

UNITED STATES PATENT AND TRADEMARK OFFICE

BEFORE THE PATENT TRIAL AND APPEAL BOARD

APPLE INC.

Petitioner

v.

IMMERVISION, INC.

Patent Owner

Case IPR2023-00472

Patent No. 10,795,120

DECLARATION OF MICHAEL LEBBY, PH.D.

TABLE OF CONTENTS

	page
I. INTRODUCTION	3
II. QUALIFICATIONS.....	4
III. MATERIALS CONSIDERED.....	16
IV. UNDERSTANDING OF THE LAW.....	18
V. LEVEL OF ORDINARY SKILL IN THE ART.....	23
VI. THE ‘120 PATENT.....	23
A. Background and Summary	23
B. Claim 1	34
VII. CLAIM CONSTRUCTION	35
VIII. SUMMARY OF THE PRIOR ART.....	37
A. Thibault.....	37
B. Matsusaka.....	38
C. Kim	40
IX. GROUND 1: CLAIMS 1-7 ARE NOT ANTICIPATED OR OBVIOUS OVER THIBAUT.....	41
X. GROUND 2: CLAIMS 1 AND 3-6 ARE NOT ANTICIPATED OR OBVIOUS OVER MATSUSAKA	46
XI. GROUND 3: CLAIMS 1, 4-5, AND 7 ARE NOT ANTICIPATED OR OBVIOUS OVER KIM	48
XII. CONCLUSION	51

I. INTRODUCTION

I, Michael Lebby, declare as follows:

1. I have been retained by Patent Owner ImmerVision, Inc. (“ImmerVision”) to provide expert opinion and testimony in connection with an *inter partes* review of U.S. Patent No. 10,795,120 (“the ‘120 Patent”) assigned to ImmerVision.

2. I was retained in this matter by ImmerVision through its counsel, Panitch Schwarze, as an expert witness in the field of optics lens design. I charge a rate of \$450 per hour for my services. My compensation in this matter is in no way dependent or contingent on my opinions and testimony or on the ultimate outcome of the case.

3. I have reviewed the ‘120 Patent, as well as the Petition and the references cited therein.

4. In this declaration, I set forth the independent opinions that I have reached and the basis for those opinions using the information currently available to me. Such opinions are based on my education, career, and relevant experience in optics and lens design unless otherwise noted. A list of documents I have reviewed and, in some cases, relied upon in forming my opinions are presented below. I reserve the right to supplement or revise my opinions should additional documents or other information be provided to me.

II. QUALIFICATIONS

5. My *curriculum vitae* (“CV”), a copy of which is provided at Exhibit 2011, provides details on my education, experience, publications, and other qualifications.

6. I received a Bachelor of Engineering degree in Electrical and Electronic Engineering in 1984 from the University of Bradford. I also received a Ph.D. in Semiconductor Physics in 1987 from the University of Bradford. I also received a Doctor of Engineering degree with a focus in optoelectronic engineering in 2004 from the University of Bradford.

7. As described in this Section, and further detailed in my *curriculum vitae* (Exhibit 2011) over the course of my 40-year career in optics and optoelectronics, I have worked in nearly every aspect of the optical and optoelectronics business, ranging from epitaxial wafer growth, optical and optoelectronic device and lens design, using modeling and simulation, optical and optoelectronic device and component fabrication, testing, and qualification, to the implementation of devices into packages, both hermetic and non-hermetic, as well as analysis of package materials such as plastics (including plastic housings such as resin-packaged lead frame housings), optical plastics, metallic-based packages, semiconductor-based packages, and ceramic-based packages. I have also designed device packages (through-pin, surface mount, flip-chip, and various combinations

thereof) for printed circuit board mounting. Many of the designed packages were implemented into modules and sub-system/luminaire applications that included various optical lens designs. The modules have been at least fiber-optic-, display-, lighting-, imaging-, and sensing-based. I have also worked in commercially based industrial research-and-development laboratories to bring new optical-, optoelectronic- and photonic-based technologies from the research proof-of-concept phase through prototyping and qualified manufacturing for volume release. This has included both transfer as well as injection molding techniques for optics.

8. I have been both an entrepreneur (*e.g.*, Ignis Optics Inc, One Chip Photonics, Lightwave Logic Inc.), as well as an intrapreneur (*e.g.*, Motorola, Intel, TE Connectivity (previously Tyco Electronics), AT&T Bell Labs), creating innovative new programs, both as venture backed start-ups as well as corporate funded divisions. I have built these entities to develop optical, optoelectronics and photonics technology from the laboratory and fabrication clean room to production factories.

9. As mentioned above, I received a Bachelor of Electrical Engineering degree in 1984, a Master of Business Administration in 1985, and a Doctorate degree in 1987, all from University of Bradford in the United Kingdom. My Ph.D. thesis involved the design and fabrication of both optoelectronic and electronic

semiconductor devices, and their associated characterization. In 2004, I was awarded a Doctor of Engineering degree (a higher doctorate degree) from University of Bradford for my technical contributions to the field, with citation to “Technical Contributions to Optoelectronics.”

10. My career started in the late 1970s at the Ministry of Defense in UK where I spent time at their R&D facility in Malvern (RSRE – Royal Signals and Radar Establishment). I worked on optoelectronic semiconductor device design, fabrication, and characterization, and especially materials using III-V compound semiconductors. These devices included optics, optical waveguides, and optoelectronic device operation. My research work in semiconductor device design then took me to AT&T Bell Laboratories in 1985, where I pursued research in novel opto-device designs using III-V semiconductor material systems that included FETs, bipolar transistors, optical waveguides, optics, LEDs, laser diodes, and photodetectors. The devices researched became in part the subject of my PhD thesis that was granted in 1987.

11. I moved to Motorola in 1989 to further develop my optical, optoelectronic, semiconductor engineering and development skills, and I became a Research and Development Manager in the photonics division of Motorola, until I left the company in 1998. During my time at Motorola, I worked on many photonic and optical technology projects that included optical lenses, display,

imaging, camera, fiber-optic optical interconnects, electronic circuits (both analog and digital), displays, LEDs, and laser devices, as well as the packaging and reliability of mobile product prototypes. At that time, I was particularly interested in miniature displays and miniature optics using a number of technologies such as LEDs, lasers, LCDs, lenses, and organic LEDs which were aimed towards (at the time) pagers, mobile phones, micro-imagers/displays, holograms, and advanced prototypes of futuristic communications hardware. I was also particularly interested in miniature color displays in which LEDs could be utilized, and the associated drive electronics for them.

12. In aiming for miniature full color displays and associated optics, the early 1990s, there was only red wavelength Phosphide (GaAsP and/or InGaAlP) and AlGaAs based LED technology that was advanced in technology and performance. Green wavelength Gallium Phosphide based LEDs had low emission output, and blue wavelength emission LEDs were only available using pure Silicon Carbide on Silicon Carbide substrate wafers, with very low emission output. I worked closely with Motorola's mobile divisions on new and novel display prototypes for mobile phones etc., and optics to research and develop how best to innovate with full color red, green, and blue displays and associated optics. A number of alternative technologies were evaluated, such as LCD (Liquid Crystal Displays), OLED (organic LEDs), and Gallium Nitride and Indium Gallium

Nitride materials grown onto Sapphire. I also explored the electronic circuits that were needed to drive, operate, and signal these types of optoelectronic displays.

13. During my time at Motorola as a Research and Development Manager, I designed optical packages for these displays and devices, which included standard TO-cans, over-molded plastic DIL solutions, and ceramic-based and semiconductor-based technology. I was also an inventor or co-inventor on several patents having various optical lens designs, including U.S. Patent No. 5,369,415 (a direct retinal scan display with planar imager), 5,644,369 (a switchable lens/diffuser), 5,757,741 (CD Rom head with VCSEL or VCSEL array), 5,491,491 (portable electronic equipment with binocular virtual display), 5,818,404 (integrated electro-optical package), and 5,428,704 (optoelectronic interface and method of making).

14. The compound semiconductors used in the early 1990s at Motorola corporate research, for which I was a Research and Development Manager, included GaAs, InP, GaN, GaP, and InGaAlP, amongst other materials, all of which were intended to be designed into various light emitting sources and detectors in their associated optical package platforms that included optics and lens design. The research work at Motorola also included work on displays and, in particular, miniature displays and optics for pagers, clam-shell phones, and head-mounted displays that included mounting onto eyeglasses (similar in concept to

Google glass™). The types of displays ranged from large arrays of visible LEDs (*i.e.*, 10,000 LEDs on a chip) that required custom LED packaging to tiny color LCDs, where work was conducted into approaches to efficiently optically package the displays. As the arrays were large, on-board integrated LED driver circuits were implemented in some of the prototypes. Some of the research work at Motorola utilized phosphor technology, especially for display projects that were based on field emission (*i.e.*, the field emission display (FED)), as well as arrays of visible LED displays and optics where a full color gamut was required by both internal and external customers. The phosphor technology performed down-conversion of light energy.

15. I also initiated Motorola's work in optical interconnect (Optobus™) technology, that incorporated both transfer and injection molded optical parts. This project involved the research and development of a multi-channel IC chip for parallel optical interconnect.

16. I was one of Motorola's most prolific inventors, having over 150 issued utility patents as an inventor or a co-inventor by the late 1990s. Many of the photonics and optical prototypes with which I was involved were subject to reliability and stress testing that included humidity, temperature, optical, mechanical, and electrical evaluation. These consumer products all were driven using standard electronic ICs and electronic signaling.

17. I filed my first GaN patent, which taught techniques using GaN and InGaN LEDs, in 1996, shortly after the invention of high performance GaN/InGaN blue LEDs by Nichia in the early 1990s. My work at Motorola addressed, in part, the big issue at the time in the mid-1990s: full color display and display electronics composed of red, green and blue LEDs that could be utilized in mobile products as well as other applications. As part of this work, I was engaged in how to optically package these technologies that allowed for electrical, optical, and thermal high performance. Examples of patents on which I am a co-inventor, with respect to high heat conductivity surface emitting optical devices, include, for example, U.S. Patent No. 5,538,919, as well as U.S. Patent No. 5,818,404, U.S. Patent No. 5,739,800, and U.S. Patent No. 5,838,703, which three patents address LED packaging solutions.

18. Another of my inventions was directed to a new semiconductor laser that had the potential to be manufactured in high volume. This device was called a VCSEL (vertical cavity surface emitting laser), and the invention was to optimize the performance using an oxide process, and is now the basis for the highest volume semiconductor laser today (with its recent implementation as a structured light sensor in facial recognition systems utilized in modern day smart mobile phones). The VCSEL is a surface emitting diode laser and operates in a similar fashion to most LED chips today. Some of the goals of the research work at

Motorola was to be able to optically package VCSEL laser diodes and their associated optical lenses in a similar approach to LEDs. Laser diodes require thermal issues to be addressed very carefully, as they develop significant levels of heat during operation. The optical package designs at the time (including for lasers and LED packages) took into account optical lensing, thermal heat sinking and thermal paths to take the heat away from the source. My additional patents, including during my time at Motorola, are listed in my *curriculum vitae* (Exhibit 2011).

19. Between 1998 and 1999, I worked as the Director of Technology/ BD (Fiber Optics) for Tyco Electronics (previously AMP). I joined Tyco Electronics as a member of the Global Optoelectronics Division's management team. I was responsible for growing the optoelectronics and optical business through external interactions that included mergers, acquisitions, strategic alliances, and technical strategic planning. Much of that work was laser- and LED-based, with associated optics, and included designing and characterizing laser- and LED-based optical packages and modules for customer qualification specifications.

20. In 1999, I left Tyco and started employment at Intel. At Intel, I was involved heavily in photonic technology, especially technology that supported silicon photonic device platforms. As a culmination of this work, I was one of Intel's founders of its silicon photonics division in the year 2000, and worked to set

up a fabrication facility in South San Jose. The work involved integrating silicon FET electronics with optoelectronics and optics onto the same silicon semiconductor wafer. I was also part of Intel Capital's optical investment team, and participated in over 30 photonics investments into photonics, optics, and optoelectronics. Focus included optical devices, packaging and modules. Technologies investigated included lasers, LEDs, optics, and optical displays.

21. At the end of 2000, I left Intel and raised venture capital funding for a company called Ignis Optics Inc. The main goal of the company was to design and manufacture, in high volume, very high-performance fiber optic transceiver modules, and associated optics with data rates up to OC-192, or approximately 10 Gbps. The fiber optic transceiver modules have the capability of transmitting and receiving optical signals that are controlled using programmable electronics and packaged optoelectronics chips, such as laser diodes, optical lenses, and photodetectors. The optoelectronics chips were packaged using laminated ceramic-based technology as can be seen in my patents, for example, U.S. Patent No. 6,999,644 (a discrete optoelectronic package for a laser diode, with a provisional filing of 15th February 2002). In this patent, a laser diode chip is mounted onto a laminated ceramic package with electrical and thermal design features. Further, other of my patented inventions, such as U.S. Patent Nos. 6,663,296 and 6,795,461, also teach the use of a laminated ceramic package for a

surface emitting laser diode and/or light emitting diodes, with a priority date of 23rd April 2001. I am also an inventor or co-inventor on ceramic-based optoelectronic packaged patents that were designed for thermal engineering issues, dating to the 1990s, for example: U.S. Patent Nos. 5,045,908; 5,125,054; 5,959,315; 5,228,101; 5,313,545; 5,337,391; 5,361,317; 5,369,529; 5,416,870; 5,428,704; 5,521,992; 5,545,359; 5,539,200; 6,064,780; 5,543,958; 5,486,946; 5,625,734; 5,739,800; and 5,905,750; as well as EP0633607A1; EP0635741A2; and JPH0756062A.

22. In 2005, I took up employment for a trade association, based in Washington, D.C., called IEEE Optoelectronics Industry Development Association (OIDA). As head of this trade association, and with photonics and optics manufacturers that included fiber optics, display, cameras, sensing, defense, aerospace, LED lighting, and automotive vendors as members, I was responsible, in part, for industry-based technology roadmaps; and I implemented common industry roadmap methodologies with common features such as “Red Brick Walls” and transferred them into optoelectronics roadmaps for the industry in which LEDs, fiber-optics, optics, fiber, cameras, optical sensors, displays, and their associated packaging, were featured. OIDA roadmaps featured purple brick walls, to show differentiation from the semiconductor industry.

23. In 2010, I became the General Manager and CTO of Translucent, Inc., a high-tech start-up company which developed and manufactured silicon and rare

earth oxide based epitaxial semiconductor wafers. One of the key drivers at Translucent was to develop a new and novel platform for the growth of GaN and InGaN onto silicon for low-cost LED manufacturing on larger format substrate wafers (*e.g.*, 200mm), in order to achieve economies of scale and lower chip costs. Translucent pioneered the deposition of single crystal rare earth oxides such as Erbium Oxide (ErOx), Gadolinium Oxide (GdOx), Neodymium Oxide (NdOx), etc., that, when grown, single crystal layers of GaN/InGaN/AlN could be grown on top of them. This allows a lattice-matched, and monolithic-based, wafer template to be manufactured for LED fabrication. While at Translucent, I researched various epitaxial semiconductor layer structures that utilized rare earth oxide technology in order to improve the performance of LEDs used individually, as well as in array form. Other material growth work at Translucent focused on the growth of Silicon Germanium (SiGe) compounds with rare earth oxides, and various crystal orientation wafer substrates.

24. I am currently Chief Executive Officer (CEO) and Chief Technology Officer (CTO) of GenusTechnik Inc. GenusTechnik Inc., is my consulting company, through which I engage in my expert witness work.

25. I also presently hold the position of CEO of Lightwave Logic Inc. (LWLG), where I also serve as a Director of the Board of Directors. Lightwave

Logic is a company that is developing electro-optical polymer modulators for the fiber optic communications industry.

26. Throughout my career, I have also had an active role in a number of technical professional organizations, including, among others, IEEE Components, Packaging, and Manufacturing Technology (CPMT), IEEE Electronic Components and Technology Conferences (ECTC); IEEE TC-10 (Technical Committee on Optoelectronics), and IEEE Optoelectronics Industry Development Association (OIDA). Through these organizations, I have consistently been a part of committees, events, and workshops relating to semiconductor, optoelectronics, electronics, and packaging technology.

27. I also serve as a Technical Expert/Consultant for the European Commission. In my work at the European Commission, I review and advise on general optics, electronics, photonics, optoelectronics, imaging, sensing, display, and related ICT (Information and communications technology) technology.

28. My work has also led to over 225 USPTO utility patents in semiconductors, electronics, optics, and optoelectronics, including a number of patents relating to optics for LEDs and laser technology. I am the author of more than 60 publications.

29. A current copy of my *curriculum vitae*, Exhibit 2011, provides further information concerning my experience and qualifications and includes: a list of my

patents, a list of the publications I have authored, and a list of the matters on which I have served as an expert witness.

III. MATERIALS CONSIDERED

30. In forming my opinions expressed in this declaration, I have considered and relied upon my education, background, and experience. In addition, I have reviewed and, in some cases, relied upon the following list of materials in the preparation of this declaration.

- The ‘120 Patent and its prosecution file history (Exs. 1001, 1002);
- Apple Inc.’s 01-18-2023 Petition for IPR of the ‘120 Patent;
- ImmerVision’s 05-05-2023 Preliminary Response;
- Declaration of Dr. David Kessler (EX1003);
- S. Thibault, J. Parent, H. Zhang, and P. Roulet, *Design, fabrication and test of miniature plastic panomorph lenses with 180° field of view*, Proceedings of SPIE, 2014 (“Thibault”) (EX1004);
- U.S. Publication No. 2010/0194853 (“Matsusaka”) (EX1005);
- Korean Patent No. 100677055 and its certified translation (“Kim”) (Exs. 1006, 1007);
- U.S. Patent No. 9,091,843 (EX1010);

- Rebiai et al., “Image Distortion from Zoom Lenses: Modeling and Digital Correction,” 1992 IBC International Broadcasting Convention (July 1992) (EX1011);
- “Fish Eye Lens” by K Miyamoto (Feb. 19, 1964) (EX1012);
- Zeljko Andreic, “Simple 180o field-of-view F-theta all-sky camera,” SPIE Proc. 1500 (Oct. 1, 1991) (EX1013);
- Abed Kassim et al., “Optical Performance of axial gradient and aspheric surface lenses: study and analysis,” SPIE’s 1994 International Symposium on Optics, Imaging, and Instrumentation, Vol. 2263 (Sept. 30, 1994) (EX1014);
- Susan Houde-Walter, “Recent Progress In Gradient-Index Optics,” SPIE Proc. 0935 (Apr. 8, 1988) (EX1015);
- Paul K. Manhart et al., “Fundamentals of macro axial gradient index optical design and engineering,” SPIE Opt. Eng. 36(6), 1607-1621 (June 1997) (EX1016);
- U.S. Patent No. 5,686,957 (EX1017);
- Zemax Output for Matsusaka’s Example 19 (EX1018);
- Zemax Output for Kim’s First Embodiment (EX1019);
- Transcript of October 12, 2023 Deposition of Dr. Kessler (“Kessler Deposition”);

- José Sasián, “Introduction to Lens Design” (2019) (“Sasián”);
- “Smart Mini-Cameras,” (Tigran V. Galstian, ed., 2014) (“Galstian”);
- “Imaging Optics A Technical Resource for Imaging Solutions”
published by Edmund Optics, V173A (“Edmund Optics”);
- Rudolf Kingslake & R. Barry Johnson, “Lens Design Fundamentals,”
(2nd ed., 2010) (“Kingslake”);
- Warren J. Smith, “Warren J. Smith’s Modern Optical Engineering,”
(3rd ed., 2000) (“Smith”);
- U.S. Patent No. 6,844,990 (“the ‘990 Patent”);
- U.S. Publication No. 2012/0314296 (“Shabtay”); and
- Exhibit B1 to Defendant Apple Inc’s December 8, 2022 Invalidity
Contentions (“Apple Contentions”).

31. Moreover, I am aware of information generally available to, and relied upon by, persons of ordinary skill in the art, including technical dictionaries and reference materials, for example, textbooks, manuals, papers, articles, and relevant standards.

IV. UNDERSTANDING OF THE LAW

32. I am not an attorney, and I am not offering any legal opinions in this declaration nor am I qualified to do so. However, I have been informed by counsel

regarding several legal standards that I am to apply in framing my technical opinions and conclusions.

33. I understand from counsel that claim terms are ordinarily determined to have their ordinary and accepted meaning as would be understood by a person of ordinary skill in the art at the time of the invention, and in view of the specification and patent prosecution file history. I further understand that a patentee is free to be his or her own lexicographer (*i.e.*, provide his or her own special meaning to any disputed terms), in which case the patentee's lexicography governs. In making this determination, I understand that the specification and prosecution history must be consulted.

34. I understand from counsel that a patent claim is invalid for anticipation when a single prior art reference discloses each element of the challenged claim as arranged in the claim. I further understand that, to be anticipating, a prior art reference must be enabling and must describe the claimed invention sufficiently to have placed it in possession of a person of ordinary skill in the art (a "POSA") in the field of the invention.

35. I also understand from counsel that a patent claim is invalid if the claimed invention would have been obvious to a POSA at the time of the invention. This means that even if all of the requirements of the claim cannot be

found in a single prior art reference that would anticipate the claim, the claim can still be invalid.

36. I understand from counsel that an obviousness analysis involves comparing a claim to the prior art to determine whether the claimed invention would have been obvious to a POSA at the time of the invention in view of the prior art and in light of the general knowledge in the art as a whole.

37. I also understand from counsel that obviousness is ultimately a legal conclusion based on underlying facts of four general types, all of which must be considered: (1) the scope and content of the prior art; (2) the level of the POSA; (3) the differences between the claimed invention and the prior art; and (4) any objective indicia of non-obviousness.

38. I also understand from counsel that obviousness may be established by combining or modifying the teachings of the prior art. Specific teachings, suggestions, or motivations to combine any first prior art reference with a second prior art reference can be explicit or implicit, but must have existed before the date of invention. I further understand from counsel that in some circumstances obviousness may be established by a single prior art reference.

39. I understand from counsel that prior art references themselves may be one source of a specific teaching or suggestion to combine features of the prior art, but that such suggestions or motivations to combine art may come from the

knowledge of a POSA. Specifically, a rationale to combine the teachings of references may include logic or common sense available to a POSA.

40. I understand from counsel that a prior art reference may be relied upon for all that it teaches, including uses beyond its primary purpose. I understand that teaching away, *e.g.*, discouragement from making the proposed modification, is strong evidence that the prior art references are not combinable. I also understand from counsel that a disclosure of more than one alternative does not necessarily constitute a teaching away.

41. I understand from counsel that to support a combination of multiple prior art references, there must be a rationale explaining why a skilled artisan would combine the references in the manner claimed and how the proposed combination meets each and every claim element.

42. I further understand from counsel that whether there is a reasonable expectation of success from combining prior art references in a particular way is also relevant to the analysis. I understand there may be a number of rationales that may support a conclusion of obviousness, including:

- Combining prior art elements according to known methods to yield predictable results;
- Substitution of one known element for another to obtain predictable results;
- Use of a known technique to improve similar devices (methods, or products) in the same way;

- Applying a known technique to a known device (method, or product) ready for improvement to yield predictable results;
- “Obvious to try” – choosing from a finite number of identified, predictable solutions, with a reasonable expectation of success;
- Known work in one field of endeavor may prompt variations of it for use in either the same field or a different one based on design incentives or other market forces if the variations are predictable to one of ordinary skill in the art; and
- Some teaching, suggestion, or motivation in the prior art that would have led one of ordinary skill to modify the prior art reference or to combine prior art teachings to arrive at the claimed invention.

43. I understand that it is not proper to use hindsight to combine prior art references or elements of prior art references to reconstruct the invention using the claims as a guide. For example, an obviousness reconstruction should only take into account knowledge within the level of ordinary skill in the art at the time the claimed invention was made, and not utilize knowledge gleaned only from the patent’s disclosure. When it appears hindsight bias is being used, I understand the modification or combination is not considered obvious.

44. I understand that so-called objective indicia may be relevant to the determination of whether a claim is obvious should the Patent Owner allege such evidence. Such objective indicia can include evidence of commercial success caused by an invention, evidence of a long-felt need that was solved by an invention, evidence that others copied an invention, or evidence that an invention achieved a surprising result. I understand that such evidence must have a nexus, or

causal relationship to the elements of a claim, in order to be relevant to the obviousness or non-obviousness of the claim.

V. LEVEL OF ORDINARY SKILL IN THE ART

45. Dr. Kessler proposed that a person of ordinary skill in the art (POSA) at the time of the invention would have had at least a bachelor's degree in Physics, Optical Engineering, and/or Electrical Engineering and at least five years' experience in developing and designing optical products or systems and have familiarity with image processing algorithms and optical design software. APPLE 1003, ¶ 24. I believe three years' experience in these areas would be sufficient rather than five, but it does not materially affect my analysis, and for purposes of my declaration, I have assumed the same level of skill in the art as Dr. Kessler has proposed. Additionally, based on my education, training, and professional experience, I met at least these minimum qualifications to be a POSA as of the relevant time-frame of the invention of the '120 Patent, which I have taken to be December 23, 2015 for the purposes of this declaration.

VI. THE '120 PATENT

A. Background and Summary

46. The '120 Patent relates to miniaturized lenses that provide wide-angle fields of view for image capture. EX1001 1:20-30. These types of lenses are particularly useful in mobile device cameras or other similar applications where low profiles are needed due to limitations in space or thickness of the overall

device. *Id.* Modern camera lenses include multiple elements that must fit inside a thickness of 10 mm or less in current mobile phone form factors. Sasián p. 187.

At the same time, consumers have come to expect high quality images out of their mobile devices.

47. A camera on a wireless phone, even with low pixel resolution, caught the imagination of not only engineers and POSAs in the field, but with consumers in general. Galstian p. 3. Low resolution cameras with associated optical lenses on mobile cell phones, as an ancillary add-on feature, began to take off in the late 1990s and early 2000s, and everyone who wanted the functionality of taking photographs quickly and efficiently without carrying an individual camera saw the benefits of a multi-functional wireless CMOS imager system with associated optics that would fit in the profile of a mobile phone. Galstian p. 3.

48. The challenge in optical lens design is to be able to emulate the performance of a standard 35mm optical lens used for traditional cameras, and scale that down in volume, size, and cost, while keeping similar optical performance. Galstian p. 13. One of the key drivers for miniaturized camera lenses and optical lens systems is cost, size and optical performance. Design criteria can typically include:

- a. Tolerances of the optical lens train (the route and component assembly where the light follows from input to sensor element) need to be

- reasonably achievable with smaller optical elements. If, for example, a 35mm lens train is scaled down over 10X then the tolerances scale similarly, which increases manufacturing costs. Alignment tolerances need to be reasonable and practical for the miniaturized camera optical train; especially if costs are to be kept in check. Galstian p. 13.
- b. The optical train may be simpler in design as the optical elements may be thicker to achieve good optical performance when scaled. This may limit the number of optical elements in the design. Further, less lenses will improve the bill of materials and reduce the overall cost structure of the optical train. Galstian p. 13.
 - c. The materials utilized for the optical train may change significantly; if a 35mm optical train is based on glass elements, a more miniaturized solution for miniaturized cameras may have to resort to optical plastics to achieve the cost goals of the design. Galstian pp. 13-15.
 - d. The miniaturized camera will most likely have a shorter optical train or optical path, which means that the optical path rays may need to be engineered for different field angles and optical performance. This is an important aspect in the optical lens design because normal optical symmetry that can be found in standard 35mm optical lens trains, may not be practically feasible when scaled down to a miniaturized design.

The main optical ray, sometimes referred to as the chief optical ray angle (CRA), may need to be non-symmetrical to achieve the optical performance desired by the design. In this case, non-symmetrical optical lenses can be designed, and these are typically called aspheric lenses.

Galstian pp. 13, 15-17.

See also Sasián pp. 190-195.

49. The basic performance of an optical lens system will be based also on for example, image quality, image sharpness, relative illumination, and modulation transfer function (MTF). Galstian pp. 18-26. While these characteristics are a subset of the performance of an optical lens system, they demand a balance of performance trade-off to reach design criteria goals such as wide-angle-field-of-view. Galstian pp. 9-10. This is becoming more important for mobile phones as the image sensors are becoming bigger (for higher resolution images), while the optical lens systems need to maintain their thickness while providing improved image quality and sharpness. The one area that has not changed considerably over the past two decades is the size of the mobile phone. Designers realize that the size of the human hand is not going to change significantly, and the working philosophy while I was employed at Motorola in the 1990s is to assume the mobile phone should be handled similarly to a pack of playing cards. Given that size of mobile phones, and especially the thickness of mobile phones have not changed

substantially since the 1990s, the optical lens system has been challenged to improve optical performance, such as increasing FOV while keeping the thickness (or miniaturization ratio) of the optical lens system relatively aggressive.

50. Relative illumination is a technique to characterize and specify the combined effects of vignetting¹ and roll-off² in an imaging lens or lens system. Edmund Optics p. 20. It is usually defined as a percentage of illumination at any point on the sensor, or detector, that has been normalized to a field position with maximum illumination. Edmund Optics p. 20. A relative illumination curve will show the percentage relative illumination across the sensor or detector. Edmund Optics p. 13; EX1001 Fig. 4. Changes in relative illumination can have detrimental effects on an image. Edmund Optics p. 13. For example, drops in relative illumination affect image quality due to increased diffraction effects and sensor noise. EX1001 1:60-62.

¹ Vignetting typically occurs when light rays do not make it through the entire lens system to the sensor, due in part to being blocked by the edges of individual lens elements or mechanical stops. Vignetting can be viewed as clipping of light rays, and can be intentionally designed or have unintentional effects on the performance of the lens system. Sasián pp. 59-60.

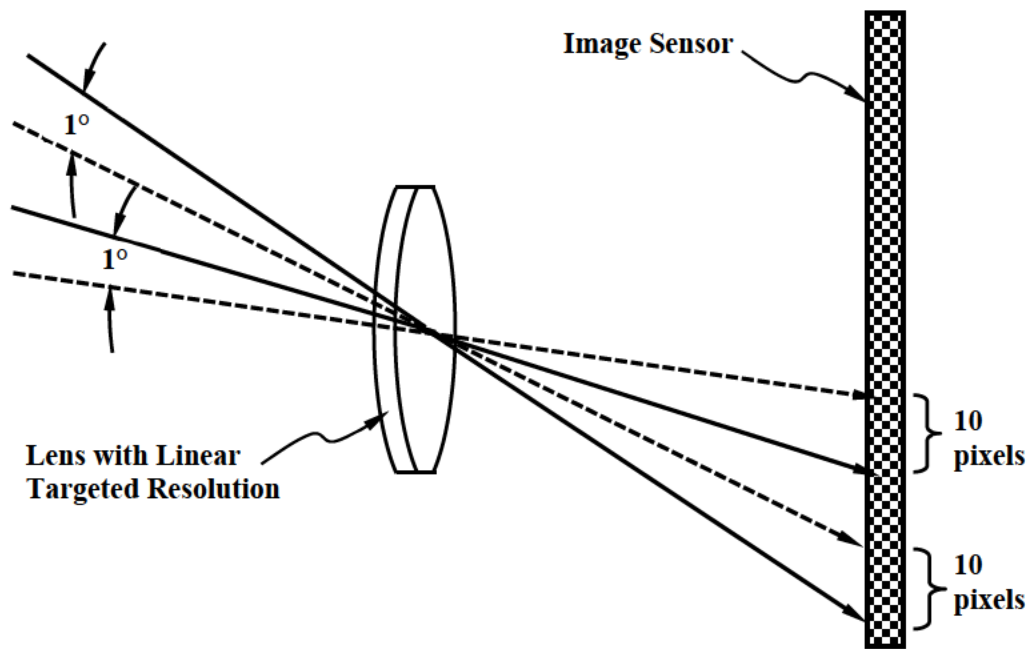
² Roll-off is typically the decrease of relative illumination with respect to the field that is not caused by vignetting and can be represented in simple systems using $\cos^4\theta$. Galstian pp. 24-25. Roll-off becomes a key design criteria for wide angle field-of-view lens systems where the chief light ray angle is steep or significantly different than the optical axis. Edmund Optics p. 23.

51. The modulation transfer function (MTF) is used by optical designers to compare the performance of optical systems that can range from single optical lenses to multi-element assemblies. Kingslake pp. 250-252. The MTF is defined from the characterization of two major elements of image performance which are contrast and resolution. Smith pp. 366-372. Contrast is the ratio of maximum values, for example to white, and minimum values, for example to black. Sasián p. 105. Contrast can be characterized as a square wave and is a method to transfer minimum and maximum intensity values from an object plane to an image plane. Sasián p. 105; Edmund Optics p. 9. Resolution is the imaging system's ability to recognize object detail and is typically defined in line-pairs per millimeter (or frequency). Smith p. 366. Images with blurred edges have low resolution, while images with clear, well-defined edges have higher levels of resolution. Edmund Optics p. 8. Typically, object resolution is calculated using the resolution of the camera and imaging magnification. Edmund Optics p. 9. Bringing both contrast and resolution together allows the MTF to be defined. The MTF of a lens is a measurement of the lens' ability to transfer contrast at a particular resolution from the object to the image in a single specification. Edmund Optics pp. 12-13. When the line spacing decreases (*i.e.*, frequency of line spacing increases), then the optical system will experience high difficulty to efficiently transfer the decrease in

contrast, and this will result in the MTF decreasing. Sasián p. 106. Declines in MTF can reduce image quality. EX1001 2:1-3.

52. The ‘120 Patent takes a unique approach to balancing the various factors in designing a miniature wide angle lens with good image quality. Instead of designing the lens to increase the relative illumination or MTF in regions where these characteristics are low, the ‘120 Patent adjusts the magnification in these regions so that the related image data will project onto more pixels of the image sensor. EX1001 2:45-55. By capturing more details in these areas, image quality can still be maintained despite low relative illumination or MTF.

53. The ‘120 Patent describes altering the image magnification compared to a linear targeted resolution. In a lens with a linear targeted resolution, the resolution is constant (within basic tolerances) across the entire field of view of the lens. In other words, each degree of the field of view will occupy the same linear space (*e.g.*, micrometers, pixels, etc.) of the image as every other degree. The illustration below shows two randomly selected regions of the image at different field angles, each spanning one degree. Each of these segments falls onto 10 pixels in this example. If one were to create a plot with the field of view on the x-axis and resolution (in pixels per degree, for example) on the y-axis for this example, the linear targeted resolution would be represented by a horizontal line having a height of 10.



54. I note that Dr. Kessler understands and agrees with this concept. He testified that the resolution curve is really a derivative of the position curve (*i.e.*, the heights of points in the image based on their field angles). EX1003 ¶¶ 164, 195. A lens with a linear targeted resolution has a position equation often represented as $f \cdot \theta$, with θ being the field angle and f being some constant such that the position curve of the lens is a line of constant slope across the field of view. Mathematically, the derivative would then be plotted as a horizontal line. Kessler Deposition 78:19-79:15.

55. A lens with a non-linear targeted resolution would exhibit a plot where the resolution varies depending on the field angle. Fig. 6 in the '120 Patent is one example. At the center of the field of view (0°), the resolution is

approximately 12 or 13 pixels per degree, but at the edge of the field of view (90°), the resolution is about 20 pixels per degree.

56. Magnification changes result where the non-linear targeted resolution differs from an equivalent linear targeted resolution. The equivalent linear targeted resolution can be determined for a lens simply by dividing the total image height (in units like microns or pixels) by the total field of view. I note that Dr. Kessler did this for his analysis. EX1003 ¶¶ 164, 195. With respect to Matsusaka, for example, he arbitrarily assigned the image radius as 1000 pixels and divided by the 100° half field of view³ to place a horizontal line at 10 pixels per degree on his plot. EX1003 ¶ 164. This is fine, provided he used the same 1000 pixel image size to derive the resolution curve for Matsusaka's actual lens (which Dr. Kessler does not confirm in his declaration) so that the comparison with the horizontal line is accurate.

57. Another way to consider this concept is that the equivalent horizontal line should be placed on the graph where the area under the line is the same as the area under the non-linear targeted resolution curve. I have used this method to annotate Fig. 6 in the '120 Patent to show the equivalent linear targeted resolution

³ I note that Dr. Kessler inexplicably rounded the half field of view in his analysis to 100° . To be accurate, Dr. Kessler should have used Matsusaka's given half field of view of 104.183° . EX1005 ¶ [0411].

since the pixel information is unavailable. The annotated version of Fig. 6 appears below.

58. Note that the red line representing the equivalent linear targeted resolution intersects the original black curve at a field angle of approximately 52° . Before that point, the black curve lies below the red line, and *vice versa*. Where the black curve lies below the red line, the image projected by the lens is compressed, because the resolution is smaller (e.g., $\sim 12\text{-}13^\circ$ at center) than it would be when using a lens with a linear targeted resolution (e.g., $\sim 16^\circ$ at center). Where the black curve is above the red line, the lens expands the image because the resolution is larger (e.g., $\sim 20^\circ$ at 90°) than it would be when using a lens with a linear targeted resolution (e.g., $\sim 16^\circ$ at 90°). In this example, the lens has a zone of lower magnification and a zone of higher magnification resulting from this particular design.

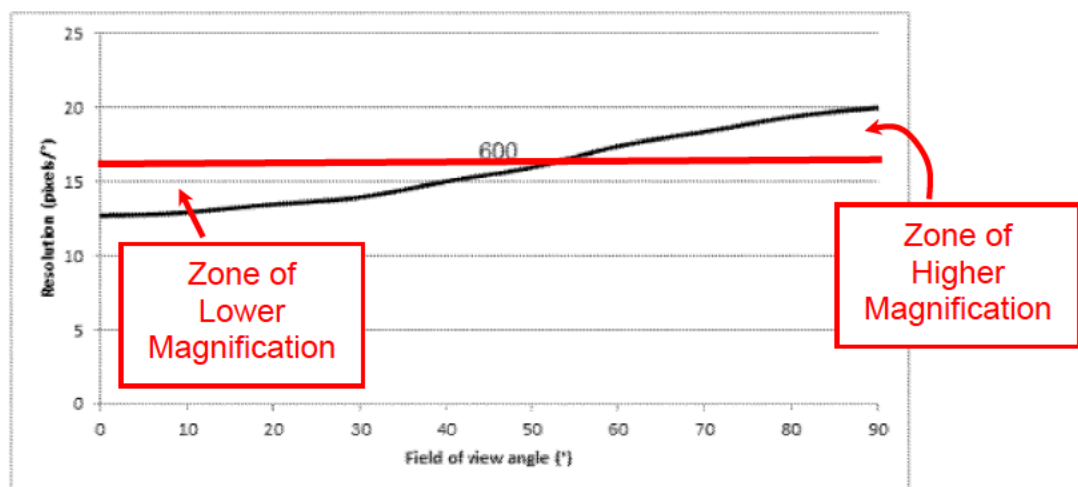


Figure 6

59. The '120 Patent uses this concept to improve image quality when drops in relative illumination and MTF occur. For example, the '120 Patent ties Fig. 6 to the relative illumination plot of Fig. 4. EX1001 6:9-27. Fig. 4 exhibits a near 100% relative illumination at the center of the field of view. At 32° or 33°, the relative illumination has dropped to 90%. But by this point the descent of the curve has steepened, and the relative illumination hits 80% before the field of view even reaches 50°. By the time the curve reaches 90°, the relative illumination is below 60%, which is approaching the lower limit of acceptability at the edges for applications like mobile phones. Galstian p. 25.

60. Comparing the plots of Figs. 4 and 6, the '120 Patent has located the zone of higher magnification to correspond to the regions where the relative illumination is lowest. In fact, the curves are functionally inverse to one another because the resolution curve tends to rise while the relative illumination curve falls, and the resolution curve climbs more steeply in step with the acceleration in relative illumination decline. With this approach, a POSA can tolerate the low relative illumination at the edges of this lens because the lens is projecting that area of the image onto more pixels. EX1001 6:19-27.

61. The '120 Patent also makes the same comparison for Fig. 5, which represents an MTF curve that the lens represented by Fig. 6 can compensate. EX1001 6:9-27. The sagittal and tangential MTF curves are approximately 85% at

the center and stay above 80% until somewhere around the 45° field angle.

Afterward, both MTF curves exhibit steeper declines and end up at 70% or below at 90°.

62. Like Fig. 4, comparing Figs. 5 and 6 shows the zone of higher magnification corresponds to the regions where the MTF is the lowest. The curves also appear to be functionally inverse to one another, as the ascent of the resolution appears to accelerate in regions where the descent of the MTF curves becomes more dramatic. Again, a POSA can tolerate lower MTF at the edge of the lens in this instance because the lens compensates by projecting that same region onto a greater area of pixels. EX1001 6:19-27.

B. Claim 1

63. The '120 Patent includes seven (7) claims of which claim 1 is independent. Independent claim 1 is directed to the concept I discussed above and recites as follows:

1. A miniature wide-angle optical apparatus comprising:
 - a light-receiving first surface;
 - a focal plane;
 - a total track length measured from a center of the first surface to the focal plane;
 - 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

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,

an opening angle of light entering the optical apparatus being over 100°.

VII. CLAIM CONSTRUCTION

64. I understand that Petitioner did not propose any formal constructions of claim terms in the '120 Patent, but does argue that “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” is an intended use clause that should be ignored when applying the prior art, rather than providing a structural limitation to claim 1. Pet. 8-12. I disagree.

65. To understand the language in question we must first examine the earlier language in the claim. Claim 1 recites:

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,

This language first introduces the concept of the non-linear targeted resolution I described above in section VI.A. This also introduces the concepts of the zones of lower or higher magnification that result from having a non-linear targeted

resolution. However, this language alone does not explain to the POSA where these zones are to be arranged. Indeed, the existence of these types of magnification zones was not new. Even ImmerVision had previously used lenses with non-linear targeted resolution for creating various magnification zones, albeit for a different purpose of obtaining increased image data on certain objects of interest located within the field of view. ‘990 Patent 3:43-4:10.

66. The language in question by Petitioner captures the novelty of the ‘120 Patent’s approach to improving image quality:

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

This tells the POSA where the magnification zones need to be placed in order to accomplish their purpose. That is, as I explained above in comparing Figs. 4 and 5 with the resolution curve of Fig. 6, the zones need to align with appropriate regions exhibited in a relative illumination or MTF curve. This is accomplished through shaping the various lens elements in such a way that the projected image will be expanded and compressed in the appropriate areas correlating to the relative illumination or MTF characteristics.

67. For these reasons, I disagree that the “being used to compensate...” language in claim 1 of the ‘120 Patent fails to describe any structural aspect of the lens.

VIII. SUMMARY OF THE PRIOR ART

A. Thibault

68. Thibault is directed to two miniature, plastic panomorph lenses for consumer electronics and mobile devices with $\sim 180^\circ$ fields of view. EX1004 p. 2. In particular, Thibault seeks to address challenges in creating these types of miniature lenses while applying the same concepts detailed in ImmerVision's prior U.S. Patent No. 6,844,990 – increasing the number of pixels in areas of interest within the image. EX1004 pp. 2, 6, 10. Thibault even cites the '990 patent for this purpose. EX1004 p. 11.

69. The second lens, which Petitioner relies on to assert unpatentability of claim 1 of the '120 Patent, is a mobile device lens constructed to increase the number of pixels in the zone of interest for mobile video chat applications. EX1004 p. 6. The right image in Fig. 9 shows an example, where the lens has its center pointed at the ceiling and participants are sitting around the mobile device. EX1004 p. 8. The resolution curve of the lens is provided in Fig 6 of Thibault, and shows a maximum value at around 60° in the field of view where it peaks before dropping back toward its starting value from center. EX1004 p. 7. When comparing Fig. 6 to Fig. 9, it is easy to see that the peak resolution is located in a region roughly corresponding to the faces of the participants of the conference. This is logical since the center of the field of view constitutes the ceiling, which

would be of little interest to the viewer of the image, and the edge of the field of view is adjacent the table, which is also of little interest.

70. Thibault provides a relative illumination curve for this lens in Fig. 7, although no explanation for its presence or description relating it to any aspects of the resolution or any other characteristic of the lens is given. EX1004 p. 7. I note that the relative illumination drops below 50% at around 72° in the field of view, which is at the bare minimum of acceptability in the image corners for mobile applications (Galstian p. 25), and remains so through the edge of the field of view. I further note that Thibault does not provide any MTF information for its lenses.

B. Matsusaka

71. Matsusaka is directed to a compact wide-angle optical system that maintains excellent optical properties despite spatial deployment restrictions and compromising environment conditions. EX1005 ¶¶ [0008]-[0010]. One example is given as a rear view system for a vehicle, which must be mounted so as to not disturb vehicle aesthetics and will be subjected to a wide range of temperatures. EX1005 ¶ [0004]. Matsusaka provides at least twenty-three (23) different optical system examples that purport to satisfy the condition of $vdp < 29$, where vdp is a minimum Abbe number of one or more positive lenses mounted in a front lens group of the optical system. EX1005 ¶¶ [0010]-[0024], [0450].

72. Petitioner lists several of these examples that supposedly anticipate or render obvious various claims of the '120 Patent. Pet. 45-46. However, Petitioner has only provided any real analysis for one of these examples, which is Example 19. Pet. 46. A lens diagram for Example 19 is shown in Fig. 23 and lens prescription data is provided in the table at paragraph [0411]. Figs. 43A-43B provide data for the Example 19 optical system, including spherical and lateral aberration curves, astigmatism image height, and distortion.

73. Matsusaka does not provide a resolution curve for any of its optical systems. However, I understand that Dr. Kessler has modeled Matsusaka's Example 19 in Zemax, which is a common optical design software. EX1003 ¶¶ 161-164. I have not confirmed the accuracy of Dr. Kessler's plot, although I do note some inconsistencies in his data. For example, he inexplicably rounded the optical system's half field of view from 104.183° (EX1005 [0411]) to 100° (EX1018 p. 1 ("Maximum Radial Field")) and allowed Zemax to set the F# of the system equal to 3 (EX1018 p. 1 ("Image Space F/#")) rather than use the listed F# of 2.828 (EX1005 [0411]). For purposes of my analysis, I have used Dr. Kessler's resolution plot for Matsusaka's Example 19.

74. Matsusaka also does not provide relative illumination or MTF data for any of its optical systems. From my review of the materials, Petitioner and Dr. Kessler also have not provided any such data related to Matsusaka.

C. Kim

75. Kim discloses a compact superwide angle optical system that purportedly provides a higher resolution performance while having a brighter F# than the prior art, as well as a short optical system with a super wide angle with a sufficient back focal length. EX1007 p. 1. Similar to Matsusaka, Kim's application tends toward a surveillance camera for a vehicle that can photograph objects in low light, is small as possible to avoid disturbing the vehicle's aesthetics, and has high resolution. EX1007 p. 3. Kim presents three embodiments that purport to satisfy the condition that the ratio of the reciprocal of the total focal length of the first and second lens groups to the reciprocal of the total focal length of the entire lens is between 0.4 and 0.8. EX1007 pp. 5-6.

76. Petitioner argues that all three disclosed lens embodiments anticipate or render obvious various claims of the '120 Patent. Pet. 68. However, Petitioner has only provided any real analysis for the first embodiment. Pet. p. 68. A lens diagram for this embodiment is shown in Fig. 1a, while spherical aberration, astigmatism, and distortion data is provided in Fig. 1b. Lens prescription data is provided on page 6 of Kim's translation.

77. Kim does not provide a resolution curve for any of its embodiments. However, I understand that Dr. Kessler has modeled Kim's first embodiment in Zemax. EX1003 ¶¶ 192-195. I have not confirmed the accuracy of Dr. Kessler's

plot, although I do note some inconsistencies in his data. For example, Dr. Kessler incorrectly entered the Abbe number (Vd) for “Surface 7” (“Surface 9” in Dr. Kessler’s Zemax data) as 44.46 (EX1019 p. 2) instead of 60.32 as listed in Kim (EX1007 p. 6). For purposes of my analysis, I have used Dr. Kessler’s resolution plot for Kim’s first embodiment.

78. Kim also does not provide relative illumination or MTF data for any of its embodiments. From my review of the materials, Petitioner and Dr. Kessler also have not provided any such data related to Kim for purposes of this proceeding. I understand that Petitioner separately submitted a relative illumination plot for Kim’s first embodiment in the related litigation. Apple Contentions p.9 of Exhibit B1. I have used this plot for purposes of my analysis.

IX. GROUND 1: CLAIMS 1-7 ARE NOT ANTICIPATED OR OBVIOUS OVER THIBAUT

79. Thibault does not disclose or render obvious all the limitations recited in independent claim 1 of the ‘120 Patent.

80. Petitioner asserts that Thibaut anticipates or renders obvious the “being used to compensate...” language of claim 1 because that phrase is a statement of intended use instead of a structural limitation, but that even if it should be considered as part of the patentability analysis, Thibault discloses a downward slope in its resolution curve similar to the one shown in Fig. 7 of the ‘120 Patent, and therefore would satisfy the claim language. Pet. 30-32.

81. As discussed above in section VII., a POSA would understand the “being used to compensate...” language of claim 1 as providing particular structural detail about the location of magnification zones as related to regions of low relative illumination or MTF. I therefore disagree that this clause should be disregarded when analyzing the patentability of claim 1 in view of Thibault.

82. From the perspective that the “being used to compensate...” must be found in Thibault, Petitioner has failed to identify magnification zones in Thibault’s resolution curve. Thibault plots the resolution over its field of view in pixels per degree. EX1004 p. 7. Thibault also gives the image height (2.01 mm) and pixel size (1.12 microns). EX1004 p. 6. Using the method I described above in section VI.A., the equivalent linear resolution could be found by dividing the image height by the pixel size and dividing the result by the total field of view (180°). The resolution plot in Fig. 6 of Thibault then could have been compared to the calculated linear resolution to determine the locations of zones with higher and lower magnification, similar to what Petitioner did for Matsusaka and Kim. Pet. 58-59, 78-79. Petitioner did not do so even though claim 1 specifically recites the presence of these zones. It is difficult to determine whether the zones are properly correlated to the relative illumination regions shown in Thibault’s Fig. 7 without this information, which Petitioner did not provide.

83. Petitioner premises their argument for this claim element on Thibault's resolution plot in Fig. 6 having a section with a "similar downward slope to Figure 7 of the '120 Patent," and that this "would therefore have the same impact on relative illumination as described in the '120 Patent." Pet. pp. 31-32. Petitioner based this analysis on a theory that ImmerVision conflated a low magnification with a downward sloped curve. Pet. 26. This analysis is incorrect because it speaks to a different technique than the one recited in claim 1 of the '120 Patent.

84. As I described above in section VI.A., an accepted way to identify zones of lower or higher magnification, per the claim language, is to compare the resolution curve to an equivalent linear targeted resolution plot. Petitioner agrees with this because that is how they identified the zones for Matsusaka and Kim in the Petition. Pet. 58-59, 79.

85. These very plots demonstrate that a downward slope does not equate to a lower magnification zone as Petitioner claims. In Matsusaka, for example, the resolution trends upward from the center through approximately 40° when it crosses the red line. EX1003 ¶ 164. It is generally agreed that this region from 0-40° is a zone of lower magnification (EX1003 ¶ 165; Kessler Deposition 81:7-14), but the slope is upward. The curve also peaks before 80° before having a downward slope. EX1003 ¶ 164. But until the curve crosses the red line, that zone

still has an increased magnification despite the direction of the slope. EX1003

¶ 165; Kessler Deposition 81:15-22.

86. Petitioner's plot of Kim is similar. In the Kim plot, the slope is downward essentially across the entire field of view starting from center. EX1003

¶ 195. But the region from the center until the curve crosses the red line shortly before 40° represents a zone of increased magnification despite the downward slope. EX1003 ¶ 196; Kessler Deposition 79:16-80:7.

87. The '120 Patent also proves this point. In Fig. 6, there is no downward slope at all in the resolution curve. But as shown in my earlier annotated diagram of Fig. 6, the zone between the center of the lens and approximately 50° is a zone of lower magnification despite having an upward slope, because until that point, the resolution lies below the linear targeted resolution.

88. Petitioner is relying on Fig. 7 in the '120 Patent and a portion of its description, which I provide below (EX1001 6:30-41):

The targeted resolution curve is chosen to have an upward curve between the center resolution value 710 and a maximum 712 (number of pixels/degree), followed by a downward curve between the maximum 712 and a region near the edge of the field of view around position 714. This downward curve between maximum value 712 and position 714 allows the lens system to have a higher relative illumination value toward the edge of the field of view by having a lower object to image magnification ratio in that region and hence redirecting the

same quantity of light from an object to a smaller region in the image with more illumination.

89. This speaks to a different concept, which is that decreasing resolution can be effective for increasing the relative illumination values for a lens. This was a known technique, which is shown for example by U.S. Publication No. 2012/0314296 (“Shabtay”), a reference that was cited against the ‘120 Patent during prosecution. Shabtay does not involve a wide angle lens, but it does use a large negative distortion (-8.5%) at the edge of the lens in order to maintain the relative illumination at a high level (roughly 90% and above) for most of the field of view. Shabtay ¶¶ [0001], [0042], [0044], [0076]-[0077], Figs. 10-11. Without this negative distortion, Fig. 1 in Shabtay shows that the relative illumination would degrade to below 40%. Shabtay ¶ [0037], Fig. 1.

90. This is the same concept the ‘120 Patent describes in relation to Fig. 7. The downward curve “allows the lens system to have a higher relative illumination value toward the edge of the field of view” (EX1001 6:35-41); *i.e.*, the downward curve allows for an increase in the relative illumination values.

91. This is different from the other technique described in the ‘120 Patent with respect to Figs. 4-6 and recited in claim 1, where the magnification zones are arranged to “compensate for” drops in relative illumination (or MTF), not to actually increase the relative illumination. Pursuant to this difference, the term “compensate” is never used in the ‘120 Patent to refer to Fig. 7 or its description of

raising the relative illumination; it is used only together with Figs. 4-6. EX1001 3:18-25, 6:9-61. There is also no relative illumination curve provided in the ‘120 Patent to compare with the Fig. 7 resolution plot.

92. Nothing in Petitioner’s analysis of Thibault demonstrates placement of magnification zones to compensate for drops in relative illumination or MTF. Their only argument is based on a description in the specification of the ‘120 Patent that does not relate to the concept recited in claim 1. Based at least on the foregoing, Petitioner has not demonstrated that Thibault discloses or renders obvious each of the limitations of the claims of the ‘120 Patent.

X. GROUND 2: CLAIMS 1 AND 3-6 ARE NOT ANTICIPATED OR OBVIOUS OVER MATSUSAKA

93. Matsusaka does not disclose or render obvious all the limitations recited in independent claim 1 of the ‘120 Patent.

94. Petitioner asserts that Matsusaka anticipates or renders obvious the “being used to compensate...” language of claim 1 because that phrase is a statement of intended use instead of a structural limitation, but that even if it should be considered as part of the patentability analysis, Matsusaka discloses a downward slope in its resolution curve similar to the one shown in Fig. 7 of the ‘120 Patent, and therefore would satisfy the claim language. Pet. 59-60.

95. As discussed above in section VII. and section IX. in connection with Thibault, a POSA would understand the “being used to compensate...” language of

claim 1 as providing particular structural detail about the location of magnification zones as related to regions of low relative illumination or MTF. I therefore disagree that this clause should be disregarded when analyzing the patentability of claim 1 in view of Matsusaka.

96. From the perspective that the “being used to compensate...” must be found in Matsusaka, Petitioner has failed to provide any relative illumination or MTF data to which the resolution curve Dr. Kessler generated can be compared. As I explained above in section IX., Petitioner identified low magnification zones in Matsusaka’s Example 19 lens at the center and edge of the field of view, and a high magnification zone between the two. But without a relative illumination or MTF curve, it is difficult to determine whether these zones are appropriately placed to compensate for drops in either lens characteristic.

97. As with Thibault, Petitioner based their argument for this claim element on Matsusaka’s resolution plot having a “downward slope” similar to Fig. 7 in the ‘120 Patent. As I explained above with respect to Thibault, this analysis is incorrect because the downward slope in Fig. 7 is used for a different purpose of actually increasing relative illumination, not compensating for its drop.

98. Nothing in Petitioner’s analysis of Matsusaka demonstrates placement of magnification zones to compensate for drops in relative illumination or MTF. Their only argument is based on a description in the specification of the ‘120

Patent that does not relate to the concept recited in claim 1. Based at least on the foregoing, Petitioner has not demonstrated that Matsusaka discloses or renders obvious each of the limitations of the claims of the ‘120 Patent.

XI. GROUND 3: CLAIMS 1, 4-5, AND 7 ARE NOT ANTICIPATED OR OBVIOUS OVER KIM

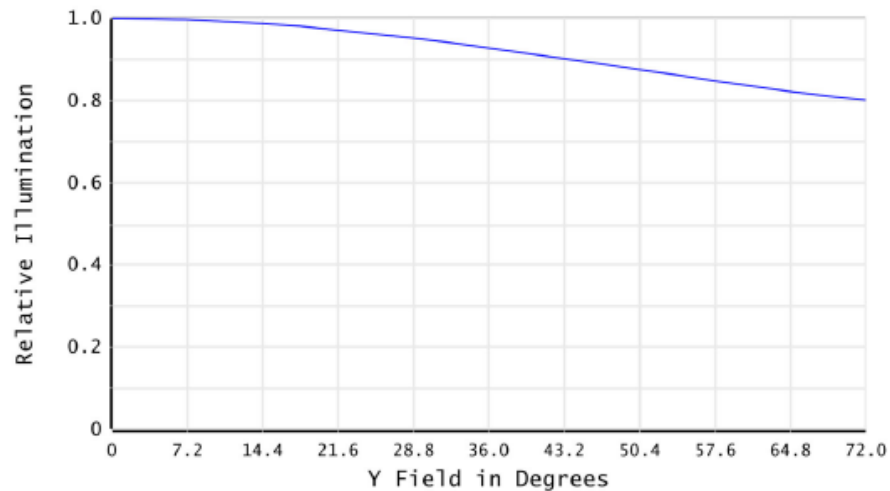
99. Kim does not disclose or render obvious all the limitations recited in independent claim 1 of the ‘120 Patent.

100. Petitioner asserts that Kim anticipates or renders obvious the “being used to compensate...” language of claim 1 because that phrase is a statement of intended use instead of a structural limitation, but that even if it should be considered as part of the patentability analysis, Kim discloses a downward slope in its resolution curve similar to the one shown in Fig. 7 of the ‘120 Patent, and therefore would satisfy the claim language. Pet. 80.

101. As discussed above in section VII. and sections IX. and X. in connection with the other references, a POSA would understand the “being used to compensate...” language of claim 1 as providing particular structural detail about the location of magnification zones as related to regions of low relative illumination or MTF. I therefore disagree that this clause should be disregarded when analyzing the patentability of claim 1 in view of Kim.

102. From the perspective that the “being used to compensate...” must be found in Kim, Petitioner has failed to provide any relative illumination or MTF

data in the Petition to which the resolution curve Dr. Kessler generated can be compared. However, I understand that Petitioner submitted a relative illumination plot for Kim's first embodiment in connection with the parallel litigation ongoing between the parties. Apple Contentions p. 9 of Exhibit B1. I have reproduced this plot below. This curve is similar to the relative illumination plot in Fig. 4 of the '120 Patent in that it is maximum at the center of the lens and continuously drops toward the edge, although the edge value is higher than in Fig. 4.



103. As I explained above in section IX., Petitioner identified high and low magnification zones in Kim's first embodiment's lens. Comparing Dr. Kessler's resolution plot with Petitioner's relative illumination plot, we find that the magnification zones are oriented opposite to what would be expected for claim 1 of the '120 Patent. Specifically, we would have expected to see a low magnification zone near the center of the lens since the relative illumination is highest in this area. We would also have expected to see a zone of higher magnification toward

the edge in order to compensate for the relative illumination having dropped by 20% by the edge of the field of the view. In short, we would have expected to see a resolution curve similar to that of Fig. 6 in the '120 Patent to offset the relative illumination characteristics we see in Petitioner's plot above. Instead, the locations of the magnification zones in Dr. Kessler's resolution plot for Kim are reversed and would not provide the compensation sought by claim 1.

104. In addition, because we do not have an MTF curve for Kim's first embodiment lens, it is difficult to determine whether the zones identified in Dr. Kessler's resolution plot are appropriately placed to compensate for a drop in MTF either.

105. As with Matsusaka, Petitioner based their argument for this claim element on Kim's resolution plot having a "downward slope" similar to Fig. 7 in the '120 Patent. As I explained above with respect to Thibault and Matsusaka, this analysis is incorrect because the downward slope in Fig. 7 is used for a different purpose of actually increasing relative illumination, not compensating for its drop, which is further demonstrated by Petitioner's relative illumination curve.

106. Nothing in Petitioner's analysis of Kim demonstrates placement of magnification zones to compensate for drops in relative illumination or MTF. Their only argument is based on a description in the specification of the '120 Patent that does not relate to the concept recited in claim 1. Based at least on the

foregoing, Petitioner has not demonstrated that Kim discloses or renders obvious each of the limitations of the claims of the '120 Patent.

XII. CONCLUSION

107. I declare that all statements made herein of my own knowledge are true and that all statements made on information and belief are believed to be true; and further, that these statements were made with the knowledge that willful false statements and the like so made are punishable by fine or imprisonment, or both, under Section 1001 of Title 18 of the United States Code, and that such willful false statements may jeopardize the Patent Owner's position in this *Inter Partes* Review proceeding.

Dated **Friday, 27 October 2023**

Michael Lebby, Ph.D.

