

UNITED STATES PATENT AND TRADEMARK OFFICE

BEFORE THE PATENT TRIAL AND APPEAL BOARD

TESLA, INC.,

Petitioner,

v.

INTELLECTUAL VENTURES II LLC,

Patent Owner.

Case No. IPR2025-00339

U.S. Patent No. 7,916,180

**DECLARATION OF DR. ELI SABER IN SUPPORT OF
PATENT OWNER'S PRELIMINARY RESPONSE**

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I, Dr. Eli Saber, do hereby declare:

I. INTRODUCTION

1. I am making this declaration at the request of Intellectual Ventures II, LLC (“Intellectual Ventures”) in the matter of the *Inter Partes* Review (“IPR”) proceedings before the United States Patent and Trademark Office (“USPTO”) of U.S. Patent No. 7,916,180 (“the ‘180 Patent”) to provide expert technical opinions with respect to the ‘180 Patent.

2. I am being compensated for my work in this matter at my standard hourly rate for such consulting services. My compensation in no way depends on the outcome of this case, and I have no financial interest in the outcome.

3. In preparing this Declaration, I considered the following materials, the subject matter of which are all within the scope of my education and professional experience:

- The ‘180 Patent, Ex. 1001;
- The Petition for *Inter Partes* Review of U.S. Patent No. 7,916,180 (“Pet.”);
- the Declaration of R. Michael Guidash (Ex. 1003);
- JP Application Publication No. JP2003-319231 to Matsushima (Certified English Translation + Declaration + Japanese) (Matsushima) (Ex. 1007);
- U.S. Patent No. 6,611,289 (Ex. 1005)(Yu);
- U.S. Patent No. 7,365,780 (Ex. 1006)(Miyazaki);

- U.S. Patent Publ. 2005/0128323 (Ex. 1008)(Choi);
- U.S. Patent No. 7,206,136 (Ex. 1010)(Labaziewicz);
- EP Appl. Pub. No. EP0858208 (Ex. 1014)(Weldy); and
- Exhibits 2005-2012 and 2015-2019.

II. PROFESSIONAL BACKGROUND

4. Based on my qualifications, education, knowledge, expertise, experience, and work background, I believe I am qualified to offer opinions relating to the technology described in the '180 Patent. Exhibit 2014 is a copy of my current *curriculum vitae* ("CV"), detailing my education and experience. Additionally, the following overview of my background pertains to my qualifications for providing expert testimony in this matter.

5. I am a Professor in the Department of Electrical and Microelectronic Engineering (EME) and at the Chester F. Carlson Center for Imaging Science at the Rochester Institute of Technology (RIT) in Rochester, New York. I also serve as the Director of the Image, Video and Computer Vision Laboratory. I joined RIT's full-time faculty in 2004. I have over thirty-four (34) years of industry and academic experience, thirty (30) of which are in the fields of Computer Vision, Digital Image/Video Processing, Pattern Recognition and Machine Learning.

6. I received a Ph.D. in Electrical Engineering from the University of Rochester in 1996. My concentration was in Signal/Image/Video Processing, Pattern Recognition, and Computer Vision. I received a Master of Science Degree in

Electrical Engineering from the University of Rochester in 1992 in the same concentration as listed above, and I received a Bachelor of Science Degree in Electrical and Computer Engineering, *Summa Cum Laude*, from the State University of New York at Buffalo in 1988.

7. Before becoming a full-time professor, I worked for Xerox Corporation from 1988 to 2004. During my 16 years at Xerox, I was – generally speaking – responsible for: a) delivering color management solutions, image processing innovations, architectures, and algorithms for high-end color printing systems, b) xerographic sub-systems for a variety of color products, and c) control systems for toner production facilities. Among other roles, as an Advanced Development Scientist and Manager, I established the Advanced Design Laboratory – an Imaging/Xerographics lab – and provided technical and managerial leadership for the Electrical, Imaging and Xerographics Department. As a Product Development Scientist and Manager, I led the research and development of color management algorithms and image quality metrics for various product platforms. I also led the Image Science, Analysis, and Evaluation area, with twelve to fifteen direct reports and a budget of approximately \$2 million.

8. From 1997 until 2004, I was an adjunct faculty member at the Electrical Engineering Department of the Rochester Institute of Technology and at the Electrical & Computer Engineering Department at the University of Rochester. I

was responsible for teaching undergraduate and graduate coursework in signal, image, video processing, pattern recognition, and communications and performing research in multimedia applications, pattern recognition, image understanding and color engineering.

9. Since joining RIT full time, I have been responsible for teaching several undergraduate and graduate courses in Digital Signal Processing, Digital Image Processing, Digital Video Processing, Engineering Analysis, Random Signal & Noise, Advanced Engineering Mathematics, Matrix Methods, Pattern Recognition, Communications, Modern Control Theory, and Linear Systems.

10. I proposed, developed and introduced the “Digital Video Processing” and the “Advanced Neural Network and Deep Learning: Part 1” courses; and reestablished the Pattern Recognition course at the Electrical Engineering Department at RIT. These graduate courses were instrumental in providing MS/PhD students with the proper foundation and knowledge in all aspects of the subject areas in order to perform in-depth research in the field and continue to advance the state of the art.

11. The Digital Video Processing course is designed to provide a thorough and comprehensive coverage of the field. Topics covered include the mathematical representation of digital video including motion and time-varying image formation models, spatio-temporal sampling/reconstruction, sampling structure conversions,

motion estimation using optical flow, block-based, pel-recursive, Bayesian and point correspondence type methodologies, segmentation, motion tracking, filtering, restoration, super-resolution and compression.

12. The Pattern Recognition course, on the other hand, covers pertinent concepts in Bayes decision theory, linear and nonlinear classifiers, artificial neural networks, feature selection/generation/extraction and clustering.

13. The graduate course titled: “Advanced Neural Networks and Deep Learning: Theory, Mathematics and Algorithms: Part 1” is intended to provide an in-depth comprehensive study of the theory, mathematics and algorithms for advanced neural networks and their usage in deep learning. It is primarily targeted for upper graduate students that are planning to pursue advanced studies/research in the field. The course begins with an in-depth study of the mathematical methodologies for neural networks and optimization (zero-, first- and second-order) techniques. It then progresses to provide a thorough study of shallow and deep neural networks architectures and algorithms, activation functions, regression, two- and multi-class classification, unsupervised learning, feature engineering/selection, backpropagation along with applications to a variety of engineering problems.

14. I am currently working to develop a follow-on course (Part 2) to the Advanced Neural Networks and Deep Learning course described above. This course is intended to cover convolutional and recurrent style neural networks, principles of

feature engineering, kernel methods, tree-based learners, attention mechanisms/transformers, reinforcement learning and generative adversarial networks. This course is targeted to debut in Fall 2025.

15. My current research focuses on machine learning for object tracking/remote sensing applications; image/video processing for multimedia, military & biomedical applications; and computer vision and three-dimensional scene reconstruction. As a principal investigator (PI) or co-principal investigator, I have acquired almost \$6 million in research funding since joining RIT and have managed multiple government grants from the Department of Defense as well as several corporate grants from Hewlett-Packard, Lenel, and Data Physics. I am currently managing (as PI) a multiyear government grant from the Department of Defense titled “Target Detection/Tracking and Activity Recognition from Multimodal Data.” In this project, we propose to develop operational target detection/tracking techniques and activity recognition/understanding methods that can leverage multimodal data in a fusion framework using deep learning algorithms while providing accurate and near real-time performance.

16. In 2012, I was awarded the Prestigious Trustees Scholarship, the highest award at RIT with regard to research recognition.

17. I am the author or co-author of 38 peer-reviewed journal publications.

18. I have also authored or co-authored 102 conference and workshop publications and a book entitled Advanced Linear Algebra for Engineers with MATLAB, published by CRC Press in February 2009, and am a named inventor on multiple U.S. and foreign patents.

19. I am a senior member of the Institute of Electrical and Electronic Engineers and a member of the IEEE Signal Processing Society, the Electrical Engineering Honor Society, and Eta Kappa Nu.

20. With respect to the technologies relevant to the '180 Patent, I have extensive experience in developing computer vision and digital image/video processing algorithms and techniques that utilize single and/or multiple RGB as well as hyperspectral/multispectral and/or multimodal camera systems for motion estimation, segmentation, registration, classification, identification, pattern recognition, shape recognition/matching, stereo imaging, facial recognition, biomedical image processing, compression, surveillance systems, 3d scene reconstruction, machine learning, deep learning for a variety of applications including object recognition and tracking, video analysis, video surveillance, change detection, biomedical, color engineering, grayscale and color document processing.

21. A complete statement of my industrial and academic records including a listing of the above publications and patents is included with my curriculum vitae in Exhibit 2014.

III. RELEVANT LEGAL STANDARDS

22. I have been asked to provide my opinion as to whether certain claims of the ‘180 Patent are obvious over specific combinations of Matsushima, Yu, Weldy, Choi and Labaziewicz.

23. The opinions I am expressing in this report involve the application of my knowledge and experience to the evaluation of certain references with respect to the ‘180 patent. My formal knowledge of patent law is no different than that of any lay person. Therefore, I have requested the attorneys from Volpe Koenig, who represent Intellectual Ventures, to provide me with guidance as to the applicable patent law in this matter. The paragraphs below express my understanding of how I must apply current principles related to patent validity to my analysis.

24. I understand that an IPR is a proceeding before the USPTO for evaluating the patentability of an issued patent’s claims based on prior-art patents and printed publications.

25. I understand that the claims of a patent are reviewed from the point of view of a hypothetical person of ordinary skill in the art (“POSITA”) at the time of the filing of the patent. The “art” is the field of technology to which a patent relates.

26. I understand that in determining whether a patent claim is anticipated or obvious in view of the prior art, the Patent Office must apply the *Phillips* standard to construe the claims.

27. I understand that, in this proceeding, Petitioners have the burden of proving that the challenged claims of the '180 Patent are unpatentable by a preponderance of the evidence. I understand that "preponderance of the evidence" means that a fact or conclusion is more likely true than not true.

28. I understand that there are two ways in which prior art may render a patent claim unpatentable. First, the prior art can "anticipate" the claim. Second, the prior art can render the claim "obvious" to a POSITA. I understand that for an invention claimed in a patent to be patentable, it must not be anticipated and must not be obvious based on what was known before the invention was made. For purposes of this Declaration only, I have applied the definition of a POSITA proposed in the Petition.

29. I understand that a patent claim may be invalid as "anticipated" under 35 U.S.C. § 102 if each and every limitation of the claim as construed by the court is found, either expressly or inherently, in a single prior art reference, such as a publication or patent, that predates the claimed subject matter. I also understand that a patent claim may be invalid as obvious under 35 U.S.C. § 103 if the differences between the subject matter claimed and the prior art are such that the claimed subject matter as a whole would have been obvious to a POSITA at the time the invention was made. I also understand that several factual inquiries underlie a determination of obviousness. These inquiries include (1) the scope and content of the prior art, (2) the

level of ordinary skill in the field of the invention, (3) the differences between the claimed invention and the prior art, and (4) any objective evidence of non-obviousness (i.e., “secondary considerations”).

30. I also understand that, when a party alleges obviousness based on a combination of references, that party should identify a reason why a POSITA would have been motivated to combine the asserted references in the manner recited in the claims and to explain why a POSITA would have had a reasonable expectation of success in making such combinations.

31. I understand that an obviousness analysis permits the application of “common sense” in examining whether a claimed invention would have been obvious to a POSITA. For example, I understand that combining familiar elements according to known methods and in a predictable way may suggest obviousness when such a combination would yield nothing more than predictable results. And I understand a party asserting obviousness should still provide a specific motivation to combine the references as recited in the claims and explain why one would have reasonably expected to succeed in doing so.

32. I understand that one indicator of non-obviousness is when a prior art reference leads in a different direction or discourages that combination, recommends steps that would not likely lead to the patent’s result, or otherwise indicates that a seemingly inoperative device would be produced.

IV. THE SPECIFICATION OF THE ‘180 PATENT

A. Background of the ‘180 Patent

33. The Background of the ‘180 Patent discussed several challenges associated with implementing a “zoom” feature in digital cameras. One challenge involved the power and time required to move the optical elements associated with a zoom lens, which limited the ability of “optical zoom” to acquire multiple fields of view in rapid and/or simultaneous fashion. From the ‘180 Patent:

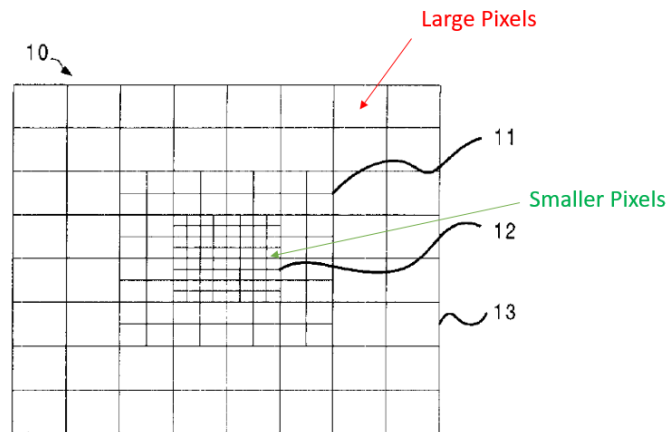
One obstacle in the challenge to deliver higher image quality is the lens system of digital cameras. The ability to image with different fields of view (zoom in and out) is a highly desired feature. Zoom, as performed by the lens system, is known as “optical zoom”. This desirable ‘zoom lens’ feature adds additional components, size and cost to a lens system. The zoom lens also requires significant *power and time to operate*. The time to move the optical elements in the zoom lens limits the ability to *acquire multiple fields of view in rapid and/or simultaneous fashion*. Ex. 1001, 1:46-55 (emphasis added).

34. Digital cameras provided an alternative to “optical zoom” which the ‘180 Patent described as “electronic zoom.” The ‘180 Patent went on to explain that “electronic zoom” resulted in a pronounced loss of resolution. As the ‘180 Patent explained:

Digital camera suppliers have one advantage over traditional film providers in the area of zoom capability. Through electronic processing, digital cameras can provide ‘electronic zoom’ which provides *the zoom capability by cropping the outer regions of an image and then electronically enlarging the center region* to the original size of the image. In a manner similar to traditional enlargements, a degree of resolution is lost when performing this process. Further, since digital cameras capture discrete input to form a picture rather than the

ubiquitous process of film, the lost resolution is more pronounced. As such, although ‘electronic zoom’ is a desired feature, it is not a direct substitute for ‘optical zoom.’ Ex. 1001, 1:56-66 (emphasis added).

35. Another known alternative discussed in the ‘180 Patent for capturing different fields of view was a foveal image sensor. In a foveal imaging sensor, “the pixels in the central fovea region have a smaller size than the pixels arranged ... about the central region.” Ex. 2005, Abstract. An exemplary foveal imaging sensor is illustrated below:



Ex. 2005, Figure 1.

36. In a foveal image sensor, the small pixels in the center (or fovea) provide a higher resolution in the relatively narrow field of view of the fovea, and pixels around the fovea provide a lower resolution in the area surrounding the fovea. The ‘180 Patent disparaged foveal image sensors as deficient, because they had high resolution only in the narrow field of view associated with the fovea:

... Foveal image sensors that use multiple pixels arranged both within and about a central fovea region of the chip can be used to acquire both

a wide and narrow field of view. The pixels in the central fovea region have a smaller size than the pixels arranged in peripheral rings about the central region. The foveal image sensor has high resolution only in the narrow field of view. Ex. 1001, 2:10-16 (emphasis added).

37. In contrast to foveal image sensors that achieved high resolution only in the narrow field of view of the fovea, the Background of the ‘180 Patent identified the need for a camera that simultaneously acquired high resolution images associated with multiple fields of view. *Id.*, 2:21-24 (“[T]here is a need for a high-performance solid-state digital camera that is capable of simultaneously acquiring imag[es] having high resolution using multiple fields of view.”) As the ‘180 Patent explained, a camera capable of simultaneously acquiring multiple high resolution images with different fields of view had utility in machine vision tasks “including search, detection, recognition and tracking” associated with “active vision systems of autonomous or semi-autonomous host systems” ranging from “robots, unmanned vehicles, self-navigating cars, automatic assembly and product inspection systems ... smart weapons and missile defense systems.” *Id.*, 3:32-34 and 3:64-4:9.

B. Overview of the ‘180 Patent

38. The first paragraph of the Detailed Description of the ‘180 Patent summarized the invention as follows:

A digital camera system and methods are described below that provide a digital camera in which multiple fields of view (FOV) of an image are simultaneously acquired. The digital camera system includes a digital camera having two or more camera channels each with independent image sensors. The sensor of each camera channel has an

active area that includes multiple picture elements (pixels), and image capture includes simultaneous or nearly simultaneous use of the multiple camera channels. Each camera channel and associated optics of that camera channel has a predetermined field of view that can be different from other camera channels of the digital camera system. The digital camera system therefore makes possible the formation of multiple high resolution images in which different fields of view are acquired simultaneously. *Id.*, 3:21-36 (emphasis added).

39. Thus, in contrast to the foveal imaging systems (described in the Background) that achieved high resolution only in the narrow field of view of the fovea, the '180 Patent was directed to a system in which multiple high resolution images with different fields of view are acquired simultaneously.

40. Figure 3 (reproduced below with annotations) illustrates “a digital camera 200 configured for simultaneous acquisition of multiple fields of view.” *Id.*, 5:45-46. The digital camera subsystem includes four camera channels 260A-260D (red boxes). *Id.*, 5:56-58. As shown in Figure 4 (also reproduced below with annotations), each of the independently controlled camera channels 260A-260D includes an optics component 290A-290D (orange circles), respectively, and a sensor component 292A-292D (green boxes), respectively. *Id.*, 6:19-22.

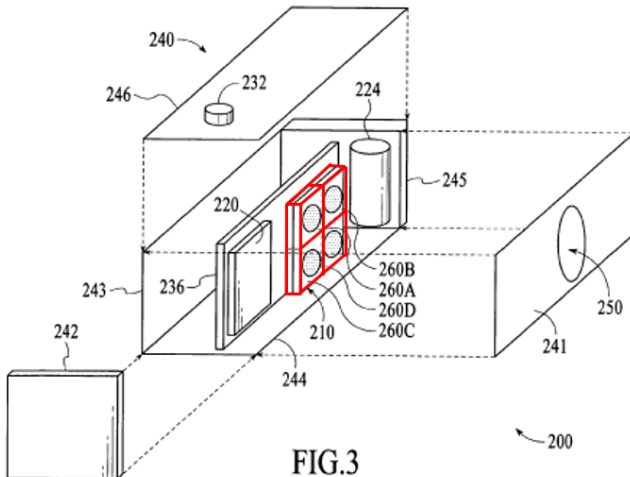


FIG. 3

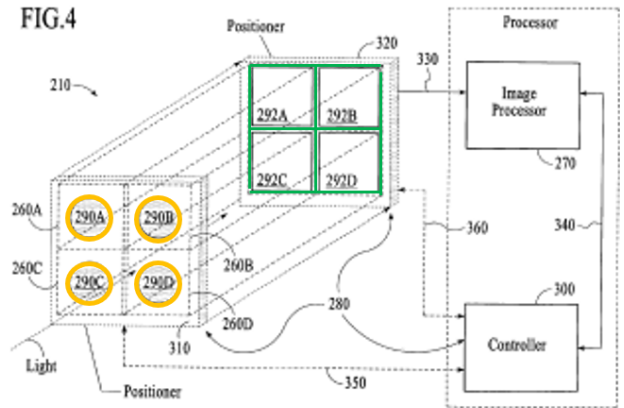


FIG. 4

41. The system disclosed in the ‘180 Patent further includes an “image processor ... configured to generate a combined image or data based at least in part on the images from the first and second camera channels (and additional camera channels when present).” *Id.*, 9:3-5; *see also*, 9:53-57 (“The signal processing circuit 710 may combine the output from signal processing 708 into output data (usually in the form of a recombined full color image)”; 10:7-10 (“These individual images are then combined with additional signal processing circuitry ... to form a full image for output”); 10:42-45 (“[I]ndividual images are created for each of these arrays. Following this process, the individual images are combined or to form one full color or black/white image”); 15:11-12 (“[T]he processor may generate a combined image based, at least in part, on the images from two or more of such optical channels.”)

42. The ‘180 Patent described the “electrical operation of each camera channel” as being “independent of the other camera channels.” In this regard, the

‘180 Patent states:

The combination of the focal plane or image sensor size along with the optical focal length associated with each image sensor is chosen to provide a desired field of view. The electrical operation of each camera channel is independent of the other camera channels and multiple fields of view can be acquired simultaneously. *Id.*, 3:49-54 (emphasis added).

43. Next, the ‘180 Patent identified two electrical parameters to be independently controlled “for each camera channel,” namely, “imager frame rate and integration time.” *Id.*, 3:58-60 (emphasis added). Later in the specification, the ‘180 Patent reiterated its disclosure of independent control of frame rate and integration time for each channel or field of view:

... The digital camera system of an embodiment improves performance of imaging systems and improves functions of search, detection, recognition and tracking by providing simultaneous high resolution imaging in multiple fields of view with optimum electrical operation (such as independent frame rate and integration time control) in each field of view. *Id.*, 4:9-15 (emphasis added).

* * *

... The four camera channels 260A-260D can be operated simultaneously with independent electrical control of features such as integration time control and frame rate ... *Id.*, 5:63-66 (emphasis added).

* * *

... In addition to array area differences between the channels, parameters of the image sensor electrical operation (e.g., integration time, frame rate, etc.) can be configured differently in order to optimize system camera performance in the field of view of one or more specific camera channels. *Id.*, 7:23-27 (emphasis added).

44. The ‘180 Patent explained that the integration time control for each sensor can be accomplished using a technique that was known as rolling mode. *Id.*, 20:48-50. As explained below, operation of an image sensor in a “rolling mode” involves control during a frame of the start and stop times of the integration period for individual rows of pixels in the sensor. An image sensor operating in a “rolling mode” is synonymous with a “rolling shutter,” meaning that the start and end time of the integration interval for each row of the sensor are staggered. A diagram illustrating a rolling shutter from the time of the ‘180 Patent is set forth below. Ex. 2006, Figure 4 (annotations added). The vertical axis (labelled scanline index) corresponds to individual rows of pixels (numbered from 1 to M) on the image sensor, while the horizontal axis corresponds to time. *Id.*, 6:1-5; Ex. 2007, Figure 2A, 1:37-42.

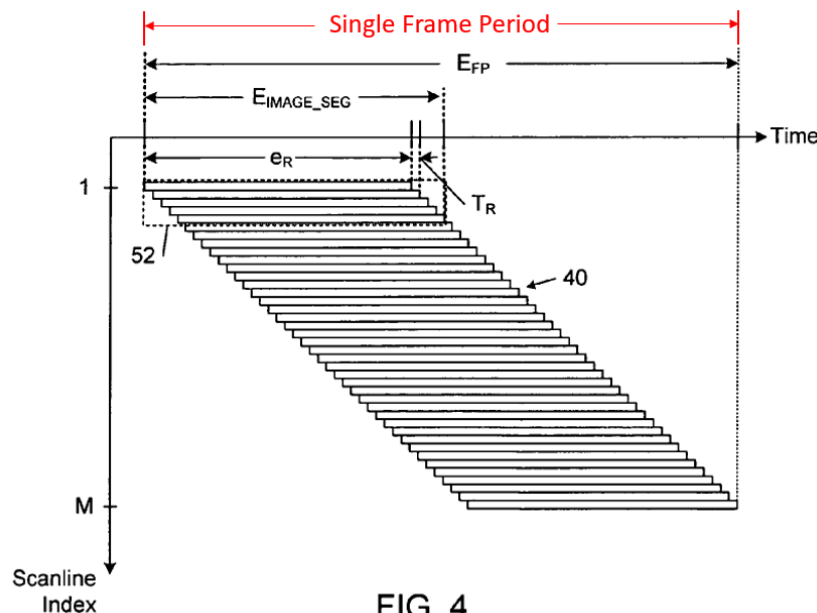


FIG. 4

Ex. 2006, Figure 4.

45. In the diagram above, the time interval labelled e_R , corresponds to the exposure interval for row 1, and T_R corresponds to the time when the information in the first row (or first scanline) is read out. *Id.*, 6:1-5. As shown above, the start time of the interval for each subsequent row (or scanline) in the sensor is some interval after the start time of the exposure interval for the previous row. *Id.*, 6:1-5; Ex. 2007, 1:37-42. In this example, the integration period for each row (or scanline) is the same, but the start and stop times for each row (or scanline) are different. Ex. 2007, 1:42-45.

46. Referring still to the diagram above, the time interval labelled E_{FP} corresponds to the frame exposure period, which extends from the start of the exposure interval of the first row (or scanline) to the stop time of the exposure interval for the last row or scanline. Ex. 2006, 6:5-19. The time interval labelled E_{FP} is also referred to as a “single frame period” and corresponds to the continuous exposure time over which any of the entire array of pixels is integrating photons. Ex. 2009, 11:49-51 (“A single frame period is the continuous exposure time over which any of the entire array of pixels or plate of film is exposed.”) When an image sensor is operating in the rolling mode (or rolling shutter mode), the start and stop time of the integration interval of individual rows (or scanlines) of pixels is controlled during the frame. In embodiments of the ‘180 Patent that use the rolling

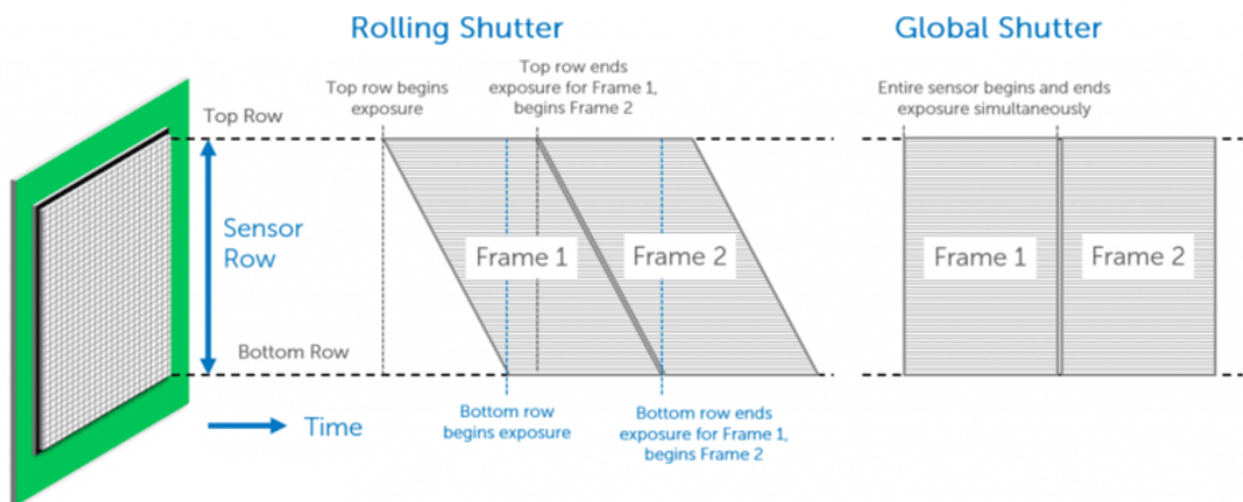
mode, integration control during the frame can occur independently for the sensor in each camera channel / field of view. Ex. 1001, 4:9-15, 5:63-66, 7:23-27 and 20:48-50. As explained more fully later, such embodiments are the subject of claim 22 of the ‘180 Patent, which recites “independently controlling simultaneous data acquisition with each of the first and second channels during a frame.” Ex. 1001, 25:31-33 (emphasis added).

47. For completeness, it bears noting that the ‘180 Patent discloses other embodiments (which are not the subject of claim 22) in which independent control of the simultaneous data acquisition of each of the channels does not occur during the frame. For example, in connection with Figure 4, the ‘180 Patent discloses the use of “positioners 310 and 320” to “position each of the one or more optics portions (e.g., optics portions 290A-290D) of a camera channel” relative to one of “respective sensor portions 292A-292D.” *Id.*, 8:16-38. Here, control of the position of the optics portions (i.e., moving each optics portion into its proper position) would necessarily need to occur before the frame during which data was acquired with the channels.

48. In another example where the simultaneous data acquisition of each of the channels does not occur during the frame, the ‘180 Patent discloses that the image sensors can be operated in a “snap-shot” mode (also referred to as a “global

shutter.”)¹ *Id.*, 20:51. When a snapshot (or global) shutter is used, there is a common exposure period for each of the plurality of rows of pixels which “begins at a common exposure start time ... and ends at a common exposure stop time.” *Ex.* 2019, 19:4-18. In contrast to an image sensor operating in the rolling shutter mode where the start and stop times of the integration interval of individual rows of pixels are controlled during the frame -- in the snapshot (or global) shutter mode, common control signals are applied only at the confines of the frame exposure rather than during the frame, i.e., rather than at some point between the beginning and the end of the exposure interval during which an image sensor captures a single image.

49. The following diagram illustrates the difference between the rolling shutter and global shutter modes:

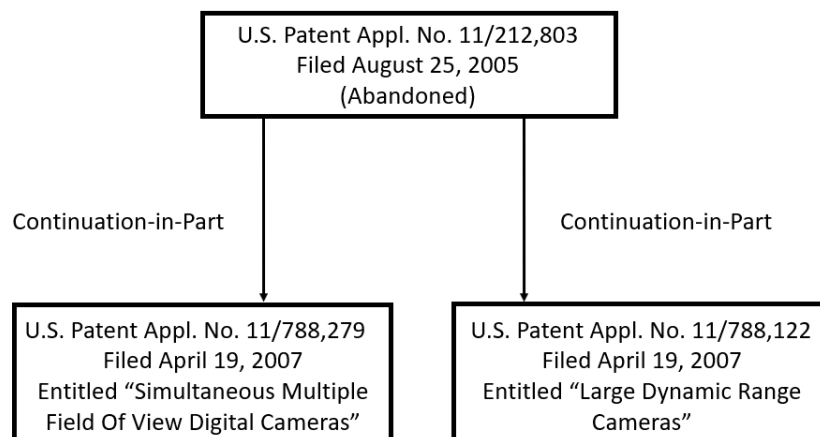


¹ See, e.g., *Ex.* 2007, at 1 (Specifications for Cypress CMOS Image Sensor, 2007) referring to a “snapshot (or global) shutter.”

Significantly, as depicted above, in the rolling shutter mode the start and stop times of the integration interval of individual rows of pixels must necessarily be controlled during the frame time, while in the global shutter mode no such control is used during the frame time.

V. PROSECUTION HISTORY OF THE ‘180 PATENT

50. The specification of the ‘180 Patent was originally filed as U.S. Patent Application No. 11/788,279 on April 19, 2007 (the ‘279 Application). Ex. 1002, 351. The ‘279 Application was a *continuation-in-part* of U.S. Patent Application No. 11/212,803, filed August 25, 2005 (the ‘803 Application). *Id.* As illustrated below, the ‘279 Application was one of *two* continuation-in-part applications filed on the same day (April 19, 2007) that claimed priority to the ‘803 Application.



51. The two continuation-in-part applications filed on April 19, 2007 were directed to different subject matter. More particularly, Application No. 11/788,122 (bottom right) was directed to *increasing the dynamic range* of digital camera

systems in scenes with, e.g., highly varying illumination. The disclosure of Application No. 11/788,122 corresponds to U.S. Patent No. 9,232,158 which is the subject of co-pending IPR2025-00222. The other continuation-in-part application filed the same day was the ‘279 Application, which, as explained above, was directed to the formation of multiple high resolution images in which different fields of view are acquired simultaneously. Ex. 1001, 3:21-36.

52. There were material differences between the specifications of the ‘237 and ‘803 Applications which are pertinent to these proceedings. These differences are discussed below in connection with a description of the prosecution history of each application.

A. Prosecution History of the ‘803 Application

53. Unlike the ‘237 Application, the Background of the ‘803 Application made no mention of the shortcomings of foveal image sensors that achieved high resolution only in the narrow field of view of the fovea. The Background of the ‘803 Application similarly made no mention of the need for a camera that simultaneously acquired high resolution images associated with multiple fields of view. Nor did the specification of the ‘803 Application mention the machine vision applications such as “active vision systems of autonomous or semi-autonomous host systems” ranging from “robots, unmanned vehicles, self-navigating cars, automatic assembly and product inspection systems ... smart weapons and missile defense systems.” Ex.

1001, 3:32-34 and 3:64-4:9. The independent claims filed as part of the '803 Application likewise made no mention of the simultaneous acquisition of images in multiple fields of view. For example, original claim 1 of the '803 Application recited:

1. A digital camera comprising:
a plurality of arrays of photo detectors, including:
a first array of photo detectors to sample an intensity of light; and
a second array of photo detectors to sample an intensity of light;
signal processing circuitry, coupled to the first and second arrays of photo detectors, to generate a composite image using (i) data which is representative of the intensity of light sampled by the first array of photo detectors, and (ii) data which is representative of the intensity of light sampled by the second array of photo detectors; and
wherein the first array of photo detectors, the second array of photo detectors, and the signal processing circuitry are integrated on or in the same semiconductor substrate.

Ex. 1050, 1172.

54. The other original independent, namely claim 34, also made no mention of the simultaneous acquisition of images in multiple fields of view. *Id.*, 1177-1178.

55. In the first Office Action, the Examiner rejected independent claims 1 and 34 as obvious based on U.S. Patent Publ. 2005/0128509 (Tokkonen) (Ex. 2015) in view of U.S. Patent No. 7,123,298 (Schroeder) (Ex. 2016). Ex. 1030, 515-517.²

² The Examiner also applied U.S. Patent No. 6,611,289 (Yu) (Ex. 1005) to certain dependent claims. Ex. 1030, 527-528.

Among other techniques, Schroeder disclosed a light sensor with separate regions where “[e]xposure control can be individually applied to the regions of the light sensor to optimize the signal-to-noise ratio of each image signal component.” Ex. 2016, 3:47-49. In this respect, Schroeder disclosed “an exposure control circuit that applies exposure control to each of the regions independently.” *Id.*, 7:21-22. Significantly, however, neither Tokkonen or Schroeder mentioned the simultaneous acquisition of high resolution images in multiple fields of view, or independent control of image acquisition during a frame.

56. In response, the Applicant amended the independent claims to recite: “timing and control logic to provide timing and control information to the signal processing circuitry. the first array of photo detectors and/or the second array of photo detectors,” and argued that the amended claims were distinguishable from the cited references. Ex. 1050, 38, 44 and 54-58.

57. The Examiner responded with a Final Office Action, wherein he maintained the rejection of the independent claims over Tokkonen and Schroeder. The Applicant subsequently allowed the ‘803 to become abandoned in due course. Ex. 1050, 1-2.

B. Prosecution History of the ‘279 Application

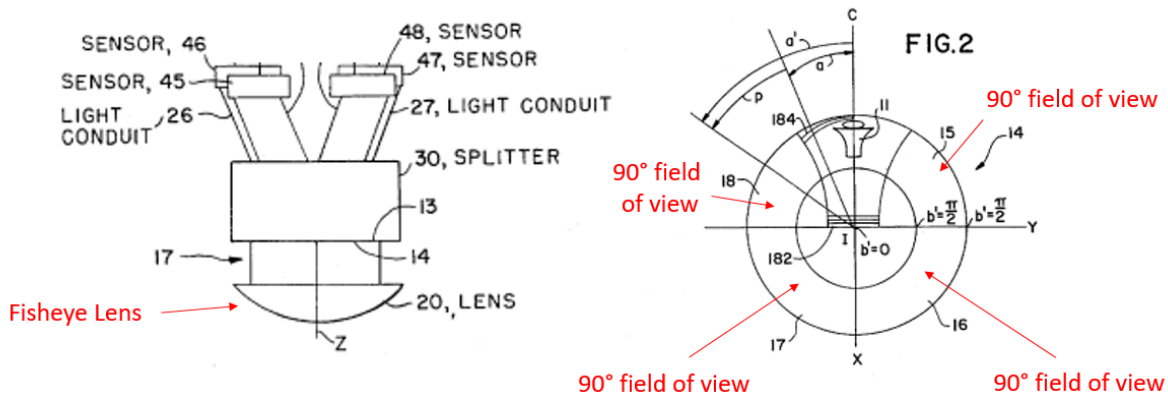
58. Prior to the abandonment of the ‘803 Application, the Applicant filed the ‘279 Application as a continuation-in-part of the ‘803 Application. Unlike the

‘803 Application, (i) the Background of the ‘279 Application (which matured into the ‘180 Patent) discussed, *inter alia*, the shortcomings of foveal image sensors that achieved high resolution only in the narrow field of view of the fovea, and the need for a camera that simultaneously acquired high resolution images associated with multiple fields of view, and (ii) the specification of the ‘279 Application explained that simultaneously acquired high resolution images associated with multiple fields of view would be useful in machine vision applications such as “active vision systems of autonomous or semi-autonomous host systems” ranging from “robots, unmanned vehicles, self-navigating cars, automatic assembly and product inspection systems ... smart weapons and missile defense systems.” Ex. 1002, 352-353 and 356. Moreover, in contrast to the Detailed Description of the ‘803 Application, the first paragraph of the Detailed Description of the ‘279 Application described a “digital camera system” that “makes possible the formation of multiple high resolution images in which different fields of view are acquired simultaneously.” *Id.*, 355.

59. Consistent with these changes in the Background and Detailed Description, and in contrast to the independent claims of the ‘803 Application, the independent claims of the ‘237 Application recited, *inter alia*, the independent control of simultaneous data acquisition using channels having different fields of view to “provide an image having a relatively high resolution”“ (original

independent claim 1), and “independently controlling simultaneous data acquisition with each of the first and second channels during a frame” (independent claims 17, 22 and 36). Ex. 1002, 389 and 391-392.

60. In the first Office Action, the Examiner did not apply Tokkonen, Schroeder or Yu -- which did not discuss the problem of simultaneously acquiring high resolution images associated with multiple fields of view. Rather, the Examiner rejected the independent claims as being anticipated by U.S. Patent No. 5,691,765 (Schieltz) (Ex. 2017). Ex. 1002, 188-194. In contrast to the references applied in the ‘803 Application, Schieltz disclosed a camera with a fisheye lens for use in surveillance systems. Ex. 2017, 2:22, 3:11-14. In the embodiment shown below, the image from the fisheye lens was split into four 90° views, each of which impinged respectively a different sensor. *Id.*, 3:16-18 and 3:52-57.



Id., Figure 1 (reproduced in part) and Figure 2 (red annotations added). One object of Schieltz was “to provide a surveillance camera apparatus” having “sufficient

resolution for effective zooming.” *Id.*, 1:41-52 and 2:3-8 (emphasis added). Thus, the Examiner mapped the original independent claims to a reference which simultaneously acquired images associated with multiple fields of view, each of which had sufficient resolution for effective zooming.

61. In response to the first Office Action, the Applicant amended independent claim 1 as follows:

1. (Currently Amended) A digital camera comprising:

a plurality of channels, wherein each channel includes an optics component and an array of photo-detectors integrated on a semiconductor substrate, the plurality of channels including a first channel having a first field of view (FOV) comprising a first angular extent of a scene imaged by the camera and a second channel having a second FOV comprising a second angular extent of the scene imaged by the camera ~~that is different than the first FOV~~, wherein the first and second angular extents are different; and

a processing component coupled to the plurality of channels, the processing component configured to independently control simultaneous data acquisition with each of the plurality of channels, the processing component configured to combine data of a frame from at least one of the plurality of channels to provide an image having a relatively high resolution.

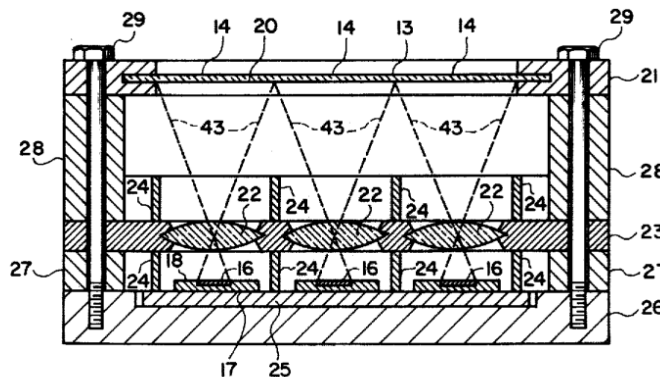
Ex. 1002, 131. The Applicant made similar amendments to the other independent claims. *Id.*, 133-134, 136.

62. In the accompanying Remarks, the Applicant argued that Schieltz failed to disclose first and second fields of view having different angular extents. In this regard, the Applicant argued:

Schieltz discloses that a single image 14 is equally divided into four separate components 15, 16, 17, and 18. Each component of the

image is then sent through its respective light conduit and is separately processed. However, *Schieltz* fails to disclose that the components 15, 16, 17, and 18 correspond to different angular extents of a scene. To the contrary, Fig. 2 of *Schieltz* appears to illustrate that the components 15, 16, 17, and 18 are identical in size and thus have same angular extents. *Id.*, 140 (emphasis added).

63. The Examiner responded with a Final Rejection of the independent claims as being obvious over *Schieltz* in view of U.S. Patent No. 4,323,925 (Abell) (Ex. 2018). Ex. 1002, 99-107. Abell disclosed a system for “arraying a plurality of image sensor modules so that their individual imaging resolutions may be combined to provide high total imaging resolution.” Ex. 2018, 2:6-9. In applying Abell, the Examiner again relied on a reference which simultaneously acquired images associated with multiple fields of view, each of which had high resolution. Figure 2 of Abell (Ex. 2018) is reproduced below:



64. In rejecting the claims as obvious over *Schieltz* and Abell, the Examiner reasoned as follows:

... [*Schieltz*] does not teach wherein the four image sensors each capture images that are images captured with different angular extents of the scene.

Abell et al depicts in Figures 2 and 3 and teaches on Column 5, Lines 18-29 the use of a camera that has multiple image sensors and in one embodiment images the scene with a lens and then transmits the captured image to multiple image sensors using fiber bundles similar to Schieltz et al. However, Abell et al teaches that it is advantageous to eliminate the single lens and fiber bundle optics and use the optics depicted in Figure 2 in order to reduce the cost of the imaging system. This configuration results in each image sensor receiving a different angular extent of the scene. Ex. 1002, 101.

65. The Applicant next filed a Response After Final Action in which the Applicant amended claim 1 as follows:

1. (Currently Amended) A digital camera comprising:
 - a plurality of channels, wherein each channel includes an optics component and an array of photo-detectors integrated on a semiconductor substrate, the plurality of channels including a first channel having a first field of view (FOV) comprising a first angular [[extent]] width of a scene imaged by the camera and a second channel having a second FOV comprising a second angular [[extent]] width of the scene imaged by the camera, wherein the first and second angular [[extents]] widths are different; and
 - a processing component coupled to the plurality of channels, the processing component configured to independently control simultaneous data acquisition with each of the plurality of channels, the processing component configured to combine data of a frame from at least one of the plurality of channels to provide an image having a relatively high resolution.

Ex. 1002, 82. The Applicant made similar amendments to the other independent claims. *Id.*, 84-85, 87. In the accompanying Remarks, the Applicant argued that “[t]here is no suggestion in *Abell* that the optical configuration of the arrayed lenses results in different angular widths ... “ *Id.*, 91.

66. The Examiner responded with a Notice of Allowance. *Id.*, 56.

VI. CHALLENGED CLAIMS OF THE '180 PATENT

67. Petitioner challenges independent claims 1 and 22, and dependent claims 2-3, 10-12, 23-25, 28, 30 and 32-33 of the '180 Patent. The challenged independent claims are set forth below.

Starting with independent claim 1, this claim recites:

1. A digital camera comprising:

a plurality of channels, wherein each channel includes an optics component and an array of photo-detectors integrated on a semiconductor substrate, the plurality of channels including a first channel having a first field of view (FOV) comprising a first angular width of a scene imaged by the camera and a second channel having a second FOV comprising a second angular width of the scene imaged by the camera, wherein the first and second angular widths are different; and

a processing component coupled to the plurality of channels, the processing component configured to independently control simultaneous data acquisition with each of the plurality of channels, the processing component configured to combine data of a frame from at least one of the plurality of channels to provide an image having a relatively high resolution.

68. Claim 1 recites independently controlling simultaneous data acquisition with first and second optical channels, each of which has a field of view with a different angular width. Claim 1 also covers combining data acquired from the first and second channels “to provide an image having a relatively high resolution.”

69. Turning next to independent claim 22, this claim recites:

22. A method comprising:

configuring a first optics component relative to a first image sensor to form a first channel having a first field of view (FOV) that comprises a first angular width of a scene;

configuring a second optics component relative to a second image sensor to form a second channel having a second FOV that comprises a second angular width of the scene, wherein the first and second angular widths are different;

independently controlling simultaneous data acquisition with each of the first and second channels during a frame; and

combining data received during the frame from one or more of the first and second channels to provide an image.

70. Claim 22 recites independently controlling simultaneous data acquisition with first and second optical channels during a frame, where each channel has a field of view with a different angular width.

VII. CLAIM CONSTRUCTION

71. I understand that the claim limitations at issue must be construed under *Phillips v. AWH Corp.*, 415 F.3d 1303 (Fed. Cir. 2005), and that the claim language, when read in light of the specification and the prosecution history, elucidates the meaning of the claim language.

A. “combine data of a frame ... to provide an image having a relatively high resolution” (claim 1)

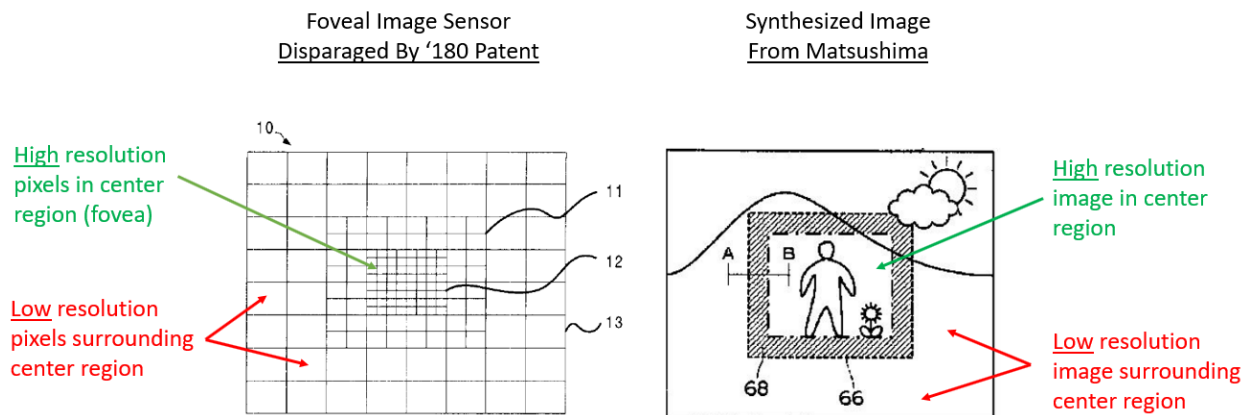
72. In claim 1, the “image having a relatively high resolution” formed by “combin[ing] data of a frame” corresponds to an image formed from multiple high resolution images with different fields of view acquired simultaneously. Petitioner

chose not to propose a formal construction of “combin[ing] data of a frame ... to provide an image having a relatively high resolution” as recited in claim 1. However, in its mappings to Matsushima,³ Petitioner argues that this limitation is met by combining a single high resolution image from one field of view with a low resolution image from another field of view. Petitioner’s implicit construction of this limitation must be rejected, as the intrinsic evidence demonstrates that an “image having a relatively high resolution” formed by “combin[ing] data of a frame” (as recited in claim 1) must be an image formed by combining multiple high resolution images with different fields of view acquired simultaneously.

72. Petitioner’s implicit construction corresponds to the output of the prior art foveal image sensor disparaged in the specification of the ‘180 Patent. As explained above, the specification disparaged the prior art foveal image sensor (below left) because it resulted in an image having a high resolution only in the narrow field of view corresponding to the center of the image. Ex. 1001, 2:10-16. Just like the image produced by the foveal image sensor (left side, Ex. 2005, Figure

³ As noted above, the limitation in claim 1 that requires combining data of a frame from “at least one of the plurality of channels” clearly covers combining data of a frame from the first and second channels to provide an image having a relatively high resolution, and that the Petition asserts that this limitation from claim 1 is met by combining images 62A and 62B in Matsushima. Pet., 57.

1), Matsushima's synthesized image (right side) corresponds to an image having a high resolution only in the narrow field of view corresponding to the center of the image.



73. In connection with addressing the shortcomings of foveal image sensors that achieved high resolution only in the narrow field of view of the fovea, the Background of the '180 Patent identified the need for a camera that simultaneously acquired high resolution images associated with multiple fields of view. Ex. 1001, 2:21-24 (“[T]here is a need for a high-performance solid-state digital camera that is capable of simultaneously acquiring imag[es] having high resolution using multiple fields of view.”) The Detailed Description that followed then described a “digital camera system” that uses separate channels to capture “multiple high resolution images in which different fields of view are acquired simultaneously,” together with an “image processor ... configured to generate a combined image or data based at least in part on the images from the first and

second camera channels (and additional camera channels when present).” *Id.*, 3:21-36 and 9:3-5 (emphasis added).

74. I understand that claims should not be read so broadly as to encompass prior art distinguished in the specification. In the present case, the specification disparaged images having high resolution only in a narrow field of view surrounded by low resolution data, in favor of a system that uses separate channels to simultaneously capture multiple high resolution images in different fields of view and then generates a combined image with a relatively high resolution based on the images from the separate channels. Ex. 1001, 3:21-36 and 9:3-5.

75. Moreover, as explained previously, during prosecution of the ‘279 Application, the Examiner only applied references which simultaneously acquired images associated with multiple fields of view, each of which had a high resolution. More specifically, the Examiner applied Schieltz, which simultaneously acquired images associated with multiple fields of view, each of which had sufficient resolution for effective zooming. Ex. 1002, 188-194 and Ex. 2011, 1:41-52 and 2:3-8. The other reference applied by the Examiner -- Abell -- disclosed simultaneously acquired images associated with multiple fields of view, each of which had high resolution. Ex. 1002, 99-107 and Ex. 2012, 2:6-9 (disclosing “arraying a plurality of image sensor modules so that their individual imaging resolutions may be combined to provide high total imaging resolution.”)

76. As noted above, Petitioner chose not to propose a formal construction of “combin[ing] data of a frame ... to provide an image having a relatively high resolution” as recited in independent claim 1. However, in its mappings to Matsushima, Petitioner argues that this limitation is met by combining a single high resolution image from one field of view with a low resolution image from another field of view. Petitioner’s implicit construction of this limitation must be rejected, as it is entirely divorced from the specification. Rather, the specification and prosecution history demonstrate that an “image having a relatively high resolution” formed by “combin[ing] data of a frame” (as recited in claim 1) must be an image formed from multiple high resolution images with different fields of view acquired simultaneously.

B. “independently controlling ... data acquisition ... *during a frame*” (claim 22)

77. Claim 22 recites “independently controlling ... data acquisition ... during a frame.” In this context, a “frame” is digital data corresponding to a single image. See, e.g., Ex. 1001, 20:19-21 (referring to “one frame of digital camera data.”) The phrase “during a frame” corresponds to the exposure interval during which an image sensor captures a single image.” See, e.g., Ex. 2009, 11:49-51 (“A single frame period is the continuous exposure time over which any of the entire

array of pixels ... is exposed.”)⁴ Consistent with Patent Owner’s proposed construction, the ‘180 Patent repeatedly speaks of controlling the “frame rate,” which is typically expressed as the number of single images captured by the sensor per second. Ex. 1001, 4:57-60 (“imager frame rate”); 4:9-15 (“independent frame rate), 5:63-66 (“frame rate”); and 7:23-27 (“frame rate.”)

78. Petitioner appears to agree with Patent Owner’s interpretation equating “during a frame” to the exposure interval during which an image sensor captures a single image.” For example, the Petition states that “[a] POSITA would have understood that “during a frame” refers to during a period of time that data for an image frame is acquired.” Pet., 7-8 (emphasis added). However, in its proposed construction of “during a frame,” the Petition omits the connection to the period of time that data for an image is acquired. Instead, the Petition proposes to construe “during a frame” as simply “during a period of time” (namely, any period of time) - - which effectively reads the limitation out of the claim. Pet., 6. Petitioner needed to take this tact because none of the references relied on in the Petition show application of the required independent control occurring during the period of time that data is acquired by an image sensor.

⁴ See also, Ex. 2006, 6:5-19 (describing the “frame exposure period” in a rolling mode shutter as extends from the start of the exposure interval of the first row (or scanline) to the stop time of the exposure interval for the last row or scanline.)

79. When used as a preposition as in the case of claim 22, the term “during” imparts a temporal requirement and means “at some time between the beginning and the end of a period.” Cambridge Dictionary, Ex. 2011, 1. Thus, “during a frame” as used in claim 22 should be construed as “at some point between the beginning and the end of the exposure interval during which an image sensor captures a single image.”

VIII. A PERSON HAVING ORDINARY SKILL IN THE ART

80. A person of ordinary skill in the art (“POSITA”) as of the effective filing date of the ‘180 Patent would have had a bachelor’s degree in electrical engineering, computer science, computer engineering, physics, or a related subject, and two to three years of work experience in digital imaging.

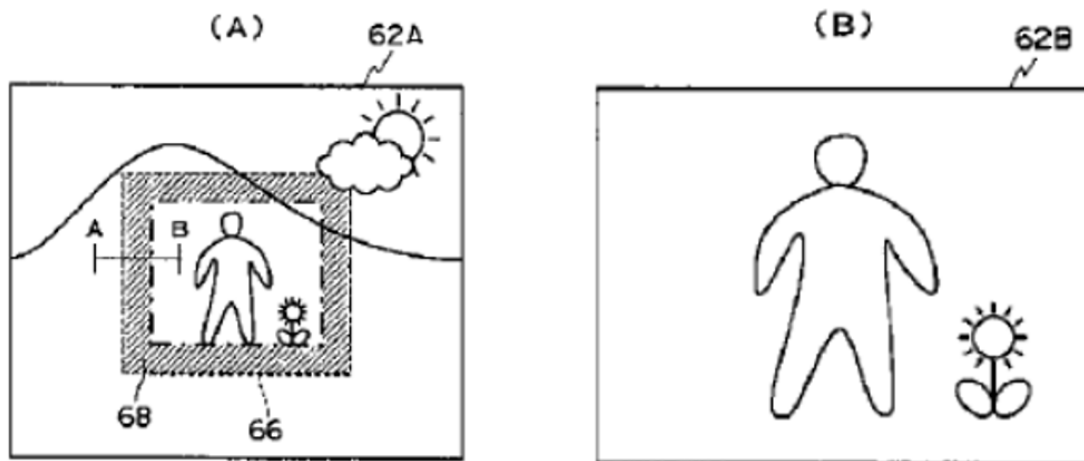
IX. GROUND 1 FAILS TO RENDER CLAIMS 1, 2-3 AND 10-12 UNPATENTABLE BECAUSE MATSUSHIMA-YU FAILS TO COMBINE MULTIPLE HIGH RESOLUTION IMAGES WITH DIFFERENT FIELDS OF VIEW

81. Ground 1 challenges independent claim 1 as obvious over the combination of Matsushima and Yu (“Matsushima-Yu”). However, with respect to limitation in claim 1 reciting “the processing component configured to combine data of frame ... to provide an image having a relatively high resolution,” Ground 1 of the Petition relies solely on Matsushima. Pet., 57-59. As explained below, Matsushima fails to meet this limitation because the reference fails to combine data from multiple

high resolution images with different fields of view acquired simultaneously. Rather, just like the images from the foveal sensor disparaged in the Background of the ‘180 Patent, Matsushima’s synthesized images have a high resolution only in a single narrow field of view surrounded by low resolution data. Ex. 1001, 3:21-36 and 9:3-5.

A. Overview of Matsushima

82. Matsushima discloses “a digital camera having a wide-angle first imaging system and a telephoto second imaging system.” Ex. 1007, 1. The first imaging system captures a first image 62A (left side) with a wide angle lens, and the second imaging system captures a second image 62B (right side) using a telephoto lens with a longer focal length than the lens used in the first imaging system. *Id.*, 1, 3.

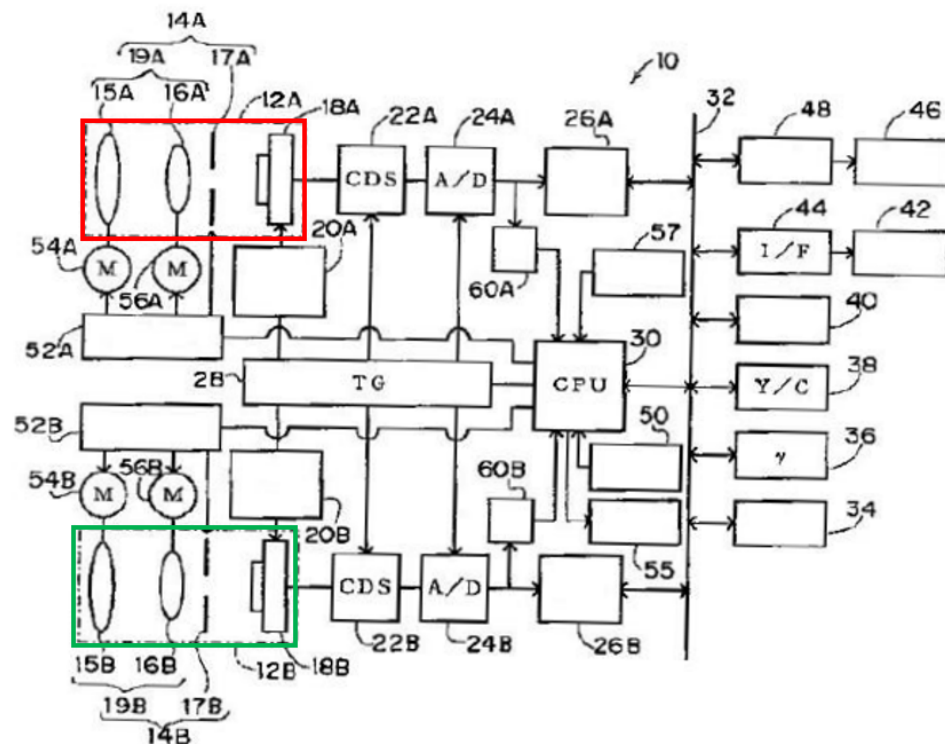


Id., 1.

83. Image 62B (captured by the second imaging system using the telephoto lens) is then “scaled down to the same magnification” as “captured image 62A taken using the first imaging system” and “synthesized with the captured image 62A taken using the first imaging system.” *Id.*, 1. As explained in Matsushima:

The synthesizing means synthesizes the first captured image with the image that has been scaled down using the scale-down means. At this time, an image that has been scaled down using the scale-down means is generated from an image taken with the telephoto second imaging system, so the amount of information is greater than the amount of information in the central portion of the first captured image. This enables the image quality in the center of the image to be improved. Ex. 1007, [0011].

84. Figure 1 of Matsushima (reproduced below) discloses a first imaging system 12A (red box) and a second imaging system 12B (green box).



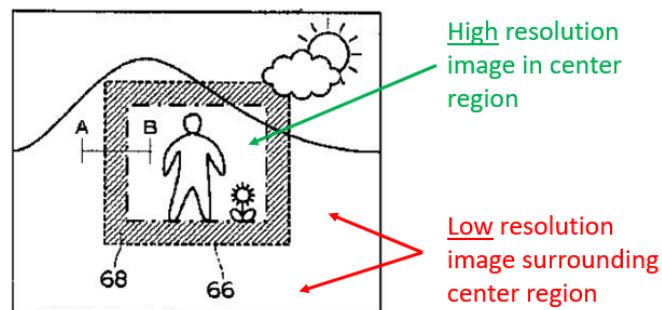
First imaging system 12A (red box) includes “[i]maging optics 14A” which “are composed of a first lens group 19A with an imaging lens 15A and a focus lens 16A, and an aperture 17A.” *Id.*, [0019]. Similarly, the second imaging system 12B (green box) includes “imaging optics 14B” which “are composed of a second lens group 19B with an imaging lens 15B and a focus lens 16B, and an aperture 17B.” *Id.* “Lens group 19A is a wide-angle single focal length lens whose shooting angle α is wider than the shooting angle β of lens group 19B.” *Id.*, [0020]. The first imaging system 12A includes CCD 18A, and the second imaging system includes CCD 18B. *Id.*, [0021]. “CCD 18A and CCD 18B can be ... CCDs of the same size, that is, the same number of pixels.” *Id.*

B. Matsushima Fails To Combine Multiple High Resolution Images With Different Fields Of View

85. As explained above, the limitation in claim 1 reciting an “image having a relatively high resolution” formed by “combin[ing] data of a frame” (as recited in claim 1) is an image formed from multiple high resolution images with different fields of view acquired simultaneously. The Petition asserts that this limitation from claim 1 is met by combining images 62A and 62B in Matsushima. Pet., 57.⁵

⁵ In this regard, the Petition (at 57) argues: “Matsushima describes *the processing component* discussed at Ground 1:[1.2.1]-[1.2.2] *is configured to combine* (synthesis processing) *data of a frame* (data of an image frame 62A and data of an image frame 62B) *from at least one of the plurality of channels* (first and second imaging systems 12A and 12B) *to provide an image having a relatively high resolution* (an image

However, only one of the images (i.e., image 62A) used to form the synthesized image in Matsushima corresponds to a high resolution image. The other image (i.e., image 62B) corresponds to a low resolution image. As shown in the annotated version of Figure 4 of Matsushima below, Matsushima's synthesized image includes a high resolution image only in the narrow field of view in the center of the image, while the surrounding areas correspond to a low resolution image.



86. Just like the image produced by the foveal image sensor and disparaged in the '180 Patent, Matsushima's synthesized image corresponds to an image having a high resolution only in the narrow field of view corresponding to the center of the image. Thus, Matsushima fails to disclose an "image having a relatively high

frame of FIG. 6 with improved image quality). Ex.1007, [0007] ("a telephoto captured image is **combined** in the center of a wide-angle captured image")" (emphasis in original, citations omitted).

resolution” formed by combining data from multiple high resolution images with different fields of view acquired simultaneously, as required by claim 1.

X. GROUND 1 FAILS TO RENDER CLAIM 22 UNPATENTABLE BECAUSE MATSUSHIMA-YU FAILS TO DISCLOSE INDEPENDENTLY CONTROLLING SIMULTANEOUS DATA ACQUISITION DURING A FRAME

87. Claim 22 recites “independently controlling simultaneous data acquisition with each of the first and second channels during a frame.” This claim limitation requires the combination of: (i) independent control of simultaneous data acquisition with the first and second channels, and (ii) that such independent control take place during a frame. Both aspects must be present for the limitation to be satisfied. The Petition identifies a laundry list of aspects of Matsushima and/or Yu as purporting to meet this limitation; however, not one of these aspects maps to “independently controlling simultaneous data acquisition with each of the first and second channels during a frame.”

88. As explained above, the limitation in claim 22 requiring application of independent control “during a frame” requires independently controlling data acquisition at some point between the beginning and the end of the exposure interval during which an image sensor captures a single image.

89. As explained above, operation of an image sensor in a “rolling mode” (illustrated again below) as disclosed in the ‘180 Patent is an example of controlling data acquisition ... during a frame. Ex. 1001, 20:48-50.

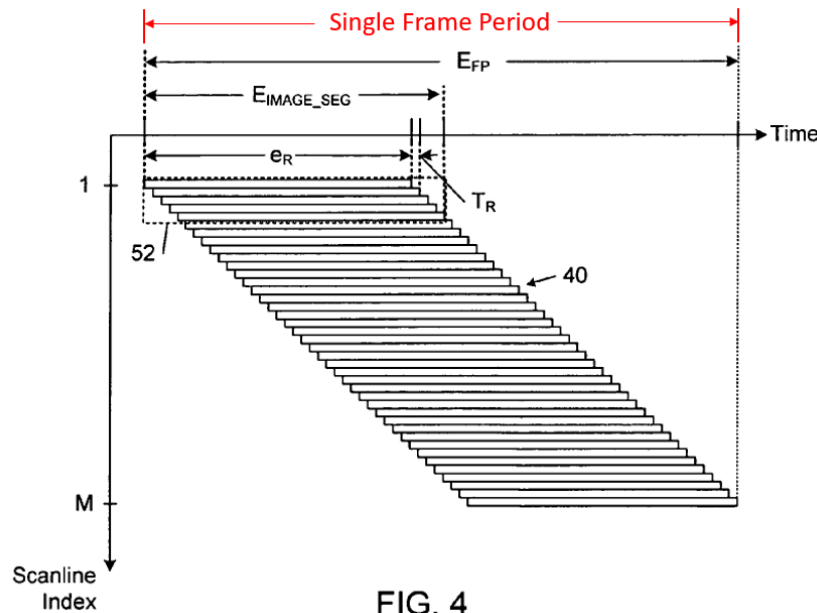


FIG. 4

Ex. 2006, Figure 3. In the rolling mode, the start time of the interval for each subsequent row (or scanline) in the sensor is some interval after the start time of the exposure interval for the previous row. *Id.*, 6:1-5; Ex. 2007, 1:37-42. Thus, as explained above, when an image sensor is operating in the rolling mode, the start and stop time of the integration interval of individual rows (or scanlines) of pixels is controlled during the frame. By contrast, a sensor can be operated in a “snap-shot” mode (also referred to as a “global shutter”) where common control signals are applied only at the confines of the frame exposure rather than during the frame, i.e., rather than at some point between the beginning and the end of the exposure interval during which the image sensor captures a single image.

90. In Ground 1, the Petition alleges that the limitation in claim 22 reciting “independently controlling simultaneous data acquisition ... during a frame” is met

by Matsushima alone, or in combination with Yu. Pet., 21-34. However, Petitioner's analysis appears to skip over the temporal aspect of this control requirement, namely that it occur "during a frame." There is no evidence that any of the control applied by Matsushima or Yu occurs "during a frame" -- as opposed, e.g., before the frame. Set forth below is analysis of each of the disclosures from Matsushima and Yu relied on in the Petition for the limitation in question.

A. Control Of Matsushima's Lenses And Apertures Does Not Occur "During A Frame"

91. The Petition maps each of (i) calculations performed by Matsushima's CPU that control "the driving circuits 52A and 52B of the imaging lenses 15A and 15B, the focus lenses 16A and 16B, and the apertures 17A and 17B" and (ii) the operation of Matsushima's automatic focus (AF) function, to the limitation requiring application of independent control "during a frame." Pet., 21 and 26. However, there is no evidence that any of this control occurs "during a frame," i.e., at a point between the beginning and the end of the exposure interval during which the image sensor captures an image. See Section II(B), *supra*. On the contrary, a POSITA would have expected any adjustments to Matsushima's lens (e.g., autofocusing) and apertures to occur before the exposure interval during which the image sensor captures a single image.

B. Matsushima's Timing Signals Do Not Control Data Acquisition "During A Frame"

92. The Petition also maps Matsushima's "timing signals" to the limitation requiring application of independent control "during a frame." Pet., 24. The Petition (at 24) relies on the following disclosure in Matsushima discussing timing signals:

A timing signal generating circuit (TG) 28 provides appropriate timing signals to the CCD drive circuits 20A and 20B, the CDS circuits 22A and 22B, and the A/D converters 24A and 24B in response to commands from the CPU 30, and each circuit is driven synchronously by timing signals applied from the timing signal generating circuit 28. Ex. 1007, [0027] (emphasis added).

93. For multiple reasons, this passage fails to disclose independent control of data acquisition "during a frame." First, Matsushima discloses that these timing signals are used to control the timing of the retrieval of information from the CCDs, rather than the acquisition of data by each CCD. See Ex. 1007, [0023] ("The accumulated signal charges are retrieved by CCD drive pulses applied by CCD drive circuits 20A and 20B, and are sequentially output from CCD 18A and CCD 18B.") Second, the Petition provides no evidence that these timing signals apply control "during a frame," i.e., at a point between the beginning and the end of the exposure interval during which the image sensor captures an image. See Section II(B), *supra*. On the contrary, a POSITA would have understood that Matsushima's timing signals for retrieving data from the CCDs could occur after the exposure interval during which the image sensor captures a single image.

C. Pressing Matsushima’s “Release Button” Does Not Independently Control Data Acquisition With First And Second Channels “During A Frame”

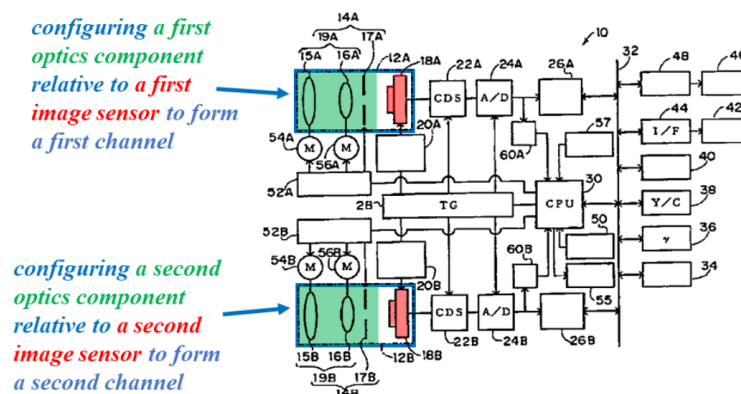
94. The Petition also maps the pressing of Matsushima’s “release button” to the limitation requiring application of independent control “during a frame.” Pet., 24-25. Pressing of the release button in Matsushima does not equate to the application of *independently controlling* data acquisition with *each of the first and second channels “during a frame.”* First, there is no evidence that depression of the release button *independently* controls the first and second channels. Rather, to the extent actuation of the release button corresponds to application of “control,” the release button corresponds to *common* control -- rather than *independent* control -- with respect to the first and second channels. Second, actuation of the release button does not occur “during a frame,” i.e., at a point *between the beginning and the end of the exposure interval* during which the image sensor captures a single image. On the contrary, a POSITA would have understood that actuation of the release button would necessarily need to occur *before* the exposure interval during which the image sensor captures an image.

D. Matsushima’s Correlated Double Sampling Circuit, A/D Converters And Integration Circuits Do Not Independently Control Data Acquisition With First And Second Channels “During A Frame”

95. The Petition also maps Matsushima’s “correlated double sampling circuits 22A and 22B, and analog-to-digital (A/D) converters 24A and 24B” and

“integration circuits 60A and 60B” to the limitation requiring application of independent control of data acquisition with each channel “during a frame.” Pet., 25 and 28. This mapping fails for at least two reasons.

96. First, Matsushima’s correlated double sampling circuits 22A and 22B, analog-to-digital (A/D) converters 24A and 24B, and integration circuits 60A and 60B are not part of the first and second channels as mapped in the Petition. As shown in the image from the Petition reproduced below, the channels simply do include correlated double sampling circuits 22A and 22B, analog-to-digital (A/D) converters 24A and 24B and integration circuits 60A and 60B.



Pet., 19. Because the correlated double sampling circuits 22A and 22B, analog-to-digital (A/D) converters 24A and 24B and integration circuits 60A and 60B are not part of the first and second channels, it is clear that any control of these components does not amount to “independently controlling simultaneous data acquisition with each of the first and second channels ...,” as claimed.

97. Second, the correlated double sampling circuits 22A and 22B, analog-to-digital (A/D) converters 24A and 24B, and integration circuits 60A and 60B are downstream of the CCDs 18A and 18B that acquire the images. The Petition provides no evidence that the correlated double sampling circuits 22A and 22B, analog-to-digital (A/D) converters 24A and 24B, and integration circuits apply control “during a frame,” i.e., at a point between the beginning and the end of the exposure interval during which the image sensor captures an image.

E. Matsushima Fails To Teach Independent Control Of Integration Time Or Exposure Time For Its Imaging Systems “During A Frame”

1. The Text Of Matsushima Describes A Common Integration Time Or Exposure Time For Both Imaging Systems

98. While Matsushima describes a dual-imaging system with separate CCD sensors, its exposure control mechanism applies a single charge accumulation time to both CCDs, indicating that integration time is not independently managed for each sensor. Matsushima’s automatic exposure (AE) control relies on a single luminance value to determine a common aperture setting and shutter speed, which are then applied uniformly to both imaging systems. The common integration time control for both imaging systems in Matsushima fails to meet the limitation in claim 22 requiring “independently controlling simultaneous data acquisition with each of the first and second channels.”

99. In Matsushima, “CPU 30 performs various calculations such as focus evaluation calculations and AE [automatic exposure] calculations.” Ex. 1007, [0031]. However, Matsushima makes clear that a single charge accumulation time is used for controlling both CCD 18A and 18B in Matsushima’s two imaging systems. From Matsushima:

For AE control, the subject luminance (imaging EV value) is determined based on integration of the R, G, and B signals in a single frame by the integration circuits 60A and 60B, and the aperture value and shutter speed are determined based on this imaging EV value. The apertures 17A and 17B are driven via the drive circuits 52A and 52B, and the CCD 18A and CCD 18B charge accumulation time is controlled using an electronic shutter to reach the determined shutter speed. ...

During imaging and recording, the AF operation is performed when the release button is “half-pressed,” and the metering operation is repeated several times to obtain the exact imaging EV. The final aperture value and shutter speed for imaging is then determined based on the imaging EV. The apertures 17A and 17B are then driven to the final aperture value when the release button is “fully press”, and the charge accumulation time is controlled by the electronic shutters at the determined shutter speed. *Id.*, [0034]-[0035] (emphasis added).

100. The fact that Matsushima refers to “the charge accumulation time” (in the singular) of both “the CCD 18A and CCD 18B” indicates that the same charge accumulation time is used to drive both devices. Matsushima’s references to “the subject luminance” (singular), one EV value (singular), “the final aperture value” (singular) used to drive for both apertures 17A and 17B, and “the determined shutter speed (singular), likewise indicate that one luminance (EV value) is determined for the subject, and a common aperture value as well as a common shutter speed are used

in both imaging systems. Matsushima's use of a common accumulation time for both of its CCDs fails to disclose "independently controlling simultaneous data acquisition with each of the first and second channels," as recited in claim 22.

2. The Testimony Of Petitioner's Expert Alleging That Matsushima Uses Different Integration Times Is Unsupported By The Reference

101. Petitioner's expert asserts that Matsushima discloses images with different integration times, but this assertion is unsupported by the actual disclosure of Matsushima. As explained below, the cited passages relied on in the expert declaration do not reference independent integration time control or variation between the two imaging systems. Instead, Matsushima consistently refers to the subject luminance and the charge accumulation time in the singular, indicating that a single exposure control is applied to both CCDs. The expert's attempt to infer different integration times based on a supposed difference in luminance across fields of view is not grounded in Matsushima's teachings.

102. In his Declaration, Petitioner's expert stated;

99. Matsushima performs independent control of aperture and charge accumulation time for each channel to achieve "optimal exposure adjustment" for image acquisition, because the AE control is based on independently determined imaging EV values of the channels with different FOVs, e.g., different EV values for each channel, where the corresponding portions of the FOVs of the same scene have different brightness. Ex.1007, [0017]. The AE control is performed by independently controlling charge accumulation times for the channels, based on the independent determination of the first subject luminance for the first FOV and the second subject luminance for the second FOV.

Ex.1007, [0034]. Matsushima describes that the first subject luminance of shooting angle α and the second subject luminance of shooting angle β are determined independently (by circuit 60A for first channel, and 60B for second channel independently). Ex.1007, [0034] (AE control is based on the subject luminance (imaging EV value) according to the scene of the respective FOV).

Ex. 1003, ¶99 (emphasis added).

103. The assertions that Matsushima has “different EV values for each channel” and that in Matsushima there is “a first subject luminance” and “a second subject luminance” are not supported (either expressly or inherently) in Matsushima. The citations (paragraphs [0017] and [0034] of Matsushima) that Petitioner’s expert cited for this assertion are set forth below:

[0017] FIG. 1 is a block diagram showing the configuration of a digital camera. This digital camera 10 has two independent imaging systems (a first imaging system 12A and a second imaging system 12B), and subject images are formed on the light-receiving surfaces of CCD 18A and 18B via imaging optics 14A and 14B, respectively.

* * *

[0034] For AE control, the subject luminance (imaging EV value) is determined based on integration of the R, G, and B signals in a single frame by the integration circuits 60A and 60B, and the aperture value and shutter speed are determined based on this imaging EV value. The apertures 17A and 17B are driven via the drive circuits 52A and 52B, and the CCD 18A and CCD 18B charge accumulation time is controlled using an electronic shutter to reach the determined shutter speed. ... (emphasis added).

The portions of Matsushima (above) relied on by Petitioner’s expert do not disclose “different EV values for each channel” -- the actual text discloses “this EV value” (singular). Nor does the text of Matsushima describe “a first subject luminance”

and “a second subject luminance” -- instead, the actual text of Matsushima refers to “the subject luminance” (singular).

104. Later, Petitioner’s expert alleges:

102. In Matsushima, the charge accumulation time/integration times of the two channels would have independent values, because the first and second channels are controlled independently based on captured images of different subject luminance with different FOVs. Ex.1007, [0034]. For example, the first sensor imaging the larger FOV (see 62A including the sun, the sky and other background objects) has a different subject illuminance (e.g., a higher subject illuminance) from the second sensor imaging the smaller FOV (see 62B including a person and a flower), thereby a different integration time (e.g., a shorter integration time) is determined for the first channel. (Emphasis added).

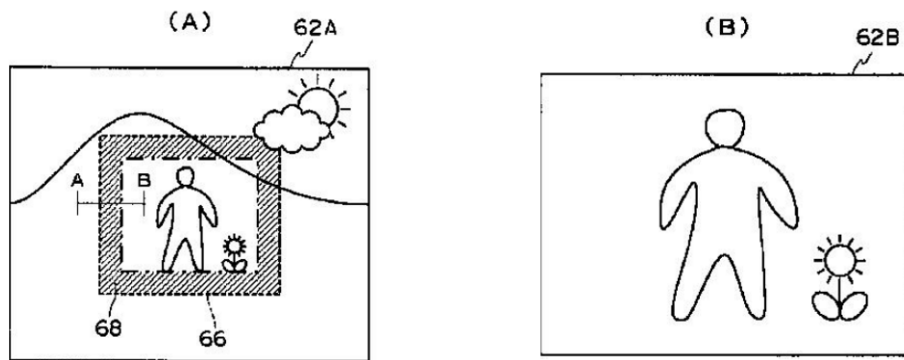
The text of Matsushima (e.g., at [0034]-[0035]) say the opposite of what Petitioner’s expert alleges. Specifically, those portions of Matsushima describe “the subject luminance” (singular) and “the charge accumulation time” (singular) -- rather than different subject luminances or different integration times. In making this analysis, Petitioner’s expert has strayed far and wide from what a POSITA would have understood from the actual words of Matsushima.

3. Given The Known Obstacles To Synthesizing Digital Images With Different Exposures, Interpreting Matsushima As Disclosing Different Integration Times Would Be Inconsistent With The Prior Art As A Whole

105. Petitioner’s argument that Matsushima’s images 62A and 62B have different exposure times—and that this equates to different integration times—is both inconsistent with Matsushima’s disclosure and contrary to the understanding of

the prior art. Matsushima explicitly describes a synthesis process aimed at achieving a natural boundary between combined images, a goal that the prior art recognized as particularly challenging when merging images with different exposures. More specifically, prior research, including studies on image mosaics, highlighted the difficulty of blending images with differing exposures without producing unnatural seams. Thus, Petitioner's argument that images 62A and 62B in Matsushima have different exposure times (which the Petition equates with different integration times) is inconsistent with the teachings of the prior art as a whole, which recognized the challenge of achieving a natural boundary (as called for Matsushima) when synthesizing images with different exposures.

106. As shown in Figures 4A and 4B of Matsushima (reproduced below), Matsushima disclosed that “a scaled down image 66 is generated from a captured image 62B” by scaling down image 62B “to the same magnification (shooting angle) as the captured image 62A,” and then “both images are synthesized by replacing the image in the center of the captured image 62A corresponding to the scaled down image 66, with the scaled down image 66.” Ex. 1007, [0049].



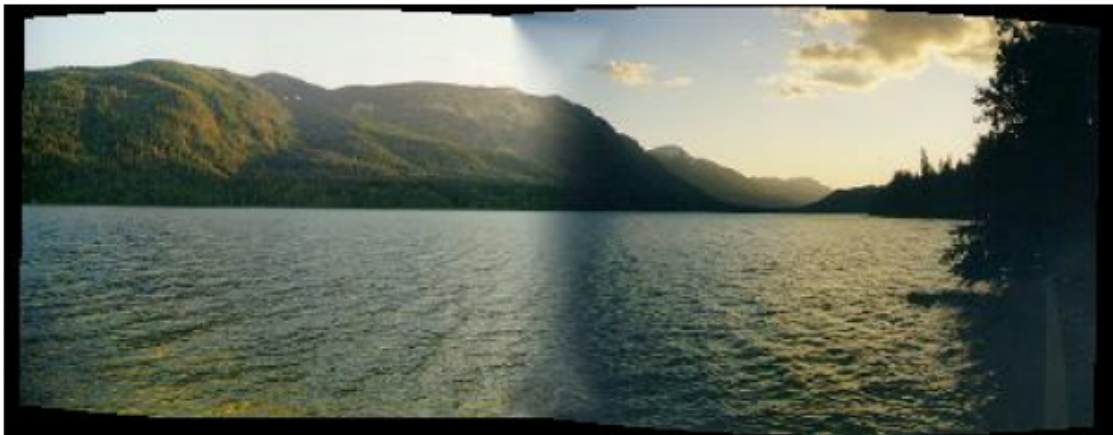
107. Matsushima recognized that “simply replacing the image in the center of the captured image 62A with the scaled down image 66 may result in an unnatural boundary between the two images,” and stated that “correction data is generated to correct the image in the peripheral regions 68 based on the image data in the peripheral region 68 (shaded region) of the scaled down image 66 and the image data in the peripheral region 68 of the captured image 62A.” Ex. 1007, [0050]-[0051] (emphasis added). The “correction data” is used so that “the boundary between the captured image 62A and the scaled down image 66 can be kept from becoming unnatural.” *Id.*, [0057]. Matsushima’s “correction data” is represented by the “correction curve” illustrated in Figure 5 of the reference, which functions to “blend” the areas of overlap.

108. Matsushima does not state that its techniques were useful for synthesizing images with different exposures. This is not surprising, because synthesizing images with different exposures in a manner that resulted in a natural boundary was a known problem.

109. As explained in one paper from the time (authored by researchers at Harvard and Microsoft):

When capturing images to create mosaics, automatic cameras often change their exposure settings. Even if the images are blended in the areas of overlap, if the exposure difference between images is too high, it will give the panorama a creased look around the edges of the overlap. Feathering [10] the effect of the blend into the rest of the image will help remove creases, but the exposure change will still be too abrupt to appear natural. (Figure 7) Uyttendaele, Matthew, Ashley Eden, and Richard Skeliski. “Eliminating ghosting and exposure artifacts in image mosaics.” *Proceedings of the 2001 IEEE Computer Society Conference on Computer Vision and Pattern Recognition. CVPR 2001*. Vol. 2. IEEE, 2001. Ex. 2012, 4 (emphasis added).

The unnatural boundary after synthesis of the images with different exposures is illustrated in Figure 7(A) of the paper (reproduced below):



(A)

Id., 6. Figure 7(A) (above) shows a two image mosaic where two images with different exposures have been blended and feathered. *Id.*, 4, 6. The boundary between the two images is a highly noticeable and far from “natural” boundary

between images 62A and 66 called for in Matsushima. *Id.*, 6 (referring to “the sharp transition between images in the center of the mosaic.”)

110. The paper discussed two methods for potentially ameliorating the unnatural boundary shown in Figure 7(A), neither of which resulted in a natural boundary. One method, referred to as a “block based exposure adjustment,” resulted in the image shown in Figure 7(B) of the paper (reproduced below):



(B)

After “block based exposure adjustment,” the boundary between the two images is still highly noticeable and far from “natural” boundary between images 62A and 66 called for in Matsushima.

111. The other method for potentially ameliorating the unnatural boundary method involved the application of an “exposure compensation algorithm” and resulted in the image shown in Figure 7(C) of the paper (reproduced below):



(C)

While somewhat improved, the boundary between the two images is still noticeable and far from “natural” boundary between images called for in Matsushima.

112. When viewed in light of the prior art as a whole -- which recognized the challenge of synthesizing images with different exposures in a manner that resulted in the natural boundary called for by Matsushima -- the actual wording of Matsushima makes sense. More specifically, Matsushima’s description of a common charge accumulation for both CCD 18A and CCD 18B would have resulted in images having the same exposure. While Matsushima’s blending of images with the same exposure may indeed have resulted in the natural boundary called for by the reference, there is no description in Matsushima or in the Petition itself of any techniques at the time that could have synthesized images with different exposures in a way that would have resulted in the natural boundary called for by Matsushima. Thus, in addition to deviating from the actual text of Matsushima, Petitioner’s

reading of the Matsushima is inconsistent with the state of the art, which recognized that achieving a natural boundary⁶ between images with different exposures was problematic. For this additional reasons, the Petitioner has failed to demonstrate that Matsushima expressly or inherently discloses independent control of the integration time of channel.

4. There Is No Evidence That Matsushima’s Integration Time Or Exposure Time Control Is Applied “During A Frame”

113. Finally, even if Matsushima independently controlled the integration time of each sensor (it does not), there is no evidence that such integration time control is applied “during the frame,” i.e., at a point between the beginning and the end of the exposure interval during which the image sensor captures an image. Matsushima does not disclose that its integration control operates in a “rolling mode” (or using a “rolling shutter”) where the start and stop time of the integration interval of individual rows (or scanlines) of pixels is controlled during the frame. Nor is

⁶ Avoiding an unnatural boundary between image seams was central to Matsushima, which, like Yu, was directed to images like those captured with film that would be pleasing to the eye. By contrast, the ‘180 Patent was directed to “visual imaging tasks including search, detection, recognition and tracking” associated with “active vision systems of autonomous or semi-autonomous host systems” ranging from “robots, unmanned vehicles, self-navigating cars, automatic assembly and product inspection systems ... smart weapons and missile defense systems.” Ex. 1001, 3:32-34 and 3:64-4:9. While high resolution images are required for these machine vision applications, there is no requirement that the images be pleasing to the eye.

such an implementation inherent that Matsushima. For example, a sensor can be operated in a “snap-shot” mode (also referred to as a “global shutter”) where common control signals are applied only at the confines of the frame exposure rather than during the frame, i.e., at some point between the beginning and the end of the exposure interval during which the image sensor captures a single image. Thus, Matsushima fails to disclose integration time control that is applied “during the frame.”

F. The Petition Presents No Evidence That Yu Independently Controls Data Acquisition With First And Second Channels “During A Frame”

1. Overview of Yu

114. Yu is directed to “digital photography,” and to a digital camera that takes digital photographs (still images) with colors and details that more closely replicate that of film cameras. Starting with its “Description of Related Art,” Yu describes the capability of film-photography to produce high-resolution images and vivid colors, and explained the shortcomings of existing digital photography techniques that lacked the high-resolution and vivid colors produced by film. From Yu:

Description of Related Art

Digital photography is one of the most exciting technologies to emerge during the twentieth century. With the appropriate hardware and software (and a little knowledge), anyone can put the principles of digital photography to work. Digital cameras are on the cutting edge of digital photography. ...

Digital cameras, however, do not work in the way as the traditional film cameras do. In fact, they are more closely related to computer scanners, copiers, or fax machines. ...

Nevertheless, there are many cases in which digital cameras simply could not be used due to the limited resolutions from today's digital cameras. Film-based photographs have immeasurably higher resolutions than digital cameras. The comparison magnitude may be somewhere millions of pixels versus tens thousands of pixels in the digital cameras. Although, it is theoretically possible to design a photosensitive chip with multimillion of pixels, the cost of such chip would be a forbidden number and may consequently drag the digital cameras out of the consumer market. ...

To have color images with higher resolutions, the number of photocells in a sensor must be increased. ... Therefore there is a great need for a generic solution that makes digital cameras capable of producing high resolution images without enormously incurring the cost of photosensitive chips with multimillion photocells.

A second noticeable quality between digital cameras and film-based cameras is the dynamic range. Films have the necessary chemical pigments to make colors much more vivid and more adaptive to light conditions than current digital cameras can do. This is largely due to the limited pixel depth the current digital cameras could produce and the limited sensitivity of the photocells in the image sensor. There is thus a further need for digital cameras that produce better colors and details in a greater range. ... Ex. 1005, 1:12-2:16 (emphasis added).

115. After discussing the deficiencies of digital photography as compared to film-based photography, Yu positioned its invention as having “been made in consideration of the above described problems and needs” in order to improve the image resolution and color ranges of existing digital cameras by providing “film-like true color” images “without incurring substantial costs.” From Yu:

SUMMARY OF THE INVENTION

Recent product introductions, technological advancements, and price cuts, along with the emergence of email and the World Wide Web, have helped make digital cameras the hottest new category of consumer electronics products. But the image qualities, noticeably the image resolutions and color dynamic ranges, have limited the popularity of digital cameras among consumers. Under the constraints of improving image qualities without incurring substantial costs to the digital cameras, the present invention discloses improved digital cameras that use multiple image sensors with multiple lenses.

The present invention has been made in consideration of the above described problems and needs and has particular applications to digital cameras that are demanded to produce digital images of high qualities. ... Using a set of digital image processes embedded in a digital signal processing chip, images from the three color image sensors are processed with reference to the image from the black-and-white image sensor and subsequently produce high quality and film-like true color digital images. Ex. 1005, 2:23-49 (emphasis added).

116. The Detailed Description Of The Preferred Embodiments of Yu also emphasized that Yu was directed to a digital camera that, in some cases, had the same look as a “regular film camera” and that could capture digital photographs that could be printed “on glossy paper.” From Yu:

FIG. 4B shows another arrangement of four lenses 402, 404, 406 and 408 in a regular camera lens opening 410 so that the exterior appearance of a digital camera with multiple sensors and multiple lenses may look the same as a regular film camera. Ex. 1005, 6:17-21 (emphasis added).

* * *

For completeness, along with digital image processing circuitry 338, post circuitry 350 includes all necessary circuits to further process vector or color image 340. It is understood to those skilled in the art that some of the functions performed may include image compression in a conventional format such as JPEG and necessary I/O functions so that color images generated by digital camera 300 may be downloaded

to other computing devices for further artistic editing/processing and subsequently for printing on glossy paper or publication on the Internet or World Wide Web. Ex. 1005, 7:9-18 (emphasis added).

2. There Is No Evidence That Yu Independently Controls Data Acquisition With First And Second Channels “During A Frame”

116. Assuming *arguendo* that Yu independently controlled the integration time of each sensor, there is no evidence that such integration time control is applied “during the frame,” i.e., at a point between the beginning and the end of the exposure interval during which the image sensor captures an image. Yu does not disclose that its integration control operates in a “rolling mode” (or using a “rolling shutter”) where the start and stop time of the integration interval of individual rows (or scanlines) of pixels is controlled during the frame. Nor is such an implementation inherent that Yu. As described above, Yu is directed to a digital camera that takes digital photographs (still images) with colors and details that more closely replicate that of film cameras. Thus, Yu’s sensor would have been expected to operate in a “snap-shot” mode (also referred to as a “global shutter”) where common control signals are applied only at the confines of the frame exposure rather than during the frame, i.e., at some point between the beginning and the end of the exposure interval during which the image sensor captures a single image. Thus, Yu fails to disclose (expressly or inherently) integration time control that is applied “during the frame.”

G. It Would Not Have Been Obvious To Combine Matsushima And Yu As Proposed In The Petition

117. The Petition argues in the alternative that it would have been obvious to apply Yu's independent integration time control to Matsushima. However, in the combination as proposed, Matsushima's images 62A and 62B would have had different exposures, resulting in a synthesized image with an unnatural boundary. *See*, Section X(E)(3), *supra*. Matsushima's focus on maintaining a natural boundary in the synthesized image between images 62A and 62B would have discouraged a POSITA from using different integration times to capture images 62A and 62B.

XI. GROUND 2 FAILS TO RENDER DEPENDENT CLAIMS 28 AND 30 UNPATENTABLE

118. Dependent claims 28 and 30 and are also challenged in Ground 2. However, the mappings for these dependent claims in Ground 2 rely on the mapping for independent claim 22 from Ground 1. Since Ground 1 of the Petition fails to demonstrate that all of the limitations of claim 22 are met by Matsushima-Yu, Ground 2 of the Petition has similarly failed to demonstrate a reasonable likelihood of success with respect to dependent claims 28 and 30.

XII. GROUND 3 FAILS TO RENDER CLAIMS 22-23, 28 AND 30 UNPATENTABLE

119. With respect to independent claim 22, Ground 3 relies on Yu for the limitation reciting "independently controlling simultaneous data acquisition with each of the first and second channels during a frame." Pet., 84-85. As explained

above, Yu fails to meet this limitation. Dependent claims 23, 28 and 30 are also challenged in Ground 3. However, the mappings for these dependent claims in Ground 3 rely on the mapping for independent claim 22 from Ground 3 which, as discussed in the paragraph immediately above, is deficient. Therefore, Ground 3 fails to demonstrate a reasonable likelihood of success with respect to dependent claims 23, 28 and 30.

XIII. DECLARATION

120. I, Dr. Eli Saber, declare that all statements made herein on 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.

Date: April 30, 2025

By: 

Dr. Eli Saber