of light intensity or a peripheral portion"), [0054], Fig. 8; Laub, ¶419. Watanabe corrects "the light intensity of a peripheral portion of the image" by "correcting brightness… according to the cosine fourth law [a peripheral portion] so that may be substantially the same brightness of the center portion[.]" Watanabe, [0056]; Laub, ¶420. This applies an algorithm (the "cosine fourth law") to "lighten" the image's "peripheral portion," which includes "corners." Laub, ¶421.

3. Limitation [3.c]

3.c	wherein the image exposure is optimized to correct the vignetting.

Takane+Watanabe+Kishida meets [3.c] because Kishida describes "exposure correction control based on shading prediction." Kishida, [0010]; *id.*, [0015]; Laub, ¶422. Kishida's shading phenomenon is vignetting. Kishida, [0002]-[0003], [0017], [0070]; Laub, ¶422. Kishida's coordinated vignetting and exposure control optimizes the image exposure to correct vignetting. Laub, ¶423.

C. Claim 18

Takane+Watanabe+Kishida meets the limitation [18.PRE] for the same reasons that Takane+Watanabe meets claim 14 (*supra* §IX.E). Takane+Watanabe+Kishida meets remaining claim 18 limitations for the reasons it meets the corresponding limitations in claim 3. Laub, ¶¶425-426.

Limitation	Corresponding Limitation	Discussion
[18.a]	[3.a]	§XI.B.1
[18.b]	[3.b]	§XI.B.2
[18.c]	[3.c]	§XI.B.3

XI. GROUND 6: TAKANE IN VIEW OF WATANABE IN FURTHER VIEW OF KITA RENDERS OBVIOUS CLAIMS 4 AND 16

A. Takane in View of Watanabe in View of Kita

Neither Takane nor Watanabe describe a detailed methodology for correcting their discussed optical aberrations other than vignetting. Kita provides detailed explanations for correcting optical aberrations using principles and techniques based on Fourier optics and inverse MTF filters for a lens under different "optical adjustment values" including zoom lens position and focus. Kita, [0059]; Laub, ¶427.

POSAs would have had reasons to use Kita's filtering, image restoration, and correction teachings in the Takane+Watanabe system to achieve Takane's aberration (distortion) corrections, or Takane's other "various types of

correction[s]" (*see, e.g.*, Takane, [0044], describing "white balance adjustment, gamma correction, sharpness correction"). Laub, ¶428. This combination would combine familiar techniques and components (Kita's image restoration with the Takane+Watanabe imaging and image processing system and various types of corrections) yielding predictable results. Laub, ¶¶; *KSR*, 550 U.S. at 416. POSAs would have had a reasonable expectation of success because Kita's techniques used software that could be implemented in the Takane+Watanabe system and doing so was within the POSA's ordinary skill. Laub, ¶429. POSAs would have known that Kita's technique applied to Takane's digital image data because Kita's technique applied to images. *Supra* §IX.B.4 ([1.c], [1.d]); Laub, ¶430.

B. Claims 4 and 16.

Takane+Watanabe+Kita meets the following limitations of claims 4, 8-9, and 16 for the same reasons that Watanabe meets the independent claims. Laub, ¶431.

Limitation	Independent Claim	Discussion
[4.PRE]	1	§X.B
[16.PRE]	14	§X.J

1. Limitations [4.a] and [16.a]

4.a	wherein the digital signal processor applies at least one fast Fourier transform (FFT) algorithm to correct the at least one optical aberration.

16.a	wherein the digital signal processor applies a fast Fourier transform (FFT) algorithm to correct optical and/or digital aberrations.

Limitations [4.a] recites the DSP "wherein the [DSP] applies at least one fast Fourier transform (FFT) algorithm" to correct "at least one optical aberration," while [16.a] recites an FFT to correct "optical and/or digital aberrations." Laub, ¶432.

Takane+Watanabe+Kita meets [4.a] and [16.a] because Kita describes correcting optical image aberrations by transforming an image using FFT, applying an "MTF filter" comprising the inverse of the lens MTF, then recovering the original image—corrected for lens aberrations—by inverse FFT. Kita, [0027]; Laub, ¶433. The "MTF correction filtering" is performed "through an MTF inverse function table 87" with parameters determined from optical system settings including zoom value, defocusing value, and iris parameters. Kita, [0059]-[0061]; Laub, ¶298. The MTF filter corrects for the optical aberrations introduced by the lens. Kita, Abstract (inverse function for MTF restores "original image"), [0011] ("restoration filtering" uses "a filter of the curve of the inverse function of the… transfer function depending on the optical adjustment values for the optics system."), [0027]; Laub, ¶299.

XII. NO BASIS FOR DISCRETIONARY DENIAL

A. *Fintiv*

1. Stay Potential

While Petitioner will seek pre-institution stay, without "specific evidence" how the court will rule this factor is neutral. *Sand Revolution II v. Continental Intermodal Group–Trucking*, IPR2019-01393, Paper 24, 7 (June 16, 2020) (informative).

2. Trial Timing

Petitioner filed this Petition before the district court has held an initial scheduling conference, so Factor 2 weighs against denial. *Apple Inc. v. Fintiv*, *Inc*., IPR2020-00019, Paper 11, 11 (Mar. 20, 2020) (precedential) ("expeditiously" filed petitions weigh against denial).

FWD can be expected in November 2025. Sony was served with the complaint on May 13. It has not answered or filed any motion (EX1038), and the court has not set a trial date. While the median-time-to-trial is 21.4 months (EX1039), Director's Interim Procedure ("IP") at 3, without accounting for such late service the median-time-to-trial analysis is inapplicable. This weighs against discretionary denial. IP, 9; *Sand Revolution II*, 9-10 ("relatively close proximity" of FWD and "scheduled trial date" weighs against discretionary denial).

3. Litigation Investment

PO filed a complaint, but Petitioner has not answered, filed any motion, and the court has not even held an initial scheduling conference. EX1038. This weighs against denial. *Samsung Elecs. v. Netlist*, IPR2022-00063, Paper 13, 8 (May 5, 2022) (instituting where no "claim construction and merits determinations" had occurred).

4. Issue Overlap

Sony challenges 10 claims, while in the Litigation PO only asserts claims 1 and 14. EX1037, ¶¶42-67. Challenging claims the district court will not address weighs against denial. *Markforged v. Continuous Composites*, IPR2022-00679, Paper 7, 32-33 (Oct. 25, 2022).

5. Litigation Defendants

Petitioner is a district court defendant, which "is far from an unusual circumstance." *Sand Revolution II*, Paper 24, 12-13. This factor is neutral.

6. Other Considerations

Ground 1 shows that a single reference renders claims 1-2, 5, 14-15, and 17 unpatentable. The Petition's "strong showing on the merits" (*supra* §§VI-XIII) weighs against denial. *Data Company v. Bright Data*, IPR2022-00138, Paper 12, 15-16 (May 11, 2022).

7. Compelling Evidence

If the Board finds Factors 1-5 favor denial then the Grounds provide "compelling evidence" of unpatentability. The Petition demonstrates the prior art

teaches the Challenged Claims—in some cases via a single reference—while dependent claims simply add well-known aberration types to the base claim. E.g., *supra* §VI.B (Ground 1). If unrebutted at trial the Grounds show at least one Challenged Claim is unpatentable, foreclosing discretionary denial under *Fintiv*. IP, 3-5; *Nokia v. TQ Delta,* IPR2022-00471, Paper 11, 19-21 (Aug. 18, 2022); *CommScope Techs. v. Dali Wireless*, IPR2022-01242, Paper 23, 4-5 (Dir. Feb. 27, 2023) (precedential). The prosecution was limited, including one action. By contrast, the Petition clearly demonstrates the unpatentability of claims 1-5 and 14-18. The Petition demonstrates that the prior art teaches the challenged claims in some cases via a single digital camera reference with only ancillary details cited in the secondary references. And that the dependent claim features added to the base claim are simply well-known aberration types. E.g., *supra* §§VI.B (claim 1), IX.B (same). The grounds present compelling evidence that forecloses discretionary denial under Fintiv.

B. Section 325(d) discretionary denial is unwarranted.

Discretionary denial is unwarranted because the Office never considered the patentability of Challenged Claims over Watanabe (Ground 1) or Watanabe in combination with any other reference (Grounds 2-4), failing *Advanced Bionics* step one. *Advanced Bionics, LLC v. Med-El Elektromedizinische Gerate GMBH*, IPR2019-01469, Paper 6, 8-10 (Feb. 13, 2020) (precedential). The Office has also

never considered the patentability of any Challenged Claim over Takane in combination with Watanabe (Ground 3), or any reference substantially similar thereto.

The Office has never considered the patentability of substantially the same prior art or arguments in any Ground in this petition. That ends the Advanced Bionics analysis and weighs against discretionary denial under Section 325(d).The Board does not need to reach step two.

XIII. CONCLUSION

The Board should institute review and cancel claims 1-5 and 14-18.

Respectfully submitted,
Sony Corporation

Date: May 20th 2024

By: /Scott A. McKeown/
Scott A. McKeown, Reg. No. 42,866
WOLF, GREENFIELD & SACKS, P.C.

APPENDIX A: U.S. PATENT NO. 7,612,339 CLAIM LIST

Ref	Limitation
1.PRE	A digital imaging system for correcting optical image aberrations comprising
1.a	a digital camera mechanism, an optical lens mechanism, a digital sensor, a microprocessor, a digital signal processor, system software, a database management system and a memory storage sub-system;
1.b	wherein the optical lens mechanism is a fixed focal length lens;
1.c	wherein a microprocessor uses system software to identify at least one optical aberration by accessing the database;
1.d	wherein the microprocessor uses the database to identify at least one algorithm to use to correct the at least one optical aberration;
1.e	wherein when the image file is captured by the digital sensor the digital file is forwarded to the digital signal processor;
1.f	wherein the image file with the at least one optical aberration is corrected by applying digital filtration by using at least one algorithm in the digital signal processor; and
1.g	wherein the modified digital file consisting of the digital data optimized from the at least one optical aberration that are corrected from the original optical image is stored in memory.
2.PRE	The system of claim 1:
2.a	wherein the optical aberrations include at least one of spherical, comatic, lens distortion, astigmatism, curvature of field, pin cushion, barrel distortion, chromatic aberrations, scattered light, red eye, dust and/or flare types of optical aberrations.
3.PRE	The system of claim 1:
3.a	wherein the optical aberration is vignetting;
3.b	wherein the digital signal processor applies neutral density filtration from one third of a stop to three stops in the center of the image and/or wherein the digital signal processor applies an algorithm to lighten the corners of the image or the digital signal processor applies both neutral density filtration in the image center and/or an algorithm to lighten the corners of the image; and
3.c	wherein the image exposure is optimized to correct the vignetting.
4.PRE	The system of claim 1:
4.a	wherein the digital signal processor applies at least one fast Fourier transform (FFT) algorithm to correct the at least one optical aberration.
5.PRE	The system of claim 1:
5.a	wherein each lens type is registered in the camera database;

Ref	Limitation
5.b	wherein the multiple optical aberrations of each lens is listed in the database;
5.c	wherein the filtration solutions to the lens optical aberrations are listed in the database;
5.d	wherein the filtration of each lens optical aberration is applied by the digital signal processor; and
5.e	wherein after the digital signal processor applies the filtration to correct the optical aberrations the corrected digital file is forwarded to storage in memory.
14.PRE	A digital imaging system for correcting image aberrations comprising:
14.a	a digital camera mechanism, an optical lens mechanism, a digital sensor, a microprocessor, a digital signal processor, system software, a database management system and a memory storage sub-system;
14.b	wherein the optical lens mechanism is a zoom lens;
14.c	wherein the zoom lens changes focal length positions;
14.d	wherein when the image file is captured by the digital sensor the file is forwarded to the digital signal processor and to memory;
14.e	wherein the microprocessor uses system software to access the database to identify at least one optical aberration in the image file at any focal length of a zoom lens configuration;
14.f	wherein the microprocessor accesses the database to obtain at least one filtration correction algorithm to the optical aberrations and forwards the at least one filtration algorithms to the digital signal processor;
14.g	wherein the image file is forwarded to the digital signal processor which applies at least one filtration algorithm to optimize the image and corrects the at least one optical aberration at the specific focal length in the zoom lens configuration; and
14.h	wherein the modified image file consisting of the digital data optimized from the at least one optical aberration of a specific focal length of the zoom lens that are corrected from the original optical image is stored in memory.
15.PRE	The system of claim 14:
15.a	wherein the optical aberrations include vignetting, spherical, comatic, lens distortion, chromatic aberrations, curvature of field, pin cushion, barrel distortion, scattered light, red eye, dust and/or flare types of optical aberrations.
16.PRE	The system of claim 14:

Ref	Limitation
16.a	wherein the digital signal processor applies a fast Fourier transform (FFT) algorithm to correct optical and/or digital aberrations.
17.PRE	The system of claim 14:
	wherein each focal length of a zoom lens is analyzed for a different set of optical aberrations.
18.PRE	The system of claim 14:
18.a	wherein the optical aberration is vignetting;
18.b	wherein the digital signal processor applies neutral density filtration from one third of a stop to three stops in the center of the image and/or wherein the digital signal processor applies an algorithm to lighten the corners of the image or the digital signal processor applies both neutral density filtration in the image center and/or an algorithm to lighten the corners of the image; and
18.c	wherein the image exposure is optimized to correct the vignetting.

CERTIFICATE OF SERVICE UNDER 37 C.F.R. § 42.6 (E)(4)

I certify that on May 20, 2024, I will cause a copy of the foregoing document, including any exhibits or appendices filed therewith, to be served via Overnight FedEx at the following correspondence address of record for the patent:

The Law Office of Michael J. Scheer
5531 Murietta Avenue
Sherman Oaks, CA 91401

Date: May 20, 2024

/MacAulay Rush/
MacAulay Rush
Paralegal
WOLF, GREENFIELD & SACKS, P.C.

CERTIFICATE OF WORD COUNT

Pursuant to 37 C.F.R. § 42.24, the undersigned certifies that the foregoing Petition for *Inter Partes* Review contains 12,236 words excluding a table of contents, a table of authorities, Mandatory Notices under § 42.8, a certificate of service or word count, or appendix of exhibits or claim listing. Petitioner has relied on the word count feature of the word processing system used to create this paper in making this certification.

Date: May 20, 2024

/MacAulay Rush/
MacAulay Rush
Paralegal
WOLF, GREENFIELD & SACKS, P.C.