IN THE UNITED STATES DISTRICT COURT
FOR THE DISTRICT OF DELAWARE

IMMERVISION, INC., Plaintiff, v. APPLE INC. Defendant.	C.A. No. 21-1484-MN-CJB
IMMERVISION, INC., Plaintiff, v. APPLE INC. Defendant.	C.A. No. 21-1570-MN-CJB
IMMERVISION, INC., Plaintiff, v. APPLE INC. Defendant.	C.A. No. 21-1733-MN-CJB

DEFENDANT APPLE INC.'S INVALIDITY CONTENTIONS

Pursuant to the June 21, 2022, Agreed Scheduling Order (21-1484-MN-CJB D.I. 26, 21-1570-MN-CJB D.I. 21, 21-1733-MN-CJB D.I. 40), Defendant Apple Inc. ("Apple") provides the following contentions regarding the invalidity of U.S. Patent Nos. 6,844,990 ("the '990 Patent") and 10,795,120 ("the '120 Patent"). Apple's Invalidity Contentions ("Invalidity Contentions")

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address the patents and asserted claims identified in Plaintiff ImmerVision, Inc.'s ("ImmerVision") Infringement Contentions of November 1, 2022.

Apple's Invalidity Contentions reflect its knowledge and contentions as of this date in the present action. The disclosures are based upon the knowledge, information and/or belief presently available to Apple. Apple's search for prior art is ongoing, and Apple reserves the right to modify and supplement its Invalidity Contentions, as permitted by this Court and any applicable Court order, rule, or statute, including in the event that additional prior art is identified during the course of discovery and/or in response to any amendment by ImmerVision of its Infringement Contentions. In particular, Apple reserves its right to serve Final Invalidity Contentions at the time directed by the Agreed Scheduling Order. Further, as noted in Exhibits A1–B4, at least portions of Apple's Invalidity Contentions are based on ImmerVision's interpretation of the asserted claims, as set forth in ImmerVision's November 1, 2022, Initial Infringement Contentions. To the extent ImmerVision later modifies its interpretation of the asserted claims, Apple reserves the right to supplement its Invalidity Contentions accordingly. As of this date in the present action, the Court has not issued any order on claim construction and Apple does not concede any claim construction based on these Invalidity Contentions.

Each of the asserted claims of the '990 and '120 Patents is anticipated by and/or obvious in view of the items of prior art identified in Exhibits A1–B4 hereto, alone or in combination, as set forth in those Exhibits. Much of the art identified in the attached Exhibits reflect common knowledge and the state of the art at the time of filing of the '990 and '120 Patents. Specific examples of anticipation and obviousness, along with the motivation to combine the selected prior art, are set forth below. The Asserted patents are also invalid for failing to meet the statutory requirements of 35 U.S.C. Sections 101 and 112, as set forth below.

I. IDENTIFICATION OF PRIOR ART

A. Prior Art Patents and Applications

Apple contends that the prior art patents and applications listed below anticipate and/or render obvious the asserted claims of the ’990 Patent under pre-AIA 35 U.S.C. §§ 102(a), (b), and/or (e) and/or 35 U.S.C. § 103, or provide information relating to the background state of the art at the time the ’990 Patent was allegedly conceived. In addition, Apple refers to the prior art patents and applications cited in any petition filed before the Patent Trial and Appeal Board relating to the ’990 Patent (or any patent claiming common priority therewith), including, IPR2014-01438, IPR2020-00179, and IPR2020-00195, to the extent they are not listed below.

Patent Number	Inventor(s)	Exemplary Priority Date	Beg Bates
EP 1 028 389	Shiota	8/16/2000	APL-IMV_00002109
JP 2000-221391 Translation	Nagaoka	8/11/2000	APL-IMV_00002215
JP 2000-221391	Nagaoka	8/11/2000	APL-IMV_00002224
JP 2000-242773 Translation	Matsui	9/8/2000	APL-IMV_00002234
JP 2000-242773	Matsui	9/8/2000	APL-IMV_00002252
JP 2001-091825 Translation	Baker	4/6/2001	APL-IMV_00002260
JP 2001-091825	Baker	4/6/2001	APL-IMV_00002276
JP 3062735 Translation	Tada	7/12/2000	APL-IMV_00002292
JP 3062735	Tada	7/12/2000	APL-IMV_00002300
JP 3485261 Translation	Baker	1/13/2004	APL-IMV_00002311
JP 3485261	Baker	1/13/2004	APL-IMV_00002327
JP 3810106 Translation	Yamanashi	8/16/2006	APL-IMV_00002343
JP 3810106	Yamanashi	8/16/2006	APL-IMV_00002354
JPH02-248910 Translation	Murata	10/4/1990	APL-IMV_00002393
JPH02-248910	Murata	10/4/1990	APL-IMV_00002395
JPH08-313804 Translation	Yamanashi	11/29/1996	APL-IMV_00002399
JPH08-313804	Yamanashi	11/29/1996	APL-IMV_00002412

Patent Number	Inventor(s)	Exemplary Priority Date	Beg Bates
JPH10-115778 Translation	Tada	5/6/1998	APL-IMV_00002432
JPH10-115778	Tada	5/6/1998	APL-IMV_00002440
JPH10-325923 Translation	Sato	12/8/1998	APL-IMV_00002451
JPH10-325923	Sato	12/8/1998	APL-IMV_00002460
JPS56-121010 Translation	Nakagawa	9/22/1981	APL-IMV_00002480
JPS56-121010	Nakagawa	9/22/1981	APL-IMV_00002482
US 2,247,068	Richter	6/24/1941	APL-IMV_00002578
US 3,552,820	Brachvogel	1/5/1971	APL-IMV_00002582
US 3,953,111	Fisher	4/27/1976	APL-IMV_00002586
US 5,185,667	Zimmerman	2/9/1993	APL-IMV_00002595
US 5,396,583	Chen	3/7/1995	APL-IMV_00002606
US 5,508,734	Baker	4/16/1996	APL-IMV_00002622
US 5,686,957	Baker	11/11/1997	APL-IMV_00002641
US 5,694,531	Golin	12/2/1997	APL-IMV_00002659
US 5,808,808	Yamanashi	9/15/1998	APL-IMV_00002671
US 5,861,999	Tada	1/19/1999	APL-IMV_00002701
US 5,870,135	Glatt	2/9/1999	APL-IMV_00002718
US 6,128,145	Nagaoka	10/3/2000	APL-IMV_00002729
US RE43,490	Gullichsen	6/26/2012	APL-IMV_00002744

To the extent that any of the patents and applications listed above describe systems, apparatuses, or methods that were implemented, built, used, or reduced to tangible form, Apple reserves the right to rely upon such systems, apparatuses, or methods as independent bases for prior art. Citations to disclosures within these prior art patents and applications should be construed to also comprise citations to the corresponding functionality in the relevant system, apparatus, or method.

Apple contends that the prior art patents and applications listed below anticipate and/or render obvious the asserted claims of ’120 Patent under pre-AIA 35 U.S.C. §§ 102(a), (b), and/or (e) and/or 35 U.S.C. § 103, or provide information relating to the background state of the art at the time the ’120 Patent was allegedly conceived. In addition, Apple refers to the prior art patents and applications cited in any petition filed before the Patent Trial and Appeal Board relating to the ’120 Patent (or any patent claiming common priority therewith), to the extent they are not listed below.

Patent Number	Inventor(s)	Exemplary Priority Date	Beg Bates
JP 2010-054646 Translation	Hagiwara	3/11/2010	APL-IMV_00001134
JP 2010-054646	Hagiwara	3/11/2010	APL-IMV_00001154
JP 2011-102863 Translation	Sato	5/26/2011	APL-IMV_00001178
JP 2011-102863	Sato	5/26/2011	APL-IMV_00001191
JP 2015-212822 Translation	Sato	11/26/2015	APL-IMV_00001213
JP 2015-212822	Sato	11/26/2015	APL-IMV_00001267
JP 5247307 Translation	Hagiwara	7/24/2013	APL-IMV_00001309
JP 5247307	Hagiwara	7/24/2013	APL-IMV_00001318
JP 5434496 Translation	Sato	3/5/2014	APL-IMV_00001341
JP 5434496	Sato	3/5/2014	APL-IMV_00001354
JP WO2009/041382 Translation	Matsusaka	4/2/2009	APL-IMV_00001377
JP WO2009/041382	Matsusaka	4/2/2009	APL-IMV_00001407
KR 10-0677055 Translation	Hyun	2/2/2007	APL-IMV_00001510
KR 10-0677055	Hyun	2/2/2007	APL-IMV_00001525
US 2010/0194853	Matsusaka	8/5/2010	APL-IMV_00001563
US 2011/109974	Sato	5/12/2011	APL-IMV_00001669
US 2012/0314296	Shabtay	12/13/2012	APL-IMV_00001719
US 6,333,826	Charles	12/25/2001	APL-IMV_00002792
US 8,488,258	Shabtay	7/16/2013	APL-IMV_00001740

To the extent that any of the patents and applications listed above describe systems, apparatuses, or methods that were implemented, built, used, or reduced to tangible form, Apple reserves the right to rely upon such systems, apparatuses, or methods as independent bases for prior art. Citations to disclosures within these prior art patents or applications should be construed to also comprise citations to the corresponding functionality in the relevant system, apparatus, or method.

B. Prior Art Publications

Apple contends that the prior art publications listed below anticipate and/or render obvious the asserted claims of the '990 Patent under pre-AIA 35 U.S.C. §§ 102(a) and (b) and/or 35 U.S.C. § 103, or provide disclosures regarding the state of the art.

Publication Title	Author(s)	Date	Beg Bates
A New Approach for Nonlinear Distortion Correction in Endoscopic Images Based on Least Squares Estimation	Asari	April 1999	APL-IMV_00001760
Anamorphic Image Processing	Yelick	May 1980	APL-IMV_00001770
Cinema Projection Distortion	Petrozzo	11/20/1999	APL-IMV_00001826
Cognitive Space in the Interactive Movie Map: An Investigation of Spatial Learning in Virtual Environments	Mohl	1/29/1982	APL-IMV_00001839
Converting Panoramas to Circular Images and Vice Versa - Without a Computer	Charles	3/24/1998	APL-IMV_00002071
Creating Image-Based VR Using a Self-Calibrating Fisheye Lens	Xiong	1997	APL-IMV_00002088
Design of an anamorphic fisheye lens	Rolland	1998	APL-IMV_00002095
Dynamic Registration Correction in Video-Based Augmented Reality Systems	Bajura	September 1995	APL-IMV_00002100

Publication Title	Author(s)	Date	Beg Bates
Fisheye Lenses	Bettonvil	January 2005	APL-IMV_00002119
Fundamentals of Optics, An Introduction for Beginners	Jenny	2/1/2001	APL-IMV_00002126
Gap Light Analyzer (GLA) Users Manual and Program Documentation, Version 2.0	Frazer	1999	APL-IMV_00002145
Image Distortion from Zoom Lenses : Modeling and Digital Correction	Rebiai	7/7/1992	APL-IMV_00002185
In-Flight Aerial Camera Calibration from Photography of Linear Features	Fryer	December 1989	APL-IMV_00002189
Interactive Viewing of Panoramic Images	Basu	1997	APL-IMV_00002193
Intrinsic Parameter Claibration Procedure for a (High-Distortion) Fish-Eye Lens Camera with Distortion Model and Accuracy Estimation	Shah	1996	APL-IMV_00002201
Kinoptik Camera Lens Catalog		1/1/1980	APL-IMV_00002485
Lens Correction and Distortion	Bourke	April 2002	APL-IMV_00002489
Lenses of Extremely Wide Angle for Airplane Mapping	Gardner	May 1948	APL-IMV_00002501
New Generation Lens Systems for the Wild Aviophot Aerial Camera System	Hildebrand	August 1983	APL-IMV_00002512
Nonlinear Distortion Correction in Endoscopic Video Images	Zhang	2000	APL-IMV_00002521
Nonmetric Calibration of Wide-Angle Lenses and Polycameras	Swaminathan	October 2000	APL-IMV_00002525
Nonparametric, Model-Based Radial Lens Distortion Correction Using Tilted Camera Assumption	Perš	March 2002	APL-IMV_00002532
Omnidirectional Video Camera	Nayar	May 1997	APL-IMV_00002543

Publication Title	Author(s)	Date	Beg Bates
Proceedings of SPIE, Fisheye lens designs and their relative performance	Kumler	10/24/2000	APL-IMV_00002550
QuickTime VR - An Image-Based Approach to Virtual Environment Navigation	Chen	1995	APL-IMV_00002561
Segmentation, Tracking and Interpretation Using Panoramic Video	Nicolescu	2000	APL-IMV_00002571
Volpi Peri-Apollar 360°		January 1983	APL-IMV_00002763
Wide-Angle Image Forming Systems	Barany	3/28/1957	APL-IMV_00002767

To the extent that any of the publications listed above describe systems, apparatuses, or methods that were implemented, built, used, or reduced to tangible form, Apple reserves the right to rely upon such systems, apparatuses, or methods as independent bases for prior art. Citations to disclosures within these prior art publications should be construed to also comprise citations to the corresponding functionality in the relevant system, apparatus, or method.

Apple contends that the prior art publications listed below anticipate and/or render obvious the asserted claims of the ’120 Patent under pre-AIA 35 U.S.C. §§ 102(a), (b), or (g) and/or 35 U.S.C. § 103, or provide disclosures regarding the state of the art.

Publication Title	Author(s)	Date	Beg Bates
Consumer Electronics Optics: How small a lens can be? The case of panomorph lenses	Thibault	9/25/2014	APL-IMV_00001125
Design, Fabrication and Test of Minature Plastic Panomorph Lenses with 180° Field of View	Thibault	June 2014	APL-IMV_00001132
Proceedings of SPIE, Design, fabrication and test of miniature plastic panomorph lenses with 180° field of view.pdf	Thibault	12/17/2014	APL-IMV_00001535

Publication Title	Author(s)	Date	Beg Bates
Proceedings of SPIE, Development of new family of wide-angle anamorphic lens with controlled distortion profile.pdf	Gauvin	2005	APL-IMV_00001546
SPIE, Innovative lens improves imaging for surveillance systems.pdf	Thibault	8/19/2006	APL-IMV_00001559

To the extent that any of the publications listed above describe systems, apparatuses, or methods that were implemented, built, used, or reduced to tangible form, Apple reserves the right to rely upon such systems, apparatuses, or methods as independent bases for prior art. Citations to disclosures within these prior art publications should be construed to also comprise citations to the corresponding functionality in the relevant system, apparatus, or method.

C. Prior Art Public Uses/Sales/Offers for Sale

Apple contends that the following prior art anticipates and/or renders obvious the asserted claims of the ’990 Patent under pre-AIA 35 U.S.C. §§ 102(a), (b), and/or (g) and/or 35 U.S.C. § 103, or provide information relating to the background state of the art at the time the ’990 Patent were allegedly conceived. Apple further contends that publications about each system also independently qualify as prior art under 35 U.S.C. §§ 102(a) and/or (b), and the publications alone or collectively render obvious the ’990 Patent under 35 U.S.C. § 103. Publications and other documents about each system are identified below, and if obtained will be made available for inspection.

- Volpi Per-Appollar 360° Lens; and
- Wild RC 10 Universal Film Camera.

Apple contends that the following prior art anticipates and/or renders obvious the asserted claims of the ’120 Patent under pre-AIA 35 U.S.C. §§ 102(a), (b), and/or (g), and/or 35 U.S.C. § 103, or provide information relating to the background state of the art at the time the ’120 Patent

was allegedly conceived. Apple further contends that publications about each system also independently qualify as prior art under 35 U.S.C. §§ 102(a) and/or (b), and the publications alone or collectively render obvious the ’120 Patent under 35 U.S.C. § 103. Publications and other documents about each system are identified below, and if obtained will be made available for inspection.

- Samsung Galaxy S6 (front-facing camera); and
- LG V10 (front-facing camera).

For the public uses, sales, and offers for sale identified above, Apple’s investigation regarding (a) the properties and details of each of these lens systems; (b) the identities of the individuals who knew about and/or were involved in the making, first public use, offer for sale and/or sale of these systems; (c) the exact date that these systems were first made, first publicly used, offered for sale and/or sold; and (d) the dates of conception and reduction to practice of these systems and when these systems were first known or used by others, is ongoing. Apple expects that its continued investigation will reveal that the public uses, sales, and offers for sale identified above anticipate or render invalid as obvious the asserted claims of the ’990 and/or ’120 Patents. Apple expressly reserves the right to supplement these Invalidity Contentions according to the additional information it expects to learn during fact discovery about the public uses, sales, and offers for sale identified above.

In the course of its investigation, Apple may identify additional prior art documents describing these systems that may also anticipate and/or render obvious the asserted patents as invalidating printed publications. Apple’s citations herein to certain documents describing any one of these systems are not intended to limit the documents, actions, or evidence Apple may rely on to prove the operation of such systems, but rather to provide notice of the features or functionalities of the systems relied upon. Apple expressly reserves the right to rely on any documents, evidence,

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testimony, or tangible articles regarding the above-referenced systems that may be produced or received during discovery.

II. ANTICIPATION AND OBVIOUSNESS

As set forth in more detail herein, the asserted claims of the ’990 and ’120 Patents are each anticipated by and/or obvious in view of the prior art identified in Exhibits A1–B4 hereto, and the background knowledge and ordinary creativity of a person of ordinary skill in the art at the time of the alleged inventions of the ’990 and ’120 Patents.

Claims lack “novelty” (i.e., claims are unpatentable as anticipated) when “a skilled artisan would ‘reasonably understand or infer’ from a prior art reference that every claim limitation is disclosed in that single reference.” 35 U.S.C. § 102; *Acoustic Tech., Inc. v. Itron Networked Sols., Inc.*, 949 F.3d 1366, 1373 (Fed. Cir. 2020) (quoting *Akamai Techs., Inc. v. Cable & Wireless Internet Servs., Inc.*, 344 F.3d 1186, 1192 (Fed. Cir. 2003). Claims are obvious, and therefore unpatentable, where “the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains.” 35 U.S.C. § 103.

In *KSR Int’l Co. v. Teleflex Inc.*, the U.S. Supreme Court noted that the obviousness analysis must also allow for consideration of “the inferences and creative steps that a person of ordinary skill in the art would employ.” 550 U.S. 398, 418 (2007). The U.S. Supreme Court mandated that the obviousness analysis allow for “common sense” and “ordinary creativity” without necessarily requiring “precise teachings directed to the specific subject matter of the challenged claim[s].” *Id.* According to the U.S. Supreme Court, “[t]he combination of familiar elements according to known methods is likely to be obvious when it does no more than yield predictable results.” *Id.* at 416. The U.S. Supreme Court also pointed out that “common sense

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directs one to look with care at a patent application that claims as innovation the combination of two known devices according to their established functions, [and] it can be important to identify a reason that would have prompted a person of ordinary skill in the relevant field to combine the elements in the way the claimed new invention does." *Id.* at 418.

To the extent that applicable law requires evidence of motivation to combine, motivation exists to combine the references included in these Invalidity Contentions with each other. Generally, motivation to combine any of these references with others exists within the references themselves, as well as within the knowledge of those of ordinary skill in the art at the relevant time. Apple further contends that motivation to combine exists for all of the following categories of references:

- References which describe the same project or system;
- References written by or created by the same author(s) or inventor(s) regarding the same or related subject matter;
- References which specifically incorporate or refer to the teachings of another reference; and
- References addressing the same problem or seeking to reach the same objective—e.g., creating user or device identifiers in order to authorize software upgrades.

Exhibits A1–B4 provide exemplary citations for specific motivations to combine particular references or particular classes, groups, or types of references.

As set forth in Exhibits A1–B4, the asserted claims of '990 and '120 Patents are anticipated or obvious over (a) the individual references described therein, taken alone; (b) the individual references described therein, in view of the background knowledge held by a person having ordinary skill in the art; and (c) the combinations of references disclosed therein. Apple may rely upon a subset of the references or all of the references depending upon the Court's claim construction and Apple's further investigation. Apple's contentions that the references in Exhibits

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A1–B4, respectively, in the disclosed combinations, render the asserted claims of ’990 and ’120 Patents obvious under 35 U.S.C. § 103 are in no way an admission or suggestion that each reference does not independently anticipate the asserted claims under 35 U.S.C. § 102.

III. PRIOR ART CHARTS

As set forth above, each of the asserted claims of the ’990 and ’120 Patents is anticipated by and/or obvious in view of one or more of items of prior art identified above. Apple has attached charts identifying the prior art that it contends anticipates and/or renders obvious the asserted claims of the ’990 and ’120 Patents as follows:

- Exhibits A1–A5 provide Apple’s theories regarding how the references illustrated above anticipate or render obvious all asserted claims of the ’990 Patent; and
- Exhibits B1–B4 provide Apple’s theories regarding how the references illustrated above anticipate or render obvious all asserted claims of the ’120 Patent.

The Court has not yet construed the asserted claims and, thus, has not determined whether the preambles of any of these claims are limiting. Apple’s statements herein should not be construed as taking a position as to whether the claim preambles are limiting. Apple reserves the right to take such a position at a later time, such as during claim construction. For the sake of completeness, however, where asserted claims include substantive limitations within their preambles, Apple has addressed the preambles in its Invalidity Charts.

Each chart identifies by citation the disclosures within the prior art references that teach the relevant claim elements, limitations, and/or rationale supporting the combinations. Any physical embodiments of the patents or publications described in the Invalidity Charts that were publicly available during the relevant time period also constitute prior art, and citations to a patent or publication are intended to encompass citations to any physical embodiment of the disclosure of that patent or publication. While Apple has identified citations in the references for the claim limitations, each and every disclosure of the same limitation in the same reference is not

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necessarily identified. In an effort to focus the issues, Apple cites only the portions of the references that it presently deems most relevant, even when a reference may contain additional support for or disclosure of a particular claim element.

Where Apple cites a particular figure in a prior art reference, the citation should be understood to encompass any text referring or relating to that figure, in addition to the figure itself. Conversely, where a cited portion of text refers to a figure, the citation should be understood to include the figure as well.

Persons of ordinary skill in the art read a prior art reference as a whole, and in the context of other publications and literature. Apple may rely on portions of a charted reference that are not specifically cited at a later time to explain, clarify, or support its contentions regarding the disclosures of that reference. Apple may rely on portions of the prior art references that are not specifically cited, other publications, and expert testimony to provide context, and as aids to understanding and interpreting the portions of references that are cited. Apple may also rely on portions of the prior art references that are not specifically cited, other publications, and the testimony of experts to establish that a person of ordinary skill in the art would have been motivated to modify or combine certain of the cited references so as to render the claims obvious.

In addition, as set forth below, Apple contends that certain limitations of the asserted claims either lack written description or are not enabled by any disclosure in the ’990 and ’120 Patents. Apple’s citations to certain portions of a prior art reference as disclosing a claim limitation for obviousness purposes is not a concession that a disclosure in the ’990 and ’120 Patents with an equivalent level of detail did or would suffice to enable that element to a person of ordinary skill in the art. As an initial matter, a reference that anticipates the asserted claims of any of the ’990 and ’120 Patents is presumed to be enabled regardless of whether an equivalent disclosure in the asserted patent would have qualified as enabling. Further, most of the prior art references cited by

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Apple provide a more detailed disclosure than is present in the ’990 and ’120 Patents, and, therefore, such references are enabling while the disclosures of ’990 and ’120 Patents are not. For the remaining references, the citations in Exhibits A1–B4 show that, to the extent ImmerVision contends that the disclosures of the ’990 and ’120 Patents are enabling, the disclosures of the prior art are equally or more detailed and are therefore enabling as well.

IV. INELIGIBLE SUBJECT MATTER

The asserted claims of the ’990 and ’120 Patents are each directed to patent-ineligible subject matter because each such claim is directed to an abstract idea and does not contain an inventive concept that amounts to substantially more than a claim directed to the abstract idea itself. The claims are thus invalid under 35 U.S.C. § 101 and the two-step test set forth in *Alice Corp. v. CLS Bank Int’l*, 573 U.S. 208, 217–18 (2014).

’990 Patent

At *Alice* step one, at least asserted claims 27, 2, 4, 29, and 30 of the ’990 Patent are directed to a method of using a mathematical formula to correct the distortion in a panoramic image. The Federal Circuit has repeatedly held claims directed to “use of an abstract mathematical formula on any general purpose computer,” “a purely conventional computer implementation of a mathematical formula,” or “generalized steps to be performed on a computer using conventional computer activity,” are abstract. *Enfish, LLC v. Microsoft Corp.*, 822 F.3d 1327, 1338 (Fed. Cir. 2016); *see also SAP Am., Inc. v. InvestPic, LLC*, 898 F.3d 1161, 1167 (Fed. Cir. 2018) (“selecting certain information, analyzing it using mathematical techniques, and reporting or displaying the results of the analysis” is “all abstract”). Additionally, the Federal Circuit has held certain claims generally directed to enhancing photographic images to be directed to an abstract idea. *See Yu v. Apple Inc.*, 1 F.4th 1040, 1043 (Fed. Cir. 2021) (“claim 1 is directed to the abstract idea of taking

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two pictures (which may be at different exposures) and using one picture to enhance the other in some way").

Although the '990 Patent couches its claims in terms of certain structural elements of the lens systems, the focus of the claimed inventions confirms that the claims are in fact directed to unpatentable abstract ideas. In determining whether claims are directed to unpatentable subject matter, the Federal Circuit often looks to the specification to determine "the focus of the claimed advance over the prior art." *Chamberlain Grp., Inc. v. Techtronic Indus. Co.*, 935 F.3d 1341, 1346 (Fed. Cir. 2019). Here, the '990 specification admits that its advance relates to the mathematical formula for distortion correction: "The present invention also relates to a method for displaying an initial panoramic image obtained in accordance with the method described above, comprising a step of correcting the non-linearity of the initial image, performed by means of a reciprocal function of the non-linear distribution function of the objective lens or by means of the non-linear distribution function." '990 Pat., 4:49–55; *see also id.* at 10:18–21 ("This second aspect of the present invention is implemented at the stage of the processing of the initial image by computer, to present an interactive panoramic image on a screen.").

At *Alice* step two, none of the distortion-correction claims add any element or combination of elements beyond "well-understood, routine, conventional activit[ies] previously known to the industry." *Alice*, 573 U.S. at 225 (quotation omitted). Rather, the claims merely recite conventional hardware components that are generically and functionally claimed, such as a "panoramic objective lens" and an "image sensor." '990 Pat., cl. 27. Indeed, the patents admit that "[t]he means for implementing the method of the present invention are shown in FIG. 10 and are classical in themselves." '990 Pat., 10:21–23.

The only allegedly inventive aspect of the claims—the distortion correction by means of the non-linear distribution function—is the unpatentable abstract idea itself, which cannot provide

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an inventive concept as a matter of law. Simply put, any alleged "advance lies entirely in the realm of abstract ideas," which is insufficient under *Alice* step two. *SAP Am., Inc. v. InvestPic, LLC*, 898 F.3d 1161, 1163 (Fed. Cir. 2018). Because the claims fail both steps of the *Alice* test, they are ineligible for patenting and thus invalid under § 101.

'120 Patent

The asserted claims of the '120 Patent are patent-ineligible because they are directed to a law of nature and/or an abstract idea—namely, the interaction between different optical properties of a lens, including magnification or resolution and relative illumination and/or modulation transfer function ("MTF"). The claims recite generic camera hardware components, including "a light-receiving first surface" and "a focal plane." '120 Pat., cl. 1. The claims do not specify how the properties (i.e., relative illumination or MTF) are measured or affected. Nor are the claims limited to a particular way of adjusting these properties; instead, they allow either a "***lower or higher*** object to image magnification" to "compensate, at least in part, for a lower image quality due to at least one of a drop of relative illumination or a drop of MTF." '120 Pat., cl. 1 (emphasis added).

Beyond the correlation between image magnification and other image properties, the asserted claims refer only to admittedly conventional and generic components operating in conventional ways. Further, the recited claims are purely functional and directed entirely to a desired result—compensating for relative illumination or MTF—without claiming or reciting any specific technical solution for achieving that result.

Finally, there is nothing in the claims of the '120 Patent that converts the claims on a natural law or abstract idea to something patent eligible. As noted above, every element recited in the '120 Patent operates and communicates exactly as lens systems were known to, and in fact did, do in conventional operation at the time of the '120 Patent. The only part of the '120 Patent that is

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claimed to be unconventional is adjusting the magnification to, in turn, impact other image properties. Because this is simply a restatement of the abstract idea, it cannot save the claims of the ’120 Patent from ineligibility.

V. INDEFINITENESS

Apple contends that the asserted claims of the ’990 and ’120 Patents that are set forth below are invalid under 35 U.S.C. § 112 as indefinite because they do not apprise, with reasonable certainty, a person of ordinary skill in the art at the time of the claimed invention of the scope of the claims. Where Apple identifies an independent claim within its disclosures, that identification should be taken to include a contention that all claims depending from that independent claim are also indefinite. For completeness, in the Invalidity Charts, Apple has attempted to identify the disclosures that most closely correspond to ImmerVision’s apparent reading of those elements of the asserted claims that Apple contends are indefinite. Apple’s identification of these disclosures corresponding to these limitations reflects Apple’s best efforts to ascertain what ImmerVision asserts that these limitations could possibly mean. This identification is not an admission that these elements are definite or that their metes and bounds could reasonably have been ascertained by a person of ordinary skill in the art.

The asserted claims of the ’990 Patent are invalid as indefinite because they contain at least the following limitations:

- “optical means for projecting a panorama into an image plane of the objective lens” (cl. 17);
- “an image point distribution function that is not linear relative to the field angle of object points” (cl. 17);
- “substantially expanded zone” and “substantially compressed zone” (cl. 17, 27); and
- “performed by retrieving image points on the obtained image in a coordinate system of center O’ using at least the non-linear distribution function and a size L of the obtained image” (cl. 27).

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The asserted claims of the ’120 Patent are invalid as indefinite because they contain at least the following limitation:

- “a non-linear targeted resolution to intentionally create a zone in an image captured by the miniature wide-angle optical apparatus with a lower or higher object to image magnification compared to linear targeted resolution” (cl. 1); and
- “the lower or higher object to image magnification being used to compensate, at least in part, for a lower image quality due to at least one of a drop of relative illumination or a drop of MTF in a zone of the image” (cl. 1).

VI. LACK OF ENABLEMENT

Apple contends that the asserted claims of the ’990 and ’120 Patents that are set forth below are invalid under 35 U.S.C. § 112, ¶ 1 because the specifications do not enable a person of ordinary skill in the art to practice the claims without undue experimentation. In particular, the specifications of the ’990 and ’120 Patents do not enable the full scope that ImmerVision has asserted those claims to have in its Infringement Contentions.

The asserted claims of the ’990 Patent are invalid for lack of enablement because the specification does not teach a person of ordinary skill in the art to practice the following limitations, combined as set forth in the claim, without undue experimentation:

- “the distribution function having a maximum divergence of at least ±10% compared to a linear distribution function, such that a panoramic image obtained by means of the objective lens comprises at least one substantially expanded zone and at least one substantially compressed zone” (cl. 17);
- “the distribution function having a maximum divergence of at least +/-0% compared to a linear distribution function, such that the panoramic image obtained has at least one substantially expanded zone and at least one substantially compressed zone” (cl. 27);
- “wherein the lens compresses the center of the image and the edges of the image, and expands an intermediate zone of the image located between the center and the edges of the image” (cl. 21); and
- “performed by retrieving image points on the obtained image in a coordinate system of center O’ using at least the non-linear distribution function and a size L of the obtained image” (cl. 27).

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The asserted claims of the ’120 Patent are invalid for lack of enablement because specification does not teach a person of ordinary skill in the art to practice the following limitations, combined as set forth in the claim, without undue experimentation:

- “a miniaturization ratio with a value less than 3.0” (cl. 1);
- “a non-linear targeted resolution to intentionally create a zone in an image captured by the miniature wide-angle optical apparatus with a lower or higher object to image magnification compared to linear targeted resolution, the lower or higher object to image magnification being used to compensate, at least in part, for a lower image quality due to at least one of a drop of relative illumination or a drop of MTF in a zone of the image” (cl. 1);
- “an angle of chief-rays reaching the focal plane is over 20° from an optical axis of the optical apparatus” (cl. 4); and
- “the miniaturization ratio value is less than 2.0” (cl. 7).

VII. LACK OF WRITTEN DESCRIPTION

Apple contends that the asserted claims of the ’990 and ’120 Patents that are set forth below are invalid under 35 U.S.C. § 112, ¶ 1 because the specifications of those patents do not describe the claimed alleged invention in sufficient detail that one skilled in the art can reasonably conclude that the named inventor had possession of the claimed alleged invention, based on ImmerVision’s apparent interpretation of those claims, as reflected in its November 1, 2022, Infringement Contentions.

The asserted claims of the ’990 Patent are for lack of written description because the specification does not describe an optical apparatus that embodies the following limitations, in combination with the other requirements of the claims, in a manner sufficient to convey that the inventors possessed the claimed invention:

- “the distribution function having a maximum divergence of at least ±10% compared to a linear distribution function, such that a panoramic image obtained by means of the objective lens comprises at least one substantially expanded zone and at least one substantially compressed zone” (cl. 17);

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- "the distribution function having a maximum divergence of at least +/-0% compared to a linear distribution function, such that the panoramic image obtained has at least one substantially expanded zone and at least one substantially compressed zone" (cl. 27);

- "wherein the lens compresses the center of the image and the edges of the image, and expands an intermediate zone of the image located between the center and the edges of the image" (cl. 21);

- "displaying the obtained panoramic image by correcting the non-linearity of the initial image, performed by retrieving image points on the obtained image in a coordinate system of center O' using at least the non-linear distribution function and a size L of the obtained image" (cl. 27);

- "wherein the objective lens expands the edges of the image and compresses the center of the image" (cl. 4); and

- "wherein the set of lenses forming an apodizer comprises at least one aspherical lens" (cl. 30).

The asserted claims of the '120 Patent are invalid for lack of written description because the specification does not describe an optical apparatus that embodies the following limitations, in combination with the other requirements of the claims, in a manner sufficient to convey that the inventors possessed the claimed invention:

- "a non-linear targeted resolution to intentionally create a zone in an image captured by the miniature wide-angle optical apparatus with a lower or higher object to image magnification compared to linear targeted resolution, the lower or higher object to image magnification being used to compensate, at least in part, for a lower image quality due to at least one of a drop of relative illumination or a drop of MTF in a zone of the image" (cl. 1); and

- "the miniaturization ratio value is less than 2.0" (cl. 7) .

VIII. DOCUMENT PRODUCTION

Pursuant to the Court's Scheduling Order, Apple is producing herewith the following documents:

- <u>All prior art referenced in Apple's invalidity contentions</u>: These documents have been produced at production numbers APL-IMV_00001125 through APL-IMV_00002859.

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CERTIFICATE OF SERVICE

I, Jennifer M. Hartjes, hereby certify that on December 8, 2022, true and correct copies of the within document were served on the following counsel of record at the addresses and in the manner indicated:

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Exhibit B1 – Invalidity of ’120 Patent in view of Kim

Korean Patent No. KR100677055 B1 (“Kim”), titled “Small Superwide Angle Optical System,” was published on February 2, 2007. Kim qualifies as prior art under at least AIA 35 U.S.C. §§ 102(a). Claims 1, 4, 5, and 7 of the ’120 Patent are invalid as anticipated by Kim or obvious over Kim in view of the background knowledge of a person of ordinary skill in the art or the references cited herein.

Kim—alone or in view of the background knowledge of a person of ordinary skill in the art—renders the asserted claims invalid based on ImmerVision’s interpretation of the claims, as set forth in its November 1, 2022, Initial Infringement Contentions. To the extent ImmerVision later modifies its interpretation of the asserted claims, Apple reserves the right to supplement its invalidity contentions accordingly.

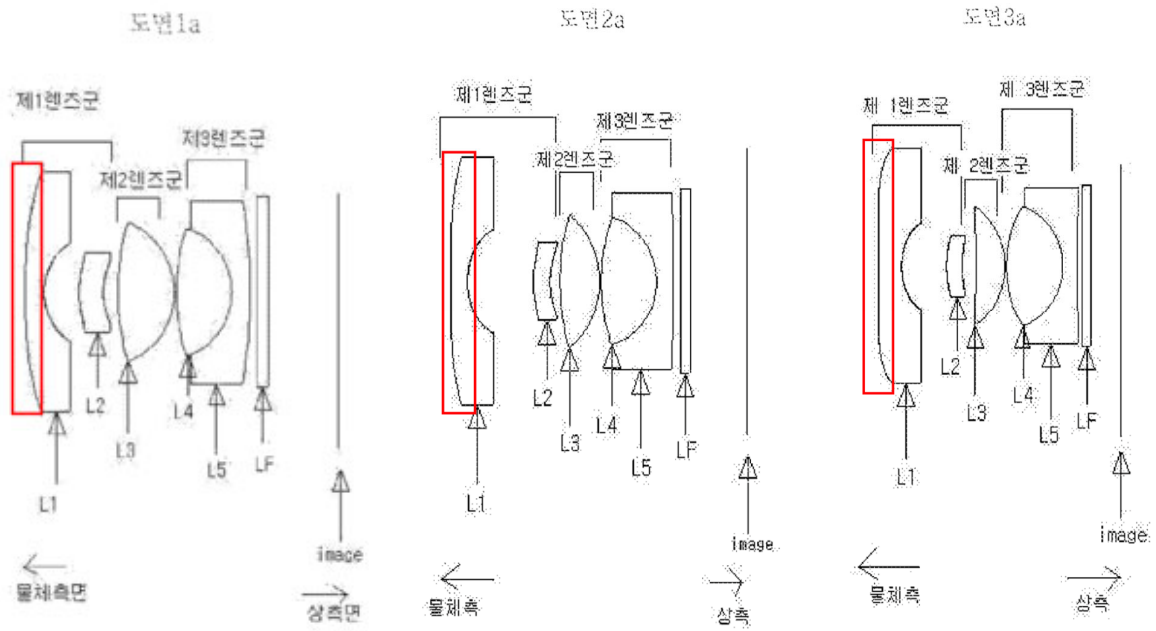
Additional documents cited herein include:

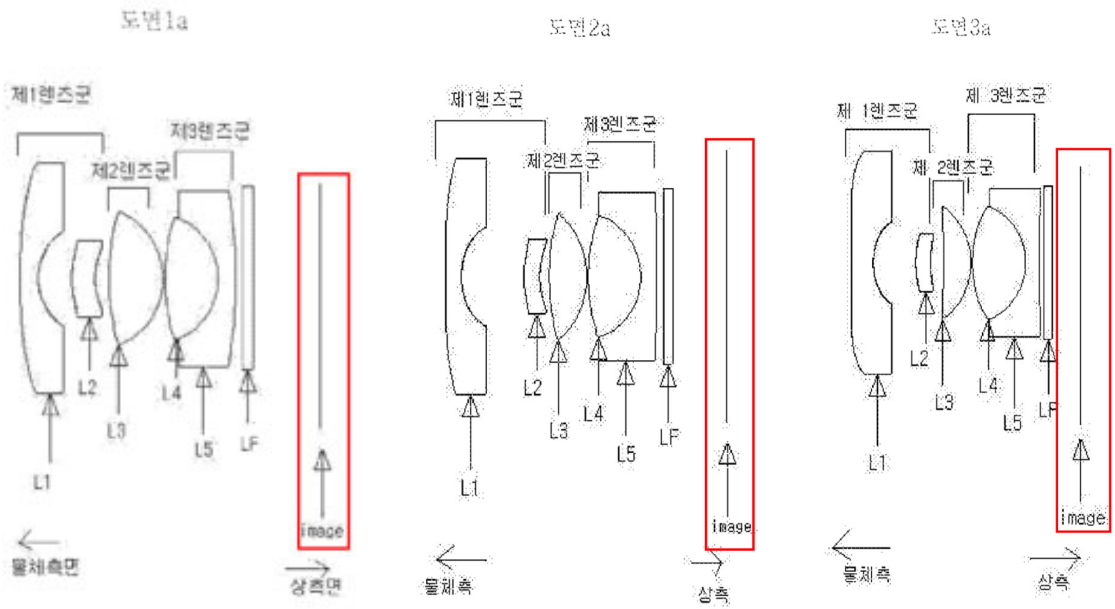
- U.S. Patent No. 6,333,826, titled “Omniramic Optical System Having Central Coverage Means Which is Associated with a Camera, Projector, or Similar Article,” issued on December 25, 2001 (APL-IMV_00002792–APL-IMV_00002859) (“Charles”); and
- U.S. Patent No. 8,488,258, titled “Enhanced Depth of Field Based on Uniform Relative Illumination via Lens with Large Distortion,” issued on July 16, 2013 (APL-IMV_00001740–APL-IMV_00001759) (“Shabtay”).

Claim	Korean Patent No. KR100677055B1 (Kim)[1]
[1] A miniature wide-angle optical apparatus comprising:	Kim discloses a miniature wide-angle optical apparatus. ***A small super-wide angle optical system is provided to secure a super-wide angle range and a short total*** *length by positioning a first lens group with strong negative refractive force in the front side of an iris.* ***A small super-wide angle optical system*** *is composed of a first lens group having a first lens(L1) having the negative refractive force and a second lens(L2) having the positive or negative refractive force, which are disposed in order from an object, and having the negative refractive force in general; a second lens group having a third lens(L3) having the positive refractive force; a third lens group comprising having a fourth lens(L4) having the positive refractive force and a*

[1] Citations in this chart to the text of Kim are to the translation of Kim produced herewith at APL-IMV_00001510–APL-IMV_00001524. Reproductions of the figures of Kim herein may include the original untranslated Korean notations as they appear in Kim. Apple reserves the right to produce a certified translation of Kim and to amend or supplement its disclosures herein to rely on such a translation.

Claim	Korean Patent No. KR100677055B1 (Kim)[1]
	fifth lens(L5) having the negative refractive force, which are arranged in order from the object, and having the positive refractive force in general; and an iris installed between the first and second lens groups. Kim at 1. *The present invention relates to a surveillance camera capable of monitoring a large area, in particular* ***a compact ultra wide-angle*** *optical system mounted on a vehicle.* Kim at 5. *SUMMARY OF THE INVENTION The present invention has been made to solve such a problem, and* ***an object of the present invention is to provide an ultra wide-angle optical system*** *that dramatically improves the lens brightness and resolution performance compared to the conventional method,* ***and greatly reduces the overall size****.* Kim at 4–5.
[1(a)] a light-receiving first surface;	Kim discloses a light-receiving first surface. ***The present invention, in order to achieve the above object, including a first lens (L1)*** *having a negative refractive power from the object side and a second lens (L2) having a positive or negative refractive power, the first lens group having a negative refractive power as a whole; A second lens group including a third lens L3 having positive refractive power; A third lens group including the fourth lens L4 having positive refractive power and the fifth lens L5 having negative refractive power from the object side, and having a positive refractive power as a whole; And an aperture provided between the first lens group and the second lens group, and arranged from the object side in the order of the first lens group, the aperture, the second lens group, and the third lens group. It provides a compact ultra wide-angle optical system.* Kim at 5. ***The lens optical system according to an exemplary embodiment of the present invention includes the first lens group and the first lens group from the object side****, as shown in FIGS. 1A, 2A, and 3A, respectively, illustrating the lens configuration according to the first, second, and third embodiments, respectively. It is arranged in the order of the two lens group, the third lens group, each lens group has a structure including one or more lenses. In addition,*

Claim	Korean Patent No. KR100677055B1 (Kim)[1]
	an aperture (not shown) is provided between the first lens group and the second lens group. Kim at 5. Further, Kim discloses a light-receiving first surface in the form of the left-most surface of element L1 in each of the three embodiments disclosed by Kim, as shown below:  FIGS. 1A, 2A, 3A.
[1(b)] a focal plane;	Kim discloses a focal plane.

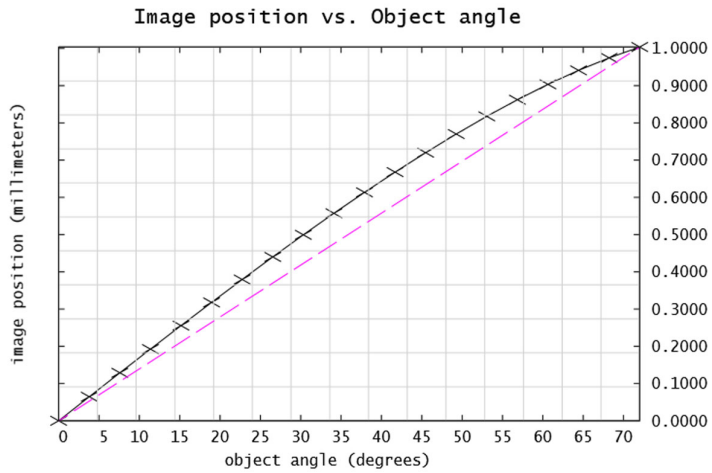
Claim	Korean Patent No. KR100677055B1 (Kim)[1]
	For instance, Figures 1A, 2A, and 3A of Kim, which depict respectively the lenses of Kim’s embodiments 1, 2, and 3, each depict a plane on which an image is produced. This plane is, or would be understood to a POSA to be, the focal plane:  FIGS. 1A, 2A, 3A.
[1(c)] a total track length measured from a center of the first surface to the	Kim discloses a total track length measured from a center of the first surface to the focal plane. In particular, Kim discloses that the total track length is represented by the parameter “TTL”:

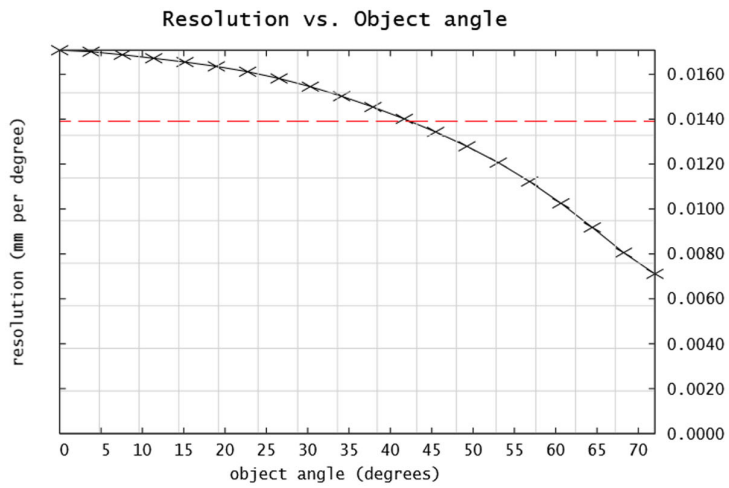
Claim	Korean Patent No. KR100677055B1 (Kim)[1]
focal plane;	*All three embodiments shown in Table 1 are based on a lens system having a height of Y, which is an image height, that is, 1 (that is, the size of an image diagonal is 2). Here,* ***TTL / 2Y is the total length of the lens divided by the image diagonal size****, and represents information about the total length of the lens.* Kim at 7. Further still, Kim discloses the total track length of the lenses represented in embodiments 1, 2, and 3 by providing information about the spacing between the surfaces of the lens elements making up each embodiment in the tables set forth on pages 8 and 9.
[1(d)] a miniaturization ratio with a value less than 3.0, the miniaturization ratio being a ratio of the total track length divided by an image circle diameter; and	Kim discloses a miniaturization ratio with a value less than 3.0, the miniaturization ratio being a ratio of the total track length divided by an image circle diameter. *All three embodiments shown in Table 1 are based on a lens system having a height of Y, which is an image height, that is, 1 (that is, the size of an image diagonal is 2). Here,* ***TTL / 2Y is the total length of the lens divided by the image diagonal size****, and represents information about the total length of the lens.* Kim at 7. [table below]

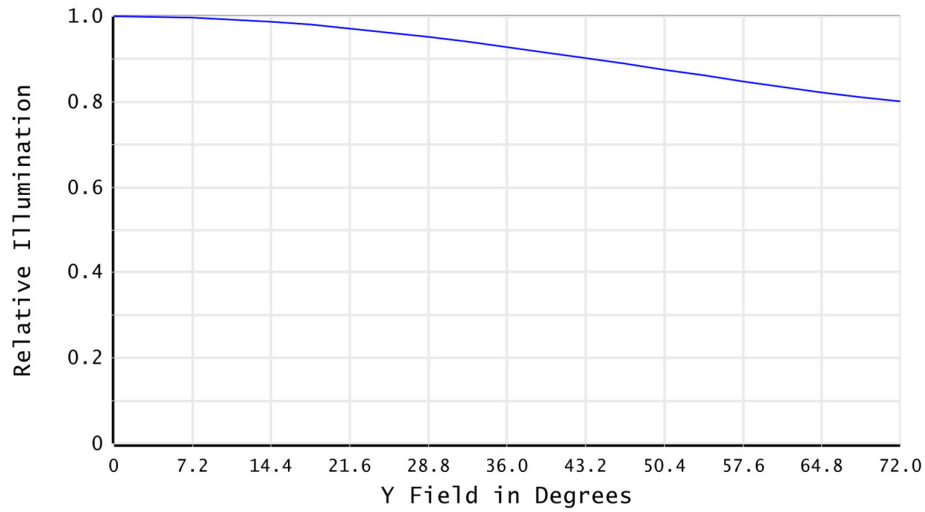
	실시예 1	실시예 2	실시예 3
FNO	1.7916	1.7916	1.8200
화각	144	148	154
TTL/2Y	1.9189	1.9750	1.9415
상고높이- Y	1	1	1
렌즈 총초점거리	0.97760	0.97730	0.96280
Φ12/Φt - 조건식1	0.62729	0.70657	0.61669
Φ3 /Φt - 조건식2	0.22170	0.15353	0.20317
V4/V5 - 조건식3	2.18726	2.18726	2.18726

Claim	Korean Patent No. KR100677055B1 (Kim)[1]
	In addition, since ***the TTL / 2Y values related to the size of the optical system are all less than 2****, it can be seen that according to the embodiment of the present invention, the optical electric field may be configured to be less than twice the diagonal size of the image sensor. Where TTL is the distance from the front surface of the lens to the image sensor, and 2Y is the diagonal size of the image sensor*. Kim at 7. *Specifically,* ***the optical system can be made smaller than twice the diagonal size of the image sensor****, thereby miniaturizing the optical system*. Kim at 10.
[1(e)] a non-linear targeted resolution to intentionally create a zone in an image captured by the miniature wide-angle optical apparatus with a lower or higher object to image magnification compared to linear targeted resolution,	Kim discloses a non-linear targeted resolution to intentionally create a zone in an image captured by the miniature wide-angle optical apparatus with a lower or higher magnification compared to linear targeted resolution. For example, the lens disclosed in Kim’s embodiment 1[2] exhibits a non-linear targeted resolution. As shown below, the distribution within the image developed by this lens of points at various object angles deviates from a linear distribution as ImmerVision appears to be using that term:

[2] In the discussions of Kim’s embodiment 1 herein, the aperture stop is placed between surface numbers 4 and 5 as specified on page 8 of Kim. The values provided herein are for a system in which the aperture stop is open, but Apple reserves the right to rely on the performance of the lenses disclosed in Kim with the aperture stop partially closed as may be relevant. Both the recited placement of the aperture stop, and any changes in its disposition from open to partially closed would, to the extent not specifically disclosed in Kim, have been obvious to a person of skill in the art reading Kim given her experience and background knowledge.

Claim	Korean Patent No. KR100677055B1 (Kim)[1]
	 This results in the creation within the image developed by Kim’s embodiment 1 lens of areas of higher (i.e., above the red dashed line) or lower (i.e., below the red dashed line) magnification as compared with what would be exhibited by a lens with a linear distribution. This distribution is intentionally introduced by the design of the lens chosen by Kim.

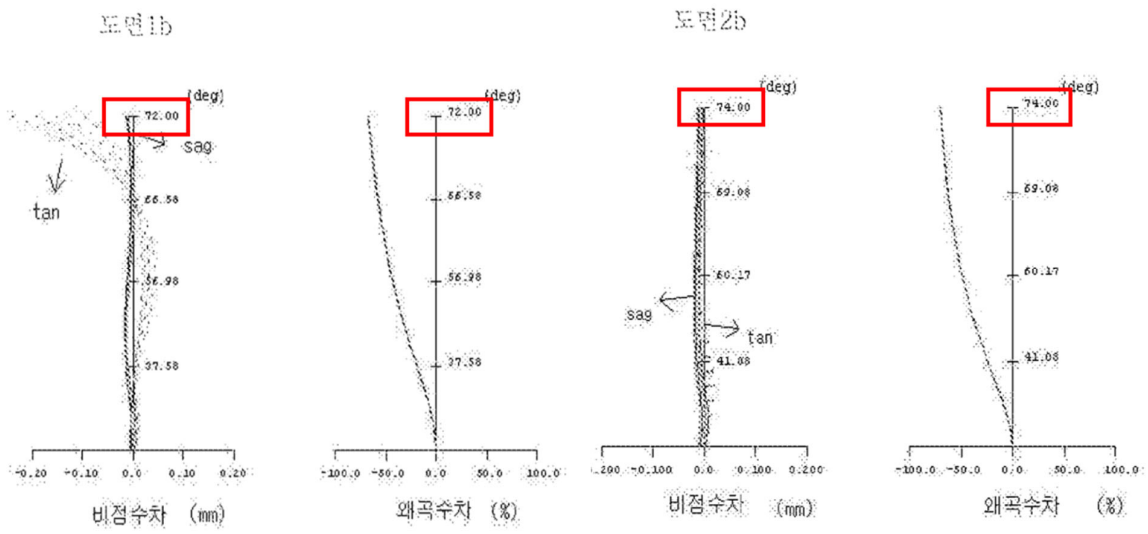
Claim	Korean Patent No. KR100677055B1 (Kim)[1]
	 In addition to embodiment 1, Apple reserves the right to rely on the lenses disclosed in Kim’s embodiments 2 and 3 for a disclosure of the creation of non-linear targeted resolution to intentionally create regions of higher or lower magnification within the projected image in a manner similar to the lens of embodiment 1, as shown above.
[1(f)] the lower or higher object to image magnification being used to compensate, at least in part, for a lower image quality due to at least one of a drop of relative illumination or a	Apple contends that this limitation has no patentable weight because it merely states an intended result. However, to the extent ImmerVision contends that this claim limitation does carry patentable weight, Kim discloses this limitation. For instance, the lens disclosed in Kim’s embodiment 1 exhibits a drop in relative illumination as the object angle increases, such that the image at these angles would also exhibit decreased resolution that would compensate, at least in part, for the drop in image quality due to the lower relative illumination at these angles.

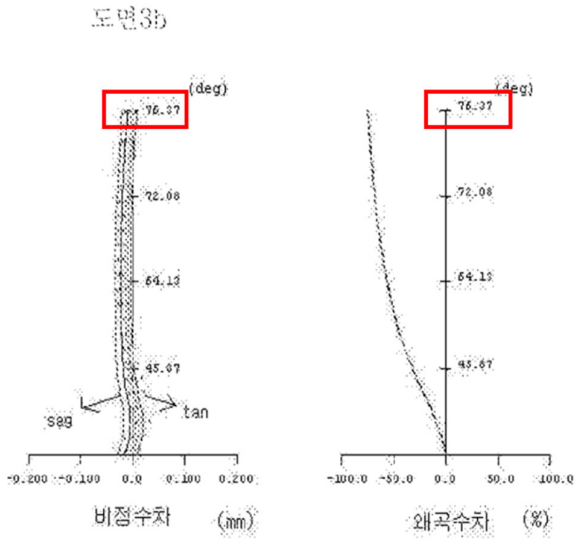
Claim	Korean Patent No. KR100677055B1 (Kim)[1]
drop of MTF in a zone of the image,	 In addition to Kim’s embodiment 1, Apple reserves the right to rely on the lenses disclosed in Kim’s embodiments 2 and 3 for a disclosure of a lens in which a zone of lower or higher magnification compensates, at least in part, for a decrease in relative illumination within that zone. To the extent that Kim does not explicitly teach that the higher magnification its lenses produce for certain image zones would compensate, at least in part, for a lower image quality due to at least one of a drop of relative illumination or a drop of MTF in that zone of the image, a person of skill in the art would have understood that this would be the case. It was well-known in the optics field in 2015 that relative illumination and MTF tend to drop in an image captured in the peripheral angles of a camera lens, particularly a wide-angle lens. It was also well-known in the optics field in 2015 that decreasing the resolution in a region of an image will impact (e.g., compensate for) the

Claim	Korean Patent No. KR100677055B1 (Kim)[1]
	effect of the drop in relative illumination in that region, and that increasing the resolution in a region of an image will impact (e.g., compensate for) the effect of the drop in MTF in that region. Further still, to the extent that Kim does not explicitly teach that the higher magnification its lenses produce for certain image zones would compensate, at least in part, for a lower image quality due to at least one of a drop of relative illumination or a drop of MTF in that zone of the image, using it in that matter would have been obvious to a person of skill in the art in view of Shabtay or Charles: *The following relates generally to imaging optics, and more specifically to a lens architecture in conjunction with a distorted image for relative illumination such that the light distribution over the lens is substantially uniform.* Shabtay at 1:7–10. *Herein, an overview of some of the embodiments for enhancing a depth of field based on a uniform (or near uniform) relative illumination utilizing a lens with large distortion has been presented above.* Shabtay at 5:23–26. *The principle of uniform relative illumination is obtained using a lens design that leads to a distorted image on the sensor such that the light distribution over the lens is substantially uniform. The disclosed aspects provide a lens that produces a distorted image, which can then be corrected during image processing by using a distortion correction function. An advantage of the various aspects disclosed herein is that the disclosed aspects enable an increase of the DoF with a higher F-number while maintaining sensor illumination commensurate to that obtained with a regular lens with a low F-number and narrow DoF.* Shabtay at 6:45–55. *FIG. 2 shows the angular distribution of a virtual image from reflection in a convex oblate aspheric reflector, also showing the reflected appearance of spheres that each occupy about 20 degrees. The radial scale decreases substantially toward the outer edge. This optical figure is useful in projection systems where a three dimensional projection surface extends from the perimeter of the reflector and it is desirable to maintain a relatively constant image brightness throughout the projection surface. More particularly, where the reflector is used at the top of a*

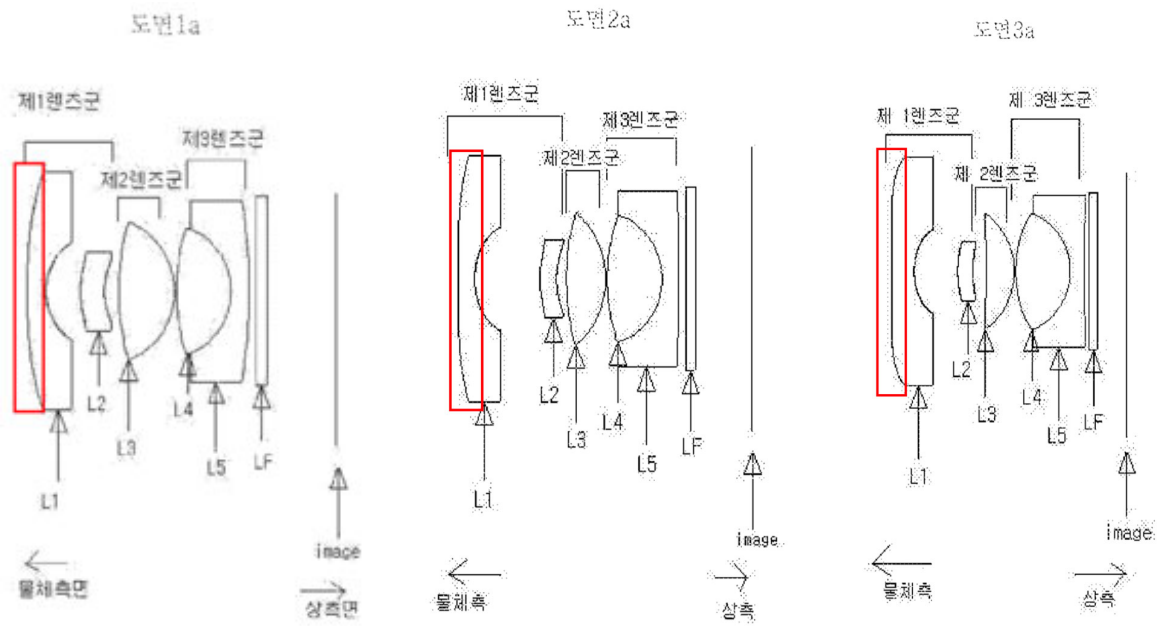
Claim	Korean Patent No. KR100677055B1 (Kim)[1]
	spherical or quasi spherical projection surface and a floor or pedestal mounted projector is directed toward it, the decreasing radial image scale results in greater expansion of the image (and thereby a greater reduction in the image brightness versus distance from the reflector) toward the top of the room, thereby providing relatively consistent brightness throughout the projection surface. The design also permits lower parts of the original projected image or image data to have a greater radial image scale. Charles at 19:24–42.
[1(g)] an opening angle of light entering the optical apparatus being over 100°.	Kim discloses an opening angle of light entering the optical apparatus being over 100°. For example, the lenses disclosed in Kim’s embodiments 1, 2, and 3 can receive light over a full field of view of approximately 144°, 148°, and 154°, respectively. [table below] Table 1. Figures 1B, 2B, and 3B of Kim further disclose that the lenses disclosed in Kim’s embodiment 1, 2, and 3 can receive light over a full field of 144°, 148°, and 154°, respectively, by illustrating aspects of the performance of these lenses a half-angle of 72°, 74°, and over 76°, respectively.

	실시예 1	실시예 2	실시예 3
FNO	1.7916	1.7916	1.8200
화각	144	148	154
TTL/2Y	1.9189	1.9750	1.9415
상고높이- Y	1	1	1
렌즈 총초점거리	0.97760	0.97730	0.96280
Φ12/Φt - 조건식1	0.62729	0.70657	0.61669
Φ3 /Φt - 조건식2	0.22170	0.15353	0.20317
V4/V5 - 조건식3	2.18726	2.18726	2.18726

Claim	Korean Patent No. KR100677055B1 (Kim)[1]
	 FIGS. 1B, 2B, and 3B.

Claim	Korean Patent No. KR100677055B1 (Kim)[1]
	 FIGS. 1B, 2B, 3B.
[4] The miniature wide-angle optical apparatus of claim 1, wherein an angle of chief-rays reaching the focal plane is over 20° from an optical axis of the optical apparatus.	Kim discloses a wide-angle optical apparatus in which an angle of chief-rays reaching the focal plane is over 20° from an optical axis of the optical apparatus. For instance, in Kim’s embodiment 1, an angle of chief-rays entering the optical apparatus at the edge of the stated field of view is approximately 22–23°. Apple reserves the right to rely on the lenses disclosed in Kim’s embodiments 2 and 3 for a disclosure of a lens in which a chief ray reaches the focal plane at an angle of over 20° from the optical axis.

Claim	Korean Patent No. KR100677055B1 (Kim)[1]
[5] The miniature wide-angle optical apparatus of claim 1, further comprising a plurality of optical elements, at least one of the plurality of optical elements defining the first surface.	Kim discloses a wide-angle optical apparatus in which the apparatus comprises a plurality of optical elements, at least one of which defines the first surface. For instance, each of Kim’s embodiments 1, 2, and 3 includes a plurality of optical elements designated L1, L2, L3, L4, and L5, in which the first surface is designated the leftmost surface of element L1. ***A small super-wide angle optical system is provided to secure a super-wide angle range and a short total*** *length by positioning a first lens group with strong negative refractive force in the front side of an iris.* ***A small super-wide angle optical system is composed of a first lens group having a first lens(L1) having the negative refractive force and a second lens(L2) having the positive or negative refractive force****, which are disposed in order from an object, and having the negative refractive force in general;* ***a second lens group having a third lens(L3) having the positive refractive force; a third lens group comprising having a fourth lens(L4) having the positive refractive force and a fifth lens(L5) having the negative refractive force****, which are arranged in order from the object, and having the positive refractive force in general; and an iris installed between the first and second lens groups.* Kim at 1. *The present invention, in order to achieve the above object,* ***including a first lens (L1) having a negative refractive power from the object side and a second lens (L2) having a positive or negative refractive power****, the first lens group having a negative refractive power as a whole;* ***A second lens group including a third lens L3 having positive refractive power; A third lens group including the fourth lens L4 having positive refractive power and the fifth lens L5 having negative refractive power from the object side****, and having a positive refractive power as a whole; And an aperture provided between the first lens group and the second lens group, and arranged from the object side in the order of the first lens group, the aperture, the second lens group, and the third lens group. It provides a compact ultra wide-angle optical system.* Kim at 5. *In detail,* ***the first lens group may have a negative refractive power as a whole, a first lens L1 having negative refractive power from an object side, and a second lens L2 having positive or negative refractive power****.*

Claim	Korean Patent No. KR100677055B1 (Kim)[1]
	In this way, the first lens group in front of the iris has a strong negative refractive power, so that it is possible to construct an ultra wide-angle system. Even if the total length of the optical system is shortened, sufficient margin of the rear focusing distance (distance from the last lens surface to the image sensor) is secured. As a result, the structure and design of the mechanism becomes easier. *In particular,* ***the first lens L1 uses a lens of a meniscus shape in which the object side is convex so as to be suitable for incidence of light in the ultra wide-angle region***. Kim at 5.  FIGS. 1A, 2A, 3A.

Claim	Korean Patent No. KR100677055B1 (Kim)[1]
[7] The miniature wide-angle optical apparatus of claim 1, wherein the miniaturization ratio value is less than 2.0.	Kim discloses that its wide-angle optical apparatus has a miniaturization ratio value is less than 2.0. *All three embodiments shown in Table 1 are based on a lens system having a height of Y, which is an image height, that is, 1 (that is, the size of an image diagonal is 2). Here,* ***TTL / 2Y is the total length of the lens divided by the image diagonal size****, and represents information about the total length of the lens.* Kim at 7. [table below] *In addition, since* ***the TTL / 2Y values related to the size of the optical system are all less than 2****, it can be seen that according to the embodiment of the present invention, the optical electric field may be configured to be less than twice the diagonal size of the image sensor. Where TTL is the distance from the front surface of the lens to the image sensor, and 2Y is the diagonal size of the image sensor.* Kim at 7. *Specifically,* ***the optical system can be made smaller than twice the diagonal size of the image sensor****, thereby miniaturizing the optical system*. Kim at 10.

	실시예 1	실시예 2	실시예 3
FNO	1.7916	1.7916	1.8200
화각	144	148	154
TTL/2Y	1.9189	1.9750	1.9415
상고높이- Y	1	1	1
렌즈 총초점거리	0.97760	0.97730	0.96280
Φ12/Φt - 조건식1	0.62729	0.70657	0.61669
Φ3 /Φt - 조건식2	0.22170	0.15353	0.20317
V4/V5 - 조건식3	2.18726	2.18726	2.18726