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UNITED STATES PATENT AND TRADEMARK OFFICE

BEFORE THE PATENT TRIAL AND APPEAL BOARD

ARASHI VISION (U.S.) LLC (D/B/A INSTA360),
Petitioners,

v.

GOPRO, INC.,
Patent Owner

Case IPR2024-01052
U.S. Patent No. 11,336,832

**SUPPLEMENTAL DECLARATION OF HASSAN FOROOSH PH.D.
IN SUPPORT OF PATENT OWNER'S RESPONSE**

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1. I have been retained on behalf of GoPro, Inc. (“Patent Owner”) in connection with the above-captioned *inter partes* review (IPR). I have been retained to provide my opinions in support of Patent Owner’s Response. I am being compensated for my time at my standard rate of \$650 per hour. I have no interest in the outcome of this proceeding.

2. In preparing this declaration, I have reviewed and am familiar with the Petition for IPR2024-01052, U.S. Patent No. 11,336,832 (“the ’832 patent”) and its file history, and all other materials cited and discussed in the Petition (including the declaration of Petitioner’s expert Dr. Aggelos Katsaggelos), and cited and discussed in this Declaration. I have also reviewed the Board’s Institution Decision.

3. The statements made herein are based upon my own knowledge and opinion. This Declaration represents only the opinions I have formed to date. I may consider additional documents as they become available or other documents that are necessary to form my opinions. I reserve the right to revise, supplement, or amend my opinions based on new information and on my continuing analysis.

I. QUALIFICATIONS

4. I have been retained to serve as a technical expert in this matter based upon my educational and research experience, and specifically my work in the fields of computer vision, image processing, and optics. My curriculum vitae

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(“CV”) submitted as Exhibit 2002, which contains details about my education, experience, publications, and other qualifications to render an expert opinion in this matter.

5. I am a Professor of Computer Science at the University of Central Florida. My primary research interests include computer vision, image/video processing, and machine learning, including deep learning and large language models.

6. I received my Ph.D. in Computer Science from INRIA (French National Institute for Research on Informatics and Control), University of Nice Sophia Antipolis in 1996. I also earned a Master of Science in Computer Science from the University of Nice Sophia Antipolis in 1993, a Master of Science in Electrical Engineering from Kingston University, U.K., in 1990, and a Bachelor of Science in Electrical Engineering from Kingston University, U.K., in 1989.

7. Prior to research and teaching, I worked as an R&D Engineer at Innovative Engineering Solutions Ltd. in London from 1990 to 1992. Between 1993 and 1996, I served as a Research Assistant in the Scene Analysis and Symbolic Image Processing Group of INRIA, where I performed research in areas such as 3D super-resolution, sub-pixel image registration, and image-based depth and shape recovery and analysis. From 1997 to 2000, I served as an Assistant Research

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Scientist at the University of Maryland, College Park, where I investigated topics such as image registration (2D and 3D), super-resolution of video data for unmanned aerial vehicles, super-resolution of Synthetic Aperture Radar (SAR) and Foliage Penetrating SAR (FOPEN-SAR), and Automatic Target Detection, Tracking, and Recognition (ATD/R). During this time, I authored one of the most cited works on sub-pixel registration and alignment based on phase correlation: (Hassan Foroosh (Shekarforoush), Josiane Zerubia and Marc Berthod, Extension of Phase Correlation to Sub-pixel Registration, IEEE Transactions on Image Processing, vol. 11, Issue 3, pp. 188-200, 2002). Between 2000 to 2002, I served as Senior Research Scientist at the University of California, Berkeley where I also served as the Technical Coordinator and Principal Research Scientist of a Multi-University Research Initiative (MURI) funded by the Office of Naval Research. As part of the project, I conducted research on multi-sensor acquisition of 3D data for autonomous 3D modeling and visualization of urban environments.

8. I joined the Department of Computer Science at the University of Central Florida (UCF) as an Assistant Professor in 2002. Since then, I have served as an Associate Professor, Professor, and CAE Link Professor of Computer Science in the same department. I also served in various other capacities within the department, such as the Graduate Program Coordinator, chair of various leadership

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committees, and most recently in the Faculty Senate Strategic Planning Council for UCF.

9. I have taught a number of courses directed to computer vision and 3D modeling, including 3D Computer Vision, Image Processing, Special Topics in 3D Computer Vision, and Visual Simulation. Since joining UCF, I have also advised and chaired the dissertation of over 30 doctoral students, 28 of whom have already successfully defended their doctoral dissertation, and secured academic positions or industry jobs with major high-tech corporations. As one example, I served as the advisor for a dissertation directed to *“Improving Matching and Classification Through Deep Learning of Structure and Varying Illumination”*. This dissertation involved also working with GoPro camera systems for mobile aerial platforms.

10. I have been the principal investigator or co-principal investigator of numerous research projects funded by the National Science Foundation (NSF), NASA, DoD, and other industry participants, with total funding exceeding \$14M since joining UCF, and ongoing funded projects for additional \$3M. As one related example, I recently served as the principal investigator in two projects funded by the National Science Foundation (NSF) on 3D modeling and camera systems, and the role of 3D information in machine understanding of digitized 3D world.

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11. I have also conducted extensive research in partnership with industry in the field of computer vision, in particular 3D computer vision and camera systems, including body-worn cameras and cameras on agile mobile platforms, or cameras operating in various different modalities (EO, FLIR, polarized, etc.). Below, I highlight some of the projects that were funded by industry and state-sponsored technology transfer initiatives that specifically involved using GoPro camera systems or similar platforms. For example, from 2012 to 2018, I received funding from Jackson Technologies related to Airborne Multisensor Visual Data Processing, which studied automated methods of reconstructing 3D panoramic models around a flying aircraft that used the GoPro camera system and software tools extensively; From 2013 to 2018, I received related funding from the Florida High Tech Corridor (“FHTC”) for Rapid Automated 3D Terrain Modeling from Airborne Data, which similarly studied automated methods of reconstructing 3D models of a terrain from a flying aircraft, again using extensively the GoPro cameras and software tools; From 2008 to 2009, I received funding from Electronic Acts – Tiburon related to Modeling and Tracking Human Activities in Sport Events. The goal of this project was to develop algorithms for tracking and recognition of human activities in sport events, using body-worn cameras similar to GoPro systems, as well as surrounding cameras, network of cell phone cameras, and other sensors.

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12. I have authored or co-authored over 200 articles in peer reviewed journals or conference proceedings, relating to the areas of Computer Vision (CVPR, ICCV, ECCV, etc.), Machine Learning (ICLR, AAAI, ACL, EMNLP, etc.), and Image Processing and Pattern Recognition (ICIP, ICPR). Some related example publications include: Yang Zhang, Zixiang Zhou, Philip David, Xiangyu Yue, Zerong Xi, Boqing Gong, Hassan Foroosh, *PolarNet: An Improved Grid Representation for Online LiDAR Point Clouds Semantic Segmentation*, Proceedings of IEEE Conference on Computer Vision and Pattern Recognition (CVPR), 2020; Chuan Sun, Imran Junejo, Marshall Tappen, Hassan Foroosh, *Exploring Sparseness and Self-Similarity for Action Recognition*, IEEE Transactions on Image Processing, vol. 24, issue 8, pp. 2488-2501, 2015; Chen Shu, Luming Liang, Wenzhang Liang, Hassan Foroosh, *3D Pose Tracking with Multi-Templates Warping and SIFT Correspondences*, IEEE Trans. on Circuits and Systems for Video Technology, 2015; Nazim Ashraf, Chuan Sun, and Hassan Foroosh, *View-Invariant Action Recognition Using Projective Depth*, Journal of Computer Vision and Image Understanding (CVIU), vol. 123, pp. 41-52, 2014; Yuping Shen and Hassan Foroosh, *View-invariant Action Recognition from Point Triplets*, IEEE Transactions on Pattern Analysis and Machine Intelligence (PAMI), vol. 31, no. 10, pp. 1898-1905, 2009; Nazim Ashraf, Yuping Shen, Xiaochun Cao, and Hassan

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Foroosh, *View-Invariant Action recognition using Weighted Fundamental Ratios*, Journal of Computer Vision and Image Understanding (CVIU), vol. 117, pp. 587-602, 2013.

13. Based on my work, I have also applied for and received several patents in the field of image processing, including U.S. Pat. No. 8,755,569 entitled Methods for Recognizing Pose and Action of Articulated Objects with Collection of Planes and Motion, which was issued in 2014.

14. I have served as the editor and/or committee member on numerous professional organizations. For instance, I have been on the editorial board of the IEEE Transactions on Image Processing (Associate Editor, 2003-2008, 2011-2016); IEEE Conference on Computer Vision and Pattern Recognition (CVPR) serving as area chairs, session chairs and Technical Committee member over many years (2004-2012, 2015-2016, 2019-2023); Organizing Committee and sponsorship chair of ACM Multimedia Conference in 2014; and frequent reviewer on various IEEE transactions, including the IEEE Transactions on Pattern Analysis and Machine Intelligence.

15. For my work, I have been honored with numerous awards, including the *Piero Zamperoni Award*, International Association for Pattern Recognition (IAPR) (2004). I have also received several Best Paper awards, including “*The Best*

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Scientific Paper Award” in the IAPR International Conference on Pattern Recognition in 2008, “*The Best Paper Award*” in the IEEE International Conference on Image Processing (ICIP) in 2018, and the *Distinguished Researcher*, UCF College of Engineering and Computer Science (2004-2005, 2005-2006).

16. In sum, I have studied, taught, practiced, and conducted research in the areas of computer vision, image processing, machine learning (deep learning and large language models), and optics.

II. LEGAL UNDERSTANDING**A. The Person of Ordinary Skill in the Art (“POSITA”)**

17. I understand that a person of ordinary skill in the relevant art at the time of the invention (also referred to herein as “ordinary artisan”) is presumed to be aware of all pertinent art, thinks along conventional wisdom in the art, and is a person of ordinary creativity—not an automaton.

18. I have been asked to consider the level of ordinary skill in the field that someone would have had at the time the claimed invention was made. In deciding the level of ordinary skill, I considered the following:

- the levels of education and experience of persons working in the field;
- the types of problems encountered in the field; and
- the sophistication of the technology.

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19. I have reviewed the declaration of Dr. Katsaggelos, including his opinions regarding the Person of Ordinary Skill in the Art, which is a person with “a bachelor’s degree in engineering or computer science, or equivalent field, and two years of experience working on image or video processing or digital cameras” or alternatively “four years of experience working on image or video processing or digital cameras.” Ex. 1002, ¶37.

20. My opinions set forth in this Declaration apply Dr. Katsaggelos’s definition of a POSITA.

21. I am well-qualified to determine the level of ordinary skill in the art. I was a person of at least ordinary skill in the art at the time of the priority date of the ’832 patent under Dr. Katsaggelos’s definition of a POSITA. If I do not explicitly state that my statements below are based on this timeframe, all of my statements are to be understood as an ordinary artisan would have understood something as of the priority date of the ’832 patent.

B. Legal Principles

22. I am not a lawyer and will not provide any legal opinions. Though I am not a lawyer, I have been advised that certain legal standards are to be applied by technical experts in forming opinions regarding the meaning and validity of patent claims.

PUBLIC VERSION1. Anticipation

23. I understand that to obtain a patent, a claimed invention must have, as of the priority date, been novel. I understand that to prove that a prior art reference anticipates a patent, the four corners of the prior art reference must describe element of the claimed invention, either expressly or inherently. I also understand that the prior art reference must describe the elements arranged as in the claim and that it is improper to combine disparate embodiments to establish anticipation unless a POSITA when reading the reference could at once envisage such a combination.

2. Obviousness

24. I understand that to obtain a patent, a claimed invention must also have, as of the priority date, been nonobvious in view of prior art in the field. I understand that an invention is obvious when the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art.

25. I understand that to prove that prior art, or a combination of prior art, renders a patent obvious, it is necessary to: (1) identify the particular references that singly, or in combination, make the patent obvious; (2) specifically identify which elements of the patent claim appear in each of the asserted references; and (3) explain how the prior art references could have been combined to create the inventions

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claimed in the asserted claim, including how there would have been a reasonable expectation of success.

26. I understand that a patent composed of several elements is not proved obvious merely by demonstrating that each of its elements was, independently, known in the prior art, and that obviousness cannot be based on the hindsight combination of components selectively culled from the prior art to fit the parameters of the patented invention.

27. I also understand that a reference may be said to teach away when a person of ordinary skill, upon reading the reference, would be discouraged from following the path set out in the reference, or would be led in a direction divergent from the path that was taken by the applicant. Even if a reference is not found to teach away, I understand its statements regarding preferences are relevant to a finding regarding whether a skilled artisan would be motivated to combine that reference with another reference.

3. *My Understanding of Claim Construction Law*

28. I have been informed that patent claims are construed from the viewpoint of a person of an ordinary artisan and that patent claims generally should be understood consistent with their ordinary and customary meaning at the time of the invention. A review of the patent claim language, the patent specification, and

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its prosecution history are also necessary to determine the proper meaning and scope of the term at issue.

29. I have further been informed that in the specification and prosecution history the patentee may define a claim term in a way that differs from the ordinary and customary meaning. I understand that during prosecution of the patent before the U.S. Patent and Trademark Office, the Applicant may make representations or provide definitions of terms that may affect the scope of the patent claims. In particular, the Applicant may, during the course of prosecution, limit the scope of the claims to overcome prior art and/or disavow claim coverage by making clear and unambiguous statements to that effect.

30. I have been informed that an ordinary artisan may, among other things, consider dictionaries, publications, other patents, and treatises (*i.e.*, “extrinsic evidence”). I understand that extrinsic evidence may generally not be relied on if it contradicts the meaning of claim language provided by the intrinsic evidence, such as express definitions given for terms in the specification.

4. *Secondary Considerations of Non-Obviousness*

31. I understand that one of the factual inquiries when determining the obviousness of a patent is to consider objective evidence related to the issue of obviousness, sometimes called “secondary considerations of non-obviousness” or

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“objective indicia of non-obviousness.” I understand that such evidence can often be probative of the issues of obviousness.

32. I understand that examples of objective evidence include (1) commercial success, (2) copying, (3) industry praise, (4) skepticism, (5) long-felt but unsolved need, and (6) failure of others.

33. I understand that there must be a nexus between the patented invention and the evidence of secondary considerations. I further understand that there is a presumption of such a nexus if the claims of the patent are coextensive with a product or products that are the subject of the secondary considerations evidence. I further understand that in order for a claim to be coextensive with a product, one must look at the claims at the whole and not just the new claimed feature. In addition, the claimed invention should not be merely a subcomponent of the products sold but should encompass the entire apparatus.

III. SUMMARY OF THE '832 PATENT

34. The '832 patent is directed to a novel method for horizon-leveling videos. The claims and specification describe collecting rotational information from various sensors, including accelerometers and gyroscopes, on a frame-by-frame basis. Ex. 1001, 8:9-11(“[T]he position may include gyroscope data and/or accelerometer data per individual video frames”). Using such rotational

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information, a viewing window is generated for each frame. *Id.*, 6:42-60, 8:6-14. The “placement (rotation, location, shape, and/or size) of the viewing window” is determined using the per-frame rotational data. *Id.*, 6:52-60. The “viewing window” is “determined so that the visual content with the presentation/generated video appears to be leveled with respect to [the] horizon.” *Id.*, 6:49-52.

35. The patent further teaches the considerations involved in resizing the viewing window from frame-to-frame. The viewing window must match the desired output aspect ratio while also fitting within the optical field of view of the captured content. Thus, the patent teaches that “[t]he size of the viewing window may be determined to take into account the maximum size of the viewing window allowed based on the image capture device rotation.” Ex. 1001, 17:60-62, 18:4-21.

36. As the patent recognizes, however, dynamically resizing the viewing window can create a zoom effect that “may be very pronounced within the horizon-level visual content” if for an “image capture device undergoing jittery/rapid rotations.” *Id.*, 18:34-37. The patent therefore teaches the desirability of “smoothing” the changes in the maximum viewing window size “as the function of progress through the progress length” in order to create “a more cinematic feel to the horizon-leveled video.” *Id.*, 19:16-42; *see also* Fig. 6C. In some implementation, “the viewing window may be **artificially** made smaller and/or larger ... during

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moments that do not require the change in viewing window size to ramp-up and/or ramp-down to the needed viewing window size.” *Id.*, 19:38-42. This ability to artificially manipulate the sizing of the viewing window allows the system to simulate changes in zoom and create a more pleasing horizon-leveled video experience. *Id.*, 19:43-20:7.

37. In addition, the patent recognizes that its approach may result in “imperfect horizon levelling” as the “amount of rotation performed on the visual content may be inaccurate and/or imprecise.” Ex. 1001, 21:54-59. Thus, the patent teaches that “[a]n off-axis horizon may be less noticeable within visual content that includes a distortion than within visual content that does not include the distortion.” *Id.*, 21:60-62. Including distortion “may create curves within the image, which may make an off-axis horizon less noticeable than in an image without distortion.” *Id.*, 22:15-18.

38. I have reviewed the prosecution history of the ’832 patent. The examiner did not issue any office actions during prosecution. I note that in its Notice of Allowance, the examiner stated that the prior art fails to teach the determination of a viewing window. Ex. 1003, 33-34.

IV. CLAIM CONSTRUCTION

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39. In my opinion, all claim terms should be given their ordinary and customary meaning in light of the specification.

40. I have reviewed the Board's discussion of claim construction in its Institution Decision. The Board's Institution Decision construed "determin[ing] a viewing window for the visual content as a function of progress through the progress length" as "requiring determining a viewing window for different times of the video." ID, 21. The Board further stated that "if the viewing window were determined only once and this single determination were applied to every frame of an entire video, this would not meet the recitation, even if the video could be played back." ID, 19. I do not dispute the Board's construction and analyze the claims under this construction.

V. GROUND 1 AND 2: THOMASON, PACURARIU, AND WATANABE DO NOT RENDER OBVIOUS THE CHALLENGED CLAIMS

41. Ground 1 asserts that claims 1, 2, 7-12, and 17-20 (of which claims 1 and 11 are independent) are obvious in view of Thomason and Pacurariu. Ground 2 asserts that dependent claims 3-6 and 13-16 are obvious in view of Thomason, Pacurariu, and Watanabe.

42. I focus my analysis on the dependent claims, but do provide reasons below why Thomason and Pacurariu do not render obvious independent claims 1 and 11.

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43. A summary of my opinions are as follows: (1) claims 3-6 and 13-16 are not obvious because Watanabe does not disclose distortion that remains after an image is horizon-leveled—instead, the distortion is removed and a different distortion is added, (2) claims 7-8 and 17-18 are not obvious because neither Thomason or Pacurariu teach changing the size of the viewing window, much less to simulate changes in zoom, (3) claims 10 and 20 are not obvious because neither Thomson nor Pacurariu teach changing the location of the viewing window, and (4) for all claims, a POSITA would not be motivated to combine Thomason and Pacurariu.

44. I first provide a summary of the references.

A. Summary of References

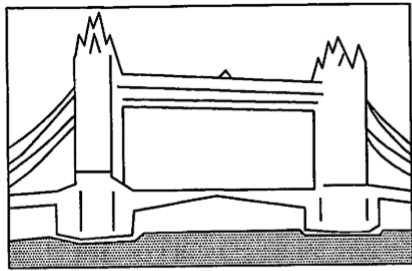
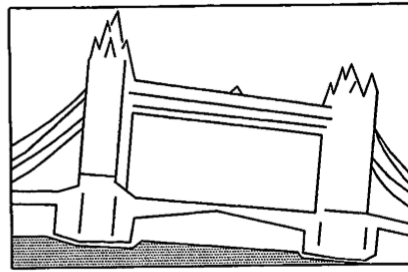
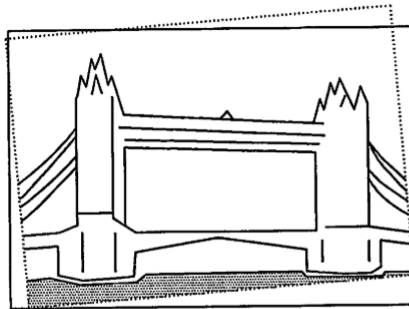
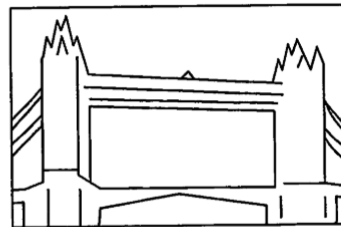
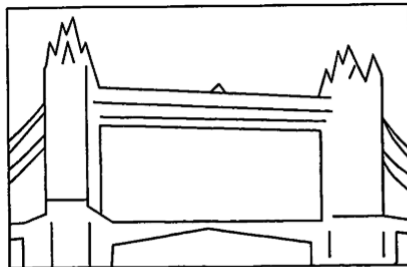
1. Summary of Thomason

45. Thomason is directed to rudimentary method for horizon leveling an image from a camera. Although Thomason describes that its methods apply to “video” cameras, there is no indication that Thomason horizon levels a video on a frame-by-frame basis, or even performs anything other than a one-time orientation measurement and correction.

46. Thomason’s method “measures the angle of the camera” by using an accelerometer. Ex. 1004, ¶29. As an ordinary artisan would be well-aware of, an accelerometer can only measure rotation on a single axis, and therefore it is clear

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that Thomason's camera is not intended to be hand-held operated. When a still image is captured by the camera, rotation data from the accelerometer data is used horizon-level the image by rotating the image in the opposite direction and degree of the rotation data. Ex. 1004, ¶36. The image is then "cropped to eliminate blank space, resulting in a horizon-leveled image. *Id.* This process is depicted in Figure 3, reproduced below.

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47. Thomason does not dynamically locate a viewing window. Rather, as a result of Thomason's method, the cropped portion of the image is always located in the center of the original image. This is shown by Thomason Figure 4, which shows that the range of possible crop operations are simply rotated about the center of the image sensor:

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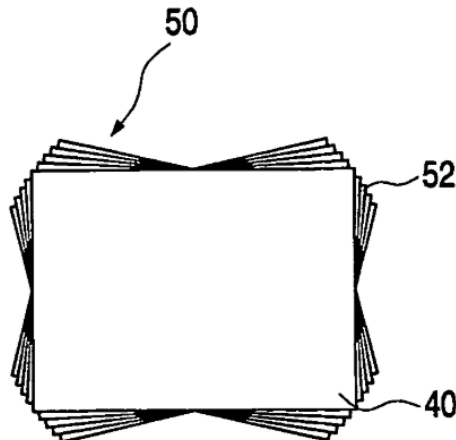


Fig.4

48. Nor does Thomason teach or suggest a dynamically sized crop region. In fact, Thomason expressly avoids any attempt at a dynamically sized crop, teaching instead a “circular sensor” where “[r]otation to any angle is possible without size reduction.” Ex. 1004, ¶39.

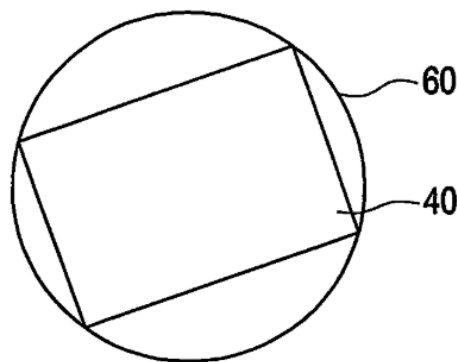


Fig.5

2. Summary of Pacurariu

49. Pacurariu also describes a rudimentary method for horizon-leveling. Although Pacurariu describes collecting rotational information on a per-frame basis, its horizon-leveling approach still lacks determination of a viewing window as a

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function of progress through the progress length as required by the claims of the '832 patent.

50. Specifically, Pacurariu teaches an “image area” (305) that defines a number of image sensor elements within the image sensor array (300). Ex. 1005, ¶40. While Pacurariu states that the “aspect ratio, size, position, and/or orientation of the image area 305 may be changed at any time” and is “dynamic,” it does not teach the ability to alter these parameters as a function of the progress length. This can be seen in Figure 5A and its associated disclosure, which teach a “reduced area of the image sensor 305” to “compensate for any rotation.” *Id.* ¶44. This demonstrates that Pacurariu did not contemplate a dynamic resizing of the image sensor 305, as a function of progress through the progress length.

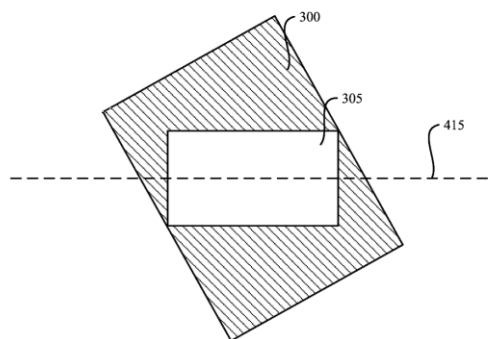


Figure 5A

3. Summary of Watanabe

51. Watanabe is not directed to horizon-leveling. Instead, Watanabe teaches a method for performing “image shake correction” on an image containing

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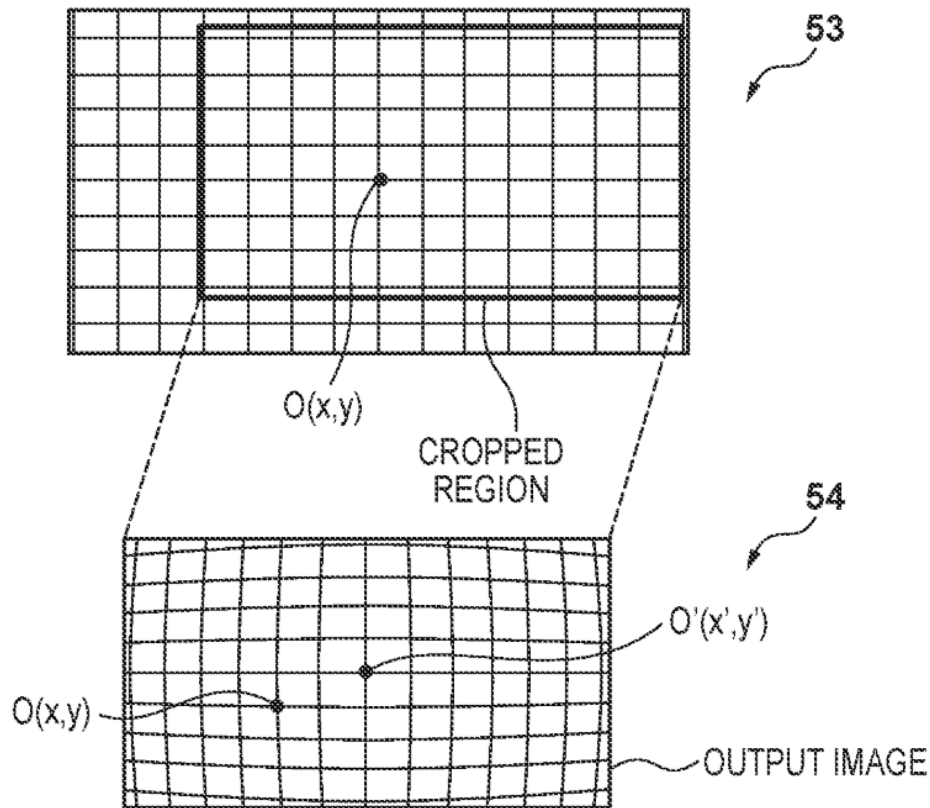
distortion from a wide-angle lens, such as barrel distortion from a fisheye lens. Ex. 1006, 9:33-35. Watanabe's process is to "perform[] distortion correction to ***remove the distortion.***" Ex. 1006, 11:21-23. The system then performs "image shake correction" by cropping the image. Ex. 1006, 11:26-30. Once the image is cropped, Watanabe's system "adds a distortion effect." Ex. 1006, 11:37-39.

52. "Image shake correction" is not horizon leveling because the purpose of such correction is to stabilize the image, not rotate the image to maintain a horizontal horizon. Thus, stabilizing a video that is deliberately tilted will not change the general tilt of the video, whereas horizon-leveling such a video will change the tilt of the video to make the horizon horizontal.

53. Because the cropped portion of the image is often located off-center from the original image, Watanabe describes that the added distortion is modified from the original fisheye lens distortion in at least two ways: (1) the amount of distortion is modified, and (2) the center of the distortion is modified. For example, Watanabe describes that the added distortion has an "effect of about 30% of the degree of the distortion of the photographing lens." Ex. 1006, 9:64-10:2. Watanabe also discloses that the center of the distortion is corrected to accommodate the new center of the cropped image. For example, because the center of the original image ($O(x,y)$) "do not match coordinate (x',y') of a center O' of the image subjected to

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image shake correction,” the added distortion instead uses the new center coordinates, as shown below from Figure 5. *Id.*, 11:39-46.



B. Claims 3-6 and 13-16: Thomason, Pacurariu, and Watanabe Do Not Render Obvious Distortion Within the Visual Content

54. In my opinion, the combination of Thomason, Pacurariu, and Watanabe, especially as proposed by Petitioner, do not render claims 3-6 and 13-16 obvious for at least the following reasons: (1) none of Petitioner’s references disclose distortion that reduces the impact of an off-axis horizon, (2) Watanabe and Petitioner’s proposed combination **removes** the original distortion and adds a completely different distortion, (3) a POSITA would not be motivated to combine

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Thomason and Watanabe because Watanabe's technique is specific to fisheye lenses and image shake removal, which Thomason and Pacurariu do not teach, and (4) for claims 6 and 16, Watanabe does not teach and Petitioner's combination does not propose adding distortion to an image before it is horizon-leveled.

1. *Claims 3 and 13: No distortion reducing impact of off-axis horizon*

55. Claim 3 recites that the “visual content includes a distortion” and that “the distortion of the visual content reducing impact of an off-axis horizon depicted within the horizon-leveled visual content.” Claim 4 further specifies that the distortion is a “barrel distortion or pincushion distortion.” Specifically, the inventors of the '832 patent discovered that a barrel or pincushion distortion may be added to the visual content to “reduce the impact of imperfect horizon leveling” (*i.e.*, reduce the impact of an off-axis horizon). Ex. 1001, 21:60-22:25, Fig. 7.

56. However, neither Thomason, Pacurariu, or Watanabe ever mention the use of distortion reduce the impact of an off-axis horizon, or even that an off-axis horizon is a problem that need to be solved. Watanabe does not discuss horizon-leveling at all, much less an off-axis horizon. And while Thomason and Pacurariu are directed to horizon-leveling, they never suggest that an off-axis

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horizon is a possible problem that needs to be solved, much less that distortion would reduce its impact.

57. Petitioner instead simply states that “[a] POSITA would have understood that the distortion of the visual content can reduce impact of an off-axis horizon depicted within the horizon-leveled visual content.” Ex. 1002, ¶153. But I note that Petitioner does not provide any documentary evidence or explanation for how distortion could reduce the impact of an off-axis horizon, and certainly does not explain how Watanabe’s distortion would reduce the impact of an off-axis horizon from Thomason or Pacurariu’s horizon-leveling. What Petitioner actually says is that such distortion might only potentially reduce the impact. But Petitioner does not explain how Watanabe’s distortion would actually impact an off-axis horizon as required by the claim. And since Thomason and Pacurariu do not disclose that their algorithms result in an off-axis horizon, and Petitioner does not even argue that they do, the combination of references simply does not result in any reduction of impact of a non-existent off-axis horizon.

2. Claims 3 and 13: No distortion remains in the image

58. In my opinion, claims 3 and 13 are not rendered obvious by Thomason, Pacurariu, and Watanabe because the combination of references does not teach a

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distortion of the original visual content impacting the horizon of the horizon-leveled content.

59. Claim 3 requires that the “visual content includes a ***distortion***,” such as a barrel distortion or pincushion distortion. Claim 3 also requires that “***the*** distortion ... reduc[es] impact of an off-axis horizon depicted within the horizon-leveled visual content.” In other words, Claim 3 requires that the ***original*** visual content upon which horizon levelling is performed contain a distortion, and that this distortion remain in the “horizon-leveled visual content” in order to impact its horizon. Note that based on claims 5 and 6, the distortion of the visual content can either be introduced by the “wide field of view optical element,” *i.e.* a lens (claim 5), or added to “non-distorted visual content” (claim 6).

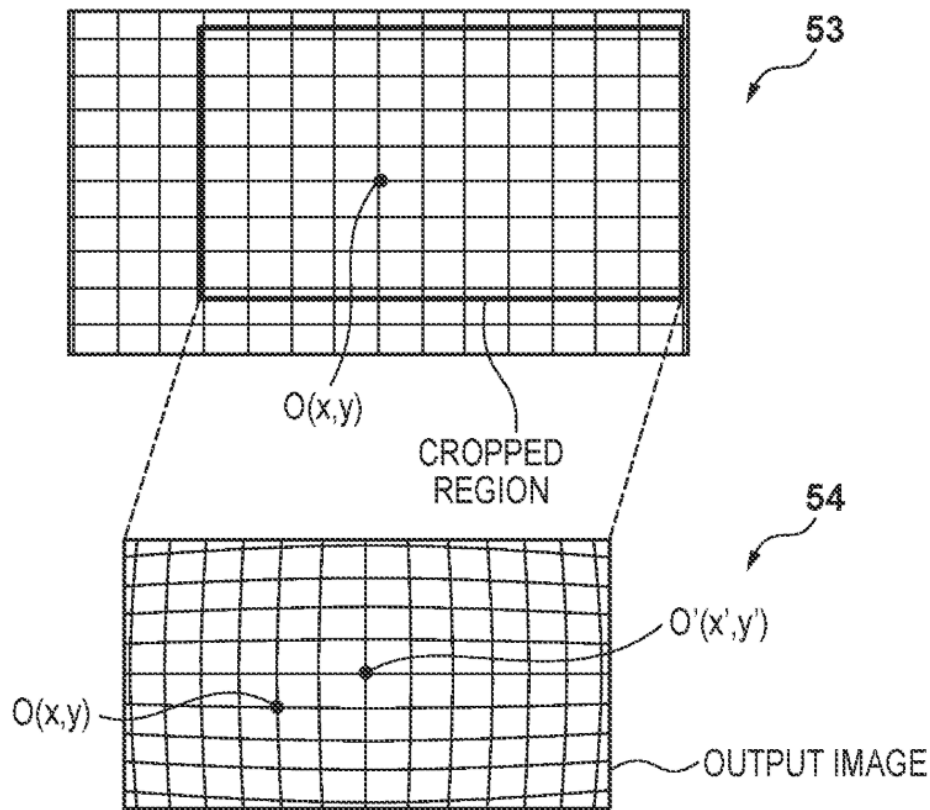
60. Watanabe’s lens distortion does not remain after the image is processed. Instead, when Watanabe processes an image containing a “barrel distortion” caused by a fisheye lens, the very first step of its process is to “perform[] distortion correction to ***remove the distortion***.” Pet. 47 (citing Ex. 1006, 11:9, 11:13, 11:21-23). In Watanabe, the system then performs “image shake correction” by cropping the image. Pet. 47-48; Ex. 1006, 11:26-30. Once the image is cropped, Watanabe’s system “adds a distortion effect.” Ex. 1006, 11:37-39.

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61. However, Watanabe does not perform its image shake correction on the originally distorted content. And, the distortion that is reintroduced into the output is significantly different from the original barrel distortion of the fisheye lens. Specifically, Watanabe describes that the added distortion is modified from the original fisheye lens distortion by (1) significantly reducing the amount of distortion, and (2) moving the center of the distortion. Watanabe describes these modifications as “corrections.” Ex. 1006, 6:35-39.

62. Watanabe describes that the amount of added distortion is reduced to “about 30%” of the original distortion from the lens, *i.e.* a reduction of 70%. Ex. 1006, 9:64-10:2. Watanabe also discloses that the center of the distortion is corrected to accommodate the new center of the cropped image. For example, because the center of the original image ($O(x,y)$) “do not match coordinate (x',y') of a center O' of the image subjected to image shake correction,” the added distortion instead uses the new center coordinates, as shown below from Figure 5. *Id.*, 11:39-46.

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63. Petitioner proposes that the combination “may **remove** image distortions from a captured image (*e.g.*, caused by characteristics of the image sensor) as taught by Watanabe, obtain horizon-leveled visual content as taught by Thomason and Pacurariu, and **intentionally add certain distortions** such that the resulting image appear more natural looking **as taught by Watanabe.**” Pet. 50.

64. Thus, in Petitioner’s combination, the original lens distortion is **removed** and replaced by a **significantly different** distortion. This simply fails to meet the language of the claim, which requires “the distortion” of the un-leveled image to remain in the horizon-leveled image in order to “impact” its horizon. The

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claim does not accommodate a removal of the original distortion prior to the image processing step. Nor does it cover replacement of the original distortion with significantly less distortion. Thus, the combination does not teach the claimed distortion.

3. *No motivation to combine Thomason-Pacurariu with Watanabe*

65. In my opinion, there is no motivation to combine Thomason and Pacurariu with Watanabe, because they are directed to very different problems.

66. Petitioner's only motivation to combine these references is to "generate horizon-leveled video content that also appears more natural looking." Pet. 50. This comes from Watanabe's disclosure that its techniques "generate a moving image that appears natural after image shake correction." Ex. 1006, 1:47-48.

67. But Petitioner does not provide important context for Watanabe's disclosure. Watanabe is clear that adding (significantly modified) barrel distortion results in a more "natural" image only because of the issues caused by the ***original*** image having barrel distortion. In other words, Watanabe is seeking to solve such problems, which do not exist in Thomason and Pacurariu as they lack barrel distortion.

68. Specifically, Watanabe teaches that in an image taken with a fisheye lens, when such distortion is corrected (as Watanabe's technique teaches), "volume

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distortion occurs in which the image of an object reflected in a peripheral portion of an image appears to be enlarged, and thus an observer feels that something is amiss.”

Ex. 1006, 9:35-39. In other words, removing the barrel distortion makes the image look unnatural because of the specific manner in which the image was captured in Watanabe. In addition, because each frame of the video is cropped to accommodate image shaking distortion, keeping the original barrel distortion results in the “peripheral portion of a moving image” to “change over time,” resulting in “a moving image that [] appear[s] unnatural when observed.” *Id.*, 10:30-34. Thus, Watanabe teaches adding a barrel distortion that is reoriented and has significantly less distortion, which results in a more natural image.

69. Watanabe does not provide some generalized motivation to add distortion to videos to make them look “more natural.” Rather, Watanabe teaches that its specific technique results in a more natural image for two reasons: (1) removing the original distortion results in an unnatural look that is corrected when the new distortion is added, and (2) removing the original distortion and adding a “corrected” distortion with a reoriented center results in a more natural look because the distortion does not appear to change over the length of the video. Watanabe describes this as “correct[ing]” the original distortion. Ex. 1006, 6:35-39. In other words, it is the original distortion that is the direct cause of any unnatural look, and

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Watanabe teaches that correcting that distortion causes the image to look “more natural.”

70. I note that Dr. Katsaggelos confirms the importance of each step in Watanabe’s algorithm. He testified that the original presence of the barrel distortion is an “important part” of Watanabe’s algorithm. Ex. 2022, 37:16-38:15; 32:8-21 (“All of these are specific algorithmic steps that are important.”). Dr. Katsaggelos explained that the initial presence of the barrel distortion is important for the algorithm, because “[y]ou need the model of how to add the barrel distortion, the model includes the distance of the camera of the objects, the distance from the center and so on and so forth.” *Id.*, 32:23-33:9.

71. In view of these teachings from Watanabe, there would be no motivation to incorporate Watanabe’s teachings into the Thomason-Pacurariu combination, because neither Thomason nor Pacurariu describe using a lens that causes barrel distortion, nor are they directed to image shake correction. As a result, Watanabe’s teaching of a more “natural” image simply does not apply to either Thomason or Pacurariu.

72. In my opinion, a POSITA would have considered it undesirable to add barrel distortion to an image that did not already have it, as the addition of such distortion was known to look ***unnatural*** for typical images. Ex. 2026, 87:21-23 (“If

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one has to choose distortion or non-distortion, one probably would choose the non-distortion option.”); Ex. 2023, 6 (“[T]he highly distorted and compressed look [of barrel distortion] is going to appear strange. So you wouldn’t usually use it for standard people shots, for example, where it’s going to distort their face and body in a distracting way.”). Watanabe itself makes this clear by describing that such barrel distortion is a result of “aberration of a photographing lens,” and the entire motivation for Watanabe is to correct such a distortion. Ex. 1006, 9:10-44. Watanabe further is clear that “it is preferred that image distortion caused by aberration does not exist.” *Id.*, 9:10-44.

73. And a POSITA would not be motivated to modify Watanabe’s algorithm to use Thomason or Pacurariu’s horizon-leveling. As Dr. Katsaggelos described it, the “specific steps” of Watanabe’s algorithm “are important.” Ex. 2022, 32:8-21 (“It teaches to remove the distortion inclusion, how to remove the shaking distortion, how to add the pin cushion inclusion distortion. All of these are ***specific algorithmic steps that are important***.”). I agree with this statement. Given their importance, a POSITA would not be motivated to make changes to Watanabe’s algorithm to instead use Thomason’s horizon-leveling instead of Watanabe’s image shake removal.

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74. The entire purpose of Watanabe’s algorithm is to accommodate known issues with image shake correction, specifically “in the case of performing image shake correction on a moving image, the positional relationship between the optical axis of the imaging optical system and the center of each moving image frame changes over time *due to image shake correction.*” Ex. 1006, 1:27-32. Yet in Thomason and Pacurariu, the center of the punch-out does **not** change, and therefore does not exhibit this problem with image shake correction described by Watanabe. There is therefore no reason for Watanabe’s distortion correction to be applied to an image that is horizon-leveled in accordance with Thomason and Pacurariu.

4. *Claim 6 is not obvious*

75. In my opinion, claim 6 is not obvious because Watanabe does not teach adding distortion to an image before it is horizon-leveled (or processed in general).

76. Claim 6 specifically requires that the distortion be applied to “non-distorted visual content,” as opposed to distortion caused by a lens (as claimed in claim 5). In particular, because of the antecedent basis of “visual content,” the distortion must be applied **before** the image is processed into the claimed “horizon-levelled visual content.”

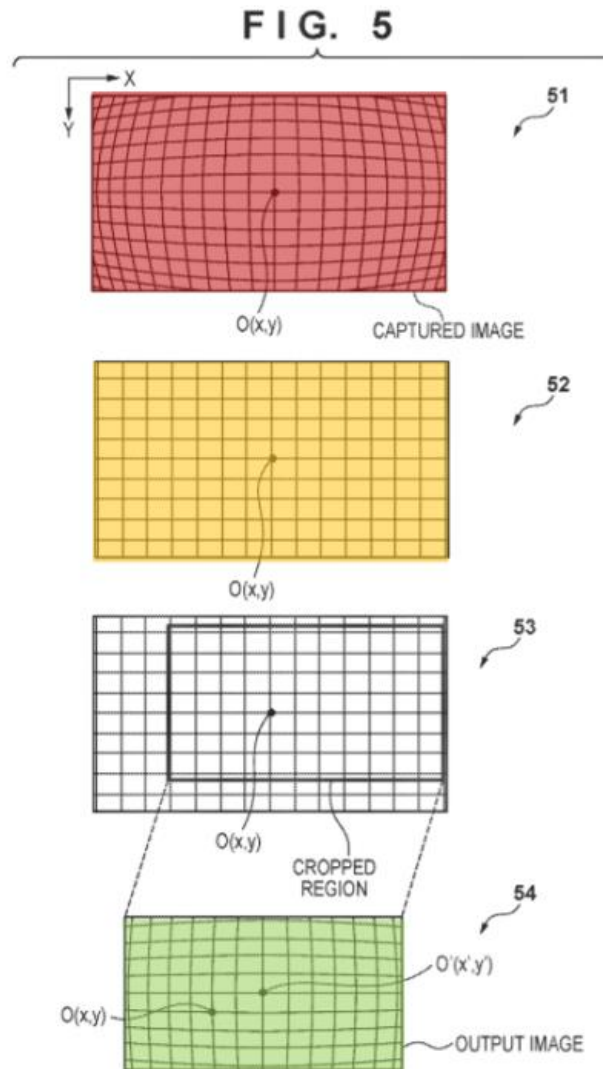
77. Watanabe does not teach adding distortion to an image prior to horizon-leveling. Putting aside that Watanabe does not discuss horizon-leveling at all, no

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distortion is added before Watanabe's image shake correction, either (which is replaced by horizon leveling in Petitioner's proposed combination). As discussed above, Watanabe teaches that the original distortion is caused by a fisheye lens, instead of being added to the image.

78. Petitioner relies on the addition of distortion to the image that has already been corrected for image shake. Pet. 53 ("In Figure 5 below, the *image 52* is the 'non-distorted visual content' to which a distortion is applied.").

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**Watanabe Figure 5 (annotated by Petitioner)**

79. But Watanabe does not teach applying distortion to “image 52.” Instead, Watanabe teaches adding distortion to a “cropped region” of image 52. Ex. 1006, 11:37-54. Thus, under Petitioner’s own mapping, Watanabe does not teach this claim.

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80. And Petitioner’s theory for claim 6 is inconsistent with Petitioner’s proposed combination described in claim 3: “[T]he Thomason-Pacurariu-Watanabe combination may remove image distortions from a captured image (e.g., caused by characteristics of the image sensor) as taught by Watanabe, obtain horizon-leveled visual content as taught by Thomason and Pacurariu, and intentionally add certain distortions such that the resulting image appear more natural looking as taught by Watanabe.” Pet. 50. Thus, for claim 3, Petitioner has proposed that the combination remove the barrel distortion, apply horizon-leveling, then add a modified barrel distortion—the Watanabe algorithm with image shake correction replaced with horizon-leveling. Yet for claim 6, Petitioner has proposed that the combination meets the claim when applying barrel distortion *after* the image is horizon-leveled. This does not render obvious claim 6, which requires that the distortion be applied *before* the visual content is horizon-leveled.

C. Claims 7 and 17: Thomason Fails to Disclose Determining a “Size” of the Viewing Window as Claimed

81. In my opinion, Thomason does not disclose determining a “size” of the viewing window as a function of progress.

82. Claims 1 and 11 require “determin[ing] a viewing window for the visual content as a function of progress through the progress length.” Dependent claims 7 and 17 further recite that the determination of the viewing window includes

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determining “a **size** of the viewing window as the function of progress through the progress length.” Claims 8 and 18 further depend from claims 7 and 17 and add that “wherein the size of the viewing window changes as the function of progress through the progress length ***to simulate changes in zoom for the visual content.***”

83. As I discussed above, the Board construed the “determin[ing] a viewing window” limitation as “requiring determining a viewing window for different times of the video.” ID, 21. This decision was based on the Board’s analysis of the term “function of progress” mentioned in the claims and the specification. ID, 13-21. The Board noted that in the ’832 patent, “function of progress refers to different frames corresponding to different points in the video.” ID, 18. I agree with the Board. Thus, in my opinion, claims 7 and 17 require a determination of a size of the viewing window at “different points in the video.”

84. I note that Petitioner only relies on Thomason for claims 7 and 17, and particularly points to its discussion of Figure 3. Pet. 37-39. Petitioner argues that “the size of the viewing window may be dependent on the rotational position of the camera—a more tilted camera angle may result in a smaller viewing window because there is less visual content in the image that may be horizon-leveled.” Pet. 38. But Thomason never discloses that it determines a size of the viewing window for multiple frames in a video. Petitioner’s assertion that the size of the viewing window

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is determined “for each image in the video” is not supported by any citation to Thomason. Pet. 38.

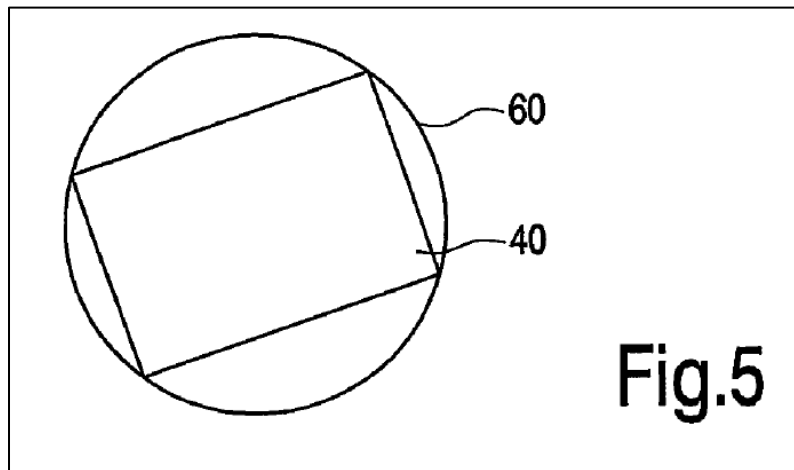
85. There is no such disclosure in Thomason of determining a viewing window for multiple frames. Thomason does not even disclose capturing rotation data for multiple frames. Thomason does disclose video, but never in any detail. When Thomason teaches storing “angle data representing the angle measured by the rotation sensor,” it never discloses that it captures such data for multiple different frames. Nor does it include any detail suggesting that it contemplated using orientation data across multiple frames to dynamically determine and size a viewing window as required by the ’832 Patent. In my opinion, all of Thomason’s disclosures are consistent with, and best read, as an approach that merely takes an initial, one-time orientation measurement and applies that measurement as a correction factor across all subsequent frames.

86. Thomason’s approach is described as suitable for “still” digital cameras, which is consistent with a one-time orientation measurement and correction. Ex. 1004, ¶1. While Thomason does make passing reference to capturing videos, it notes that video cameras “are frequently used by amateurs who may have difficulties correctly orienting the camera.” *Id.*, ¶2. In my opinion, this passage suggests that Thomason is directed to an approach involved a fixed, yet

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slightly misaligned video camera that would merely require a one-time orientation measurement and correction. I note that Thomason describes “process[ing] the recorded image data 8 [i.e. the captured video] and **rotation angle**,” i.e. a single rotation angle, not plural. Ex. 1004, ¶32. This indicates that the rotation angle is only captured once for the video, not multiple times across the video.

87. Thomason’s Figure 5 further confirms the lack of size teaches, as it teaches a “circular sensor 60 with nominal image frame 40” that allows “[r]otation to any angle . . . **without size reduction**.” Ex. 1004, ¶39; see also Fig. 5.



88. This embodiment is expressly designed to avoid any need to dynamically resize the purported viewing window 40. This confirms that Thomason’s other teachings do not contemplate arbitrary rotations throughout a video capture duration requiring dynamic resizing of the frame based on rotational positions.

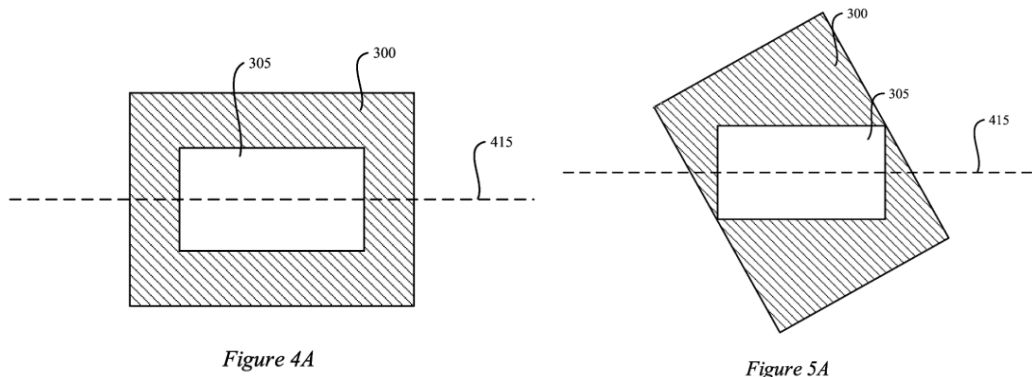
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89. Finally, Thomason only discloses the use of a single accelerometer for collecting rotational information. Ex. 1004, ¶29. A POSITA would understand that a single accelerometer is not suitable for capturing rotational information and determining viewing windows for multiple frames in a video. This is because a single accelerometer is not suitable for obtaining rotational information from a moving camera. An accelerometer can only measure rotation in one dimension, whereas a moving camera may rotate in three dimensions. Thus, Thomason's rotational data is simply not suitable for determining viewing windows for multiple frames in a video.

90. I note that Petitioner does not rely on Pacurariu for this claim. Regardless, in my opinion, Pacurariu also does not disclose determining different viewing window sizes for multiple points in a video. Instead, the size of Pacurariu's viewing window remains constant across the frames of a video. Specifically, in Pacurariu, the alleged "viewing window" of a rotated image is the "image area 305" which is specifically reduced in size "to compensate for future or potential rotations of the image area 305 relative to the image sensor array 300." Ex. 1005, ¶¶42, ¶44 ("A reduced area of the image area 305 may be used to compensate for any rotation."). In other words, the size of the image area is made small enough so that

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it can accommodate any rotation of the image. Figures 4A and 5A illustrate this, as the size of image area 305 remains the same as the camera is rotated.



D. Claims 8 and 18: Thomason Does Not Disclose Changes in Size of the Viewing Window to “Simulate Changes in Zoom for the Visual Content”

91. In my opinion, Thomason does not disclose simulating changes in zoom by resizing the viewing window as a function of progress.

92. Claim 8 further recites that the “size of the viewing window *changes* as the function of progress through the progress length *to simulate changes in zoom* for the visual content.” Because neither Thomason nor Pacurariu disclose claim 7 and 17’s requirement for determining the size of the viewing window, they also fail to disclose the additional limitations of claims 8 and 18 that the viewing window size changes as a function of progress through the progress length to simulate changes in zoom for the visual content.

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93. And in my opinion, Petitioner’s analysis for claim 8 shows that Petitioner misunderstands the claim language. Petitioner suggests that this limitation is met simply by changing the size of the viewing window as a result of rotation. Pet. 39 (“A POSITA would understand that a smaller viewing window may make the object in the viewing window appear more zoomed-in..”). But claim 7 already recites changing the size of the window based on the rotation. I understand that claim 8 needs to be interpreted differently than claim 7, and a POSITA would do so. Thus, the resizing of the viewing window “to simulate changes in zoom” requires more than just changing the size of the viewing window as a result of rotation.

94. The ’832 patent supports this understanding. The specification teaches that merely resizing the viewing window without regard to zoom “may result in pronounced (e.g., rapid, jittery) changes in zoom/viewing window size within the horizon-leveled visual content.” Ex. 1001, 18:32-37; *see also id.* Fig. 6A. To alleviate this problem, the ’832 patent explains that “the viewing window may be **artificially** made smaller and/or larger (e.g., **artificially** zoom-in and/or zoom-out) during moments that do not require the change in viewing window size to ramp-up and/or ramp-down to the needed viewing window size.” *Id.*, 19:38-42. The artificial (*i.e.* **simulated**) zooming can be implemented using a “smoothed zoom curve 604,” such as depicted in Figure 6C, which “allow[s] for rapid changes in zoom to be

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replaced with smoothed zooms, creating a more cinematic feel to the horizon-leveled video than use of the zoom curve 600” from Figure 6A.

95. Petitioner does not provide any analysis for how the size of the viewing window is changed for the purpose of simulating changes in zoom. Thomason actually teaches that a rotated image is “cropped to eliminate blank space.” Ex. 1004, ¶36. In other words, the viewing window is the maximum-sized rectangular window, as only blank space is removed. Thomasson does not teach dynamically changing the size of any viewing window for purposes of simulating a controlled zoom effect.

E. Claims 10 and 20: Thomason Does Not Disclose Determining a “Location” of the Viewing Window to Determine Framing

96. Claims 1 and 11 require determination of a viewing window that “includes determination of a **placement** of the viewing window.” Claims 10 and 20 further recite that the determination of placement include determining “a **location** of the viewing window” which determines “framing of the visual content.” Note that claims 9 and 19 recite that the **placement** of the viewing window includes determination of the window’s “**rotation**.” I therefore understand that determining the location of the viewing window cannot be the same as determining the rotation of the viewing window.

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97. I note that Petitioner’s expert Dr. Katsaggelo testified that “determination of the viewing window” requires some “process” by the camera “based on some logic,” where there is some potential for change Ex. 2022, 60:7-20; 61:1-6 (“It is just to be based on some *algorithmic* logic”); 61:8-16 (“[T]he placement could potentially change, yes.”). The Board also construed “determining a viewing window as a function of progress” to require some change. ID, 19-21. In other words, determination of the location of the viewing window requires an algorithmic process that allows for change of the location. The viewing window cannot have the same location throughout the video.

98. In my opinion, the meaning of the “location of the viewing window” refers to the x-y coordinate at which the viewing window is placed. This is consistent with the claim language and the specification, which consistently refer to the four properties of the viewing window: “rotation, location, shape, and/or size.” Ex. 1001, 15:6-10. This is also consistent with the description in the specification teaching that changing the “location” of the viewing window may “simulate panning in the horizon-leveled visual content.” Ex. 1001, 10:51-54.

99. In addition, the claims and specification describe that the location of the viewing window determines “framing of the visual content.” In the context of photography, framing refers to drawing the viewer’s attention to certain elements

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within the image. *See, e.g.*, Ex. 1001, 20:29-50 (“One or more of location, shape, size, and/or other characteristics of the viewing window may be determined based on the content detection so that the horizon-leveled visual content includes portions of the visual content ***framed based on one or more things depicted within the visual content***. ... [T]he viewing window may be positioned to include one or more particular depictions (e.g., faces, smiles) within the viewing window.”); *see also* Ex. 1001, 20:62-63 (“The location of the viewing window may be changed to pan from one thing of interest to another thing of interest.”). In order for the location of a viewing window to frame a certain element within the image, the center of the viewing window must correspond with the center of the element of interest, as the center is where the user’s attention is naturally drawn.

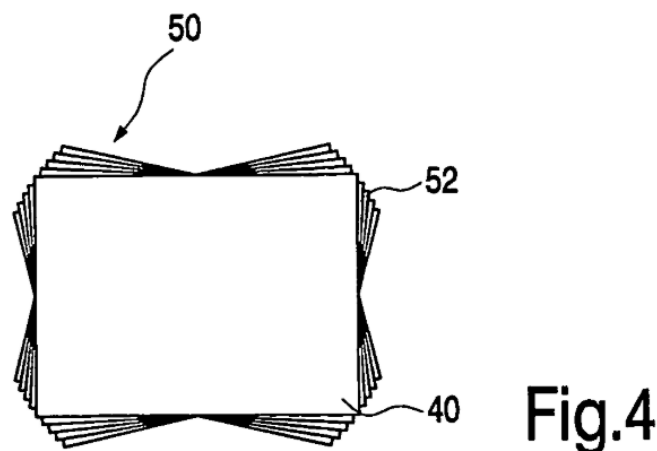
100. In view of all the above and the plain meaning of “location,” changing the location of the viewing window cannot be accomplished by merely changing its rotation or its size.

101. Thomason does not disclose determining the location of a viewing window as a function of progress, much less one that determines framing of the image. The Petition’s analysis for this limitation states without explanation that “Thomason determines a location for each ***viewing window*** within the ***field of view*** such that the viewing window includes horizon-leveled visual content.” Pet. 41-42

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(emphasis in original). The Petition cites to its analysis for the “viewing window” limitations of claim 1, yet those portions merely describe Thomason’s algorithm of rotating the image and cropping it.

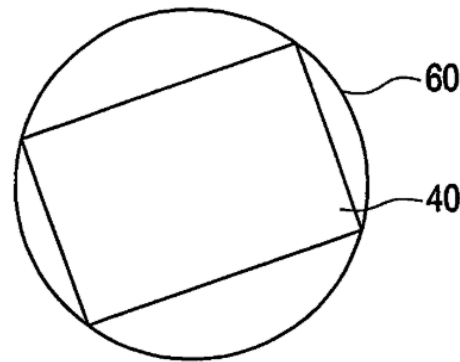
102. Thomason only describes that the image is rotated and then “cropped to eliminate blank space.” Ex. 1004, ¶36. In other words, the viewing window is the maximum-sized rectangular window, as only blank space is removed. This therefore always results in a viewing window that is located in the **center** of the image, without any possibility of dynamically determining its “location.” For example, Thomason’s Figure 4 clearly depicts that the image is rotated about its center, and therefore the location of the viewing window is always in the center.



103. Similarly, for Figure 5, Thomason describes a “circular sensor” where “[r]otation to any angle is possible without size reduction,” indicating that the image

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is rotated about its center and therefore no change in the location of the viewing window occurs. Ex. 1004, ¶39.

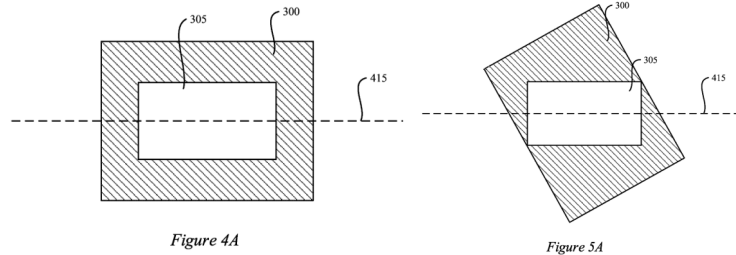
**Fig.5**

104. In addition, Petitioner does not explain how the location of the viewing window in Thomason determines the framing of the visual content. Pet. 41-42. Again, Thomason simply describes rotating the image and, to the extent necessary, cropping the image “to eliminate blank space.” Ex. 1004, ¶36. There is no teaching in Thomason of locating the viewing window such that a certain element within the image is framed. Thomason’s algorithm simply uses the maximum-sized viewing window based on its rotation without concern of the content of the image.

105. The Petition also relies on Pacurariu, though merely states in a single sentence that “Pacurariu also discloses this limitation,” with a citation to the Petition’s analysis for claim 1’s “viewing window” limitations. Pet. 42-43. Pacurariu similarly does not disclose determining a location of the viewing window, or that such a location determines the framing of the image. The only teachings in

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Pacurariu indicate that the viewing window is located in the center of the image, such as the “image area 305” depicted in Figures 4A and 5A.



F. All Claims: No Motivation to Combine Thomason and Pacurariu

106. Thomason alone does not anticipate or render obvious claims 1 and 11. Moreover, a POSITA would not be motivated to combine Thomason and Pacurariu.

1. Thomason does not disclose rotational information as a function of progress

107. In my opinion, Thomason does not disclose limitation 1[c]’s “rotational position information characterizing rotational positions of the image capture device as a function of progress through the capture duration.” Thomason’s rotational information is not captured for multiple points in a video.

108. The Board held in construing “determin[ing] a viewing window ... as a function of progress” that such a determination must be made “for different times of the video.” ID, 21. In my opinion, the same reasoning would also apply to the determination of rotational position information, that is, rotational position information must be collected for different times of the video.

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109. As I discussed above, Thomason never discloses that rotational position information is collected for different frames of a video. While Thomason discloses storing “angle data representing the angle measured by the rotation sensor,” it never discloses that it captures such data for different frames. Thomason’s disclosure of a video is cursory, simply stating that the image data could be “moving.” Ex. 1004, Abstract. And yet Thomason describes “process[ing] the recorded image data 8 [*i.e.* the captured video] and **rotation angle**,” indicating that the rotation angle is only captured once for the video, not multiple times across the video—for example, the camera could be mounted or otherwise held still in place. Ex. 1004, ¶32.

110. Thomason only discloses the use of a single accelerometer for collecting rotational information. Ex. 1004, ¶29. As I explained above, a POSITA would understand that a single accelerometer is not suitable for capturing rotational information for a moving camera. Thus, Thomason’s rotational data is simply not suitable for performing horizon leveling on a moving camera.

2. *A POSITA would not be motivated to combine Thomason and Pacurariu*

111. The entirety of Petitioner’s rationale to combine Thomason and Pacurariu is provided below:

Thomason in the same way. (*Id.*) Combining the teachings of Thomason and Pacurariu as such would yield predictable results of effectively and efficiently horizon-leveling video data. (*Id.*) Further, it would have been

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obvious to try combining the technical features of Pacurariu with the teachings of Thomason, as there is a finite number of identified, predictable solutions, without requiring much effort and with a reasonable expectation of success. (*Id.*) The known benefits of Pacurariu would prompt the application of Pacurariu in the same field based on design incentives and other market forces. (*Id.*)

Pet. 23-24. Dr. Katsaggelos also provides the same conclusory statements. Ex. 1002, ¶81.

112. In my opinion, Petitioner is essentially saying that a POSITA would combine Thomason and Pacurariu because it would result in improvements. But Petitioner does not explain what those improvements are, or how the combination would result in an improvement. Moreover, Petitioner merely asserts predictable results and a reasonable expectation of success, but does not provide any explanation for why a POSITA would think that.

113. Petitioner also asserts an “obvious to try” argument, but appears to simply be repeating the language found in certain cases. Petitioner does not explain what the “finite number of identified, predictable solutions” are, or the “known benefits of Pacurariu,” or how the “design incentives and other market forces” would prompt a POSITA to apply Pacurariu.

114. In addition, I find no connection between Petitioner’s motivation to combine and the specific teachings Petitioner wishes to combine. According to Petitioner, the combination would use the “tilt value as taught by Pacurariu ...

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obtained for each frame in Thomason’s video content [and] saved as metadata or as part of each video frame as taught by Pacurariu, and be used to generate a rotated image for each video frame in Thomason’s video content.” Pet. 23. But Petitioner does not explain why a POSITA would find using Pacurariu’s tilt values an improvement on Thomason, or how it would yield predictable results or a reasonable expectation of success, or why that particular combination would be obvious to try.

115. I note that in the Board’s institution decision, it interpreted the Petition as alleging that “combining Pacurariu would predictably improve Thomason by allowing a horizon-leveled video frame to be obtained effectively.” ID, 34 (citing Pet. 23, 30, 34-36). But nothing in the Petition explains how the combination would improve Thomason’s horizon-leveling.

116. In my opinion, Pacurariu would not improve Thomason’s horizon-leveling. Thomason’s accelerometer-only camera is simply not capable of generating a rotated image for each video frame. In particular, Thomason discloses a camera whose “rotation sensor is an accurate accelerometer” or “tilt meter.” Ex. 1004, ¶29. I note that Dr. Katsaggelos admitted that he did not consider whether “horizon level frame by frame” could be performed with an “accelerometer alone” system like Thomason, which renders his opinions regarding motivation to combine unreliable.” Ex. 2022, 10:20-11:7.

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117. As I discussed above, a single accelerometer is only is designed to correct for basic motion (*e.g.*, a one-time tilt adjustment), but would not be suitable for a frame by frame horizon-leveling algorithm. Thomason's accelerometer, for instance, cannot accurately differentiate between a tilt motion, and lateral acceleration. For a camera that is subject to frame-to-frame movements, the lateral acceleration will result in erroneous measurement readings that accumulate across the frames of the video.

118. Similarly, a POSITA would understand that Thomason's accelerometer only camera is not designed to detect certain movements, such as the camera spinning around a vertical axis (yaw movements) and that accelerometers and video data are typically recorded using different clocking mechanisms, such that frame by frame horizon-leveling requires overcoming problems related to synchronization and alignment of the position and video data.

119. Obtaining rotational position information for frame by frame horizon leveling would thus require completely overhauling Thomason's position sensor in a manner that would add unwanted complexity and computational cost in terms of processing power, processing time, and/or battery consumption. Petitioner did not propose doing this, nor explain why a POSITA would be motivated to extensively redesign the camera of Thomason by combining teachings of Pacurariu that are

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directed to cameras having entirely different movements, such as “wearable” cameras or security cameras with a “rotatable camera core.” Ex. 1004, ¶2 (“portable video cameras that are often wearable”), ¶70 (“a camera housing 1005 and a rotatable camera core 1010 that is removable and/or rotatable.”).

VI. GROUND 3 AND 4: VOSS, DERBANNE, AND WATANABE DO NOT RENDER OBVIOUS THE CHALLENGED CLAIMS

120. Ground 3 asserts that claims 1, 2, 7-12, and 17-20 are obvious in view of Voss and Derbanne. Ground 4 asserts that dependent claims 3-6 and 13-16 are obvious in view of Voss, Derbanne, and Watanabe.

121. A summary of my opinions are as follows: (1) claims 3-6 and 13-16 are not obvious because Watanabe does not disclose distortion that remains after an image is horizon-leveled—instead, the distortion is removed and a different distortion is added, (2) claims 1 and 11 are not obvious because neither Voss nor Derbanne teach determination of a **viewing window** as a function of progress through the progress length, (3) claims 7 and 17 are not obvious because neither Voss nor Derbanne each changing the size of the viewing window, (4) claims 8 and 18 are not obvious because the references also do not teach simulating changes in zoom, (5) claims 10 and 20 are not obvious because neither Voss nor Derbanne teach changing the location of the viewing window, and (6) for all claims, a POSITA would not be motivated to combine Voss and Derbanne.

PUBLIC VERSION**A. Summary of References**1. Summary of Voss

122. Like Thomason and Pacurariu, Voss also describes a fairly rudimentary horizon-level technique implemented in a camera of a mobile device. Voss teaches when the capture sensor of a mobile is selected, the system requests an initial measurement from an inertial sensor 330 indicating whether the mobile device is in a “horizontal and/or vertical” position. Ex. 1007, 12:4-7. The sensor may also send “periodic” measurements to the processor thereby continuously indicating the vertical and/or horizontal orientation of the mobile device. *Id.*, 12:7-10. Voss is thus inherently based on simply distinguishing between a vertical and horizontal orientation. Voss also recognizes that the measurements from its inertial sensor and the time stamps of the video or still image may not be ideally synchronized, resulting in an inaccurate orientation for the video or image or “choppy” looking video. *Id.*, 15:12-16.

123. Once the initial horizontal/vertical orientation is determined, the mobile device of Voss depicts an inset rectangle on the display. *Id.*, 12:14-16, 10:2-4. The aspect ratio of the inset rectangle depends on whether the device is in a vertical or horizontal orientation, and an “optimal” aspect ratio is chosen for each of the vertical and horizontal orientations. *Id.*, 9:23-10:2. The size of the inset rectangle 225 is

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inscribed within the overall sensor that is “best-fit” to the maximum boundaries of the sensor given the desired optimal aspect ratio for the orientation. *Id.*, 10:2-4.

124. Petitioner generally relies on Figure 2 of Voss, as annotated by Petitioner below:

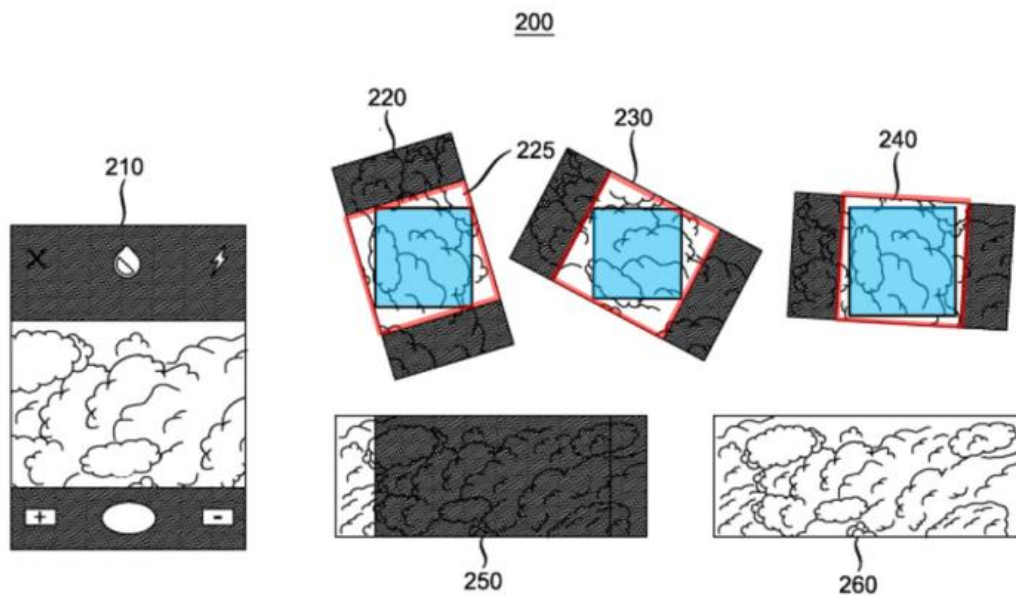


FIG. 2

Voss Fig. 2 (annotated by Petitioner)

125. It is not clear whether Petitioner relies on the blue box or the red box as the “inset” rectangle discussed in Voss. Voss itself is not very clear about this either. While Voss states that “[t]he inset rectangle 225 is transformed to compensate for rotation 220, 230, 240 by essentially rotating in the inverse of the device’s own rotation.” Ex. 1007, 10:5-7. Neither the red outline box nor the blue

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shaded box in Figure 2 appear to meaningfully change in size or aspect ratio. For example, the Figure 2 embodiment describes a 1:1 aspect ratio for the inscribed rectangle in portrait mode, and a 16:9 aspect ratio in landscape mode, but Voss Figure 2 does appear to depict any such change from the portrait to the landscape orientation. *Id.* at 10:13-16. Note that while the output box 260 in Voss is described as a 16:9 aspect ratio, the blue shaded box for the device in landscape mode 240 appears to completely different aspect ratio that is much closer to that of the blue rectangle of the device in other orientations.

126. Moreover, while Voss describes that its technique allows the user to “visualiz[e] the final output in an overlay on the device’s viewfinder during shooting,” *id.* at 9:15-19, Figure 2 in Voss does not show the preview screens depicting horizon-levelled content at all. Rather, notice how the clouds depicted on the preview screen of Voss appear to rotate with the device as the blue shaded rectangle appears to remain fixed in orientation, aspect ratio, and size.

127. I note that in its Written Opinion on Voss, the World International Patent Office Searching Authority expressed serious confusion about the relevant disclosures. *See* Ex. 2030. In paragraph 3.2, for example, the Office noted a “potential contradiction between description and figure 2.” *Id.*, 5. In paragraph 4,

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the Office noted a “contradiction” in the expression that “the framing . . . is maintained by zooming.” *Id.*, 7.

128. But more importantly, Voss teaches that the inset rectangle is **not** the final outputted image. After video capture is complete, Voss teaches that the “inscribed rectangle is sampled and then transformed to fit an optimal output dimension.” *Id.*, 10:16-17. This new output dimension may have a completely different aspect ratio from the aspect ratios selected for the inset rectangle during video capture, which would require “cropping data as necessary.” *Id.* For example, “[i]f a user records a video that is mostly portrait . . . [] the video will be portrait and fill the output optically, cropping any landscape content that falls outside of the **output rectangle**.” Thus, the inset rectangle in Voss does *not* define the extents of the final video. Rather, Voss teaches the creation of a new “output rectangle” that may have a different size and shape, and mere subset of the content defined within the extents of the inset rectangle during video capture.

2. Summary of Derbanne

129. Derbanne is a patent filed and assigned to Patent Owner that is directed to a different feature in its action cameras called HyperSmooth, and is directed to “systems and methods for stabilizing videos.” Ex. 1008, Title. It is not directed to horizon leveling, which is not mentioned anywhere in Derbanne.

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130. Unsurprisingly, both Derbanne and the '832 patent use some terminology given their common ownership. For example, Derbanne describes “punch-outs” (portions that are cropped) from a “capture field of view” that Derbanne determines from the “optical field of view” based on rotation of the image capture device. However, Derbanne’s determination of a “capture field of view” is different from the determination of the “viewing window” in the '832 patent. These two different determination steps are for different purposes and involve different considerations as reflected in the claim language of the respective inventions.

131. For example, the capture field of view in Derbane is generated to stabilize a video. It is determined based on the calculation of what Derbanne calls a “capture trajectory of the image capture device.” *Id.*, 3:58-63. The intent of the “capture trajectory” is to smooth camera motion through the minimization of a combination of rotational velocity and rotational acceleration of the camera housing. *Id.*, 10:61-66. The “capture trajectory” at any point in a video is therefore based on past and subsequent points of positional information within that video—which Derbanne calls the “observed trajectory.” *Id.*, 3:52-58. As shown in Figure 5C, the “capture yaw trajectory” is a smoothed version of the “observed yaw trajectory.”

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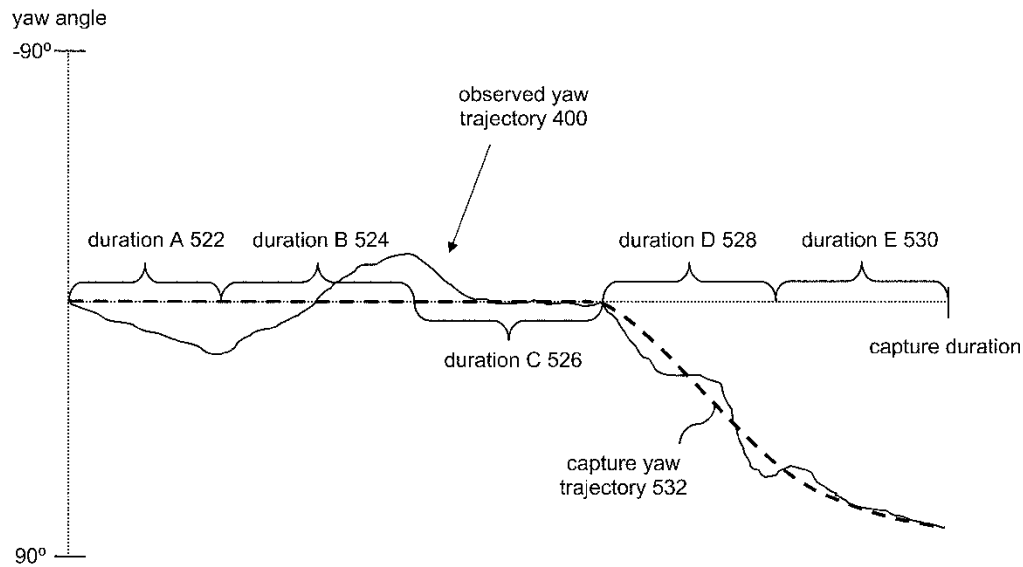


FIG. 5C

132. Derbanne explains that the smoothed “capture trajectory” may define “yaw angle position, pitch angle position, and/or roll angle position” and may be generated by “minimiz[ing] a combination of a time derivative, a second time derivative, and/or other time derivative(s) of the yaw angle position, pitch angle position, and/or roll angle position while respecting the set of constraints:

$$\min \left(\left\| \frac{d}{dt} \theta \right\|^2 + \left\| \frac{d^2}{dt^2} \theta \right\|^2 + \dots \right)$$

Ex. 1001, 11:2-15.

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133. In addition, the “capture trajectory” accounts for “jitters” from the image capture by using “exposure start time and exposure duration time” and “the position information (e.g., position sensor readings).” *Id.*, 11:23-37. The “capture trajectory” also attempts to remove “inter-frame motion” while preserving “intra-frame motion.” *Id.*

134. Thus, while Derbanne does disclose the determination of a window based on rotation of an image capture device, this determination is substantially different from the determination of a “viewing window” in accordance with the ’832 patent. Derbanne’s determination is intended to provide improved video stabilization by taking into account yaw, pitch, roll information, positional information, exposure information, and other relevant information. The purpose of Derbanne is not to level the horizon but rather to stabilize the video. Indeed, the tilt of the camera may be deliberate, and Derbanne’s methods will preserve such a tilt—previous methods failed to “take into account how the positions/motions changes during the capture duration” and therefore failed to “preserve the intent of the user that captured the images.” *Id.*, 8:65-9:1.

B. Claims 3-6 and 13-16: Voss, Derbanne, and Watanabe Do Not Render Obvious Distortion Within the Visual Content

135. Petitioner’s challenge to claims 3-6 and 13-16 in Ground 4 are identical to its arguments from Ground 2. Petitioner relies on the same teachings

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in Watanabe as allegedly disclosing claim 3. Pet. 81. Petitioner's rationale to combine Voss-Derbanne with Watanabe is also pretty much identical with its rationale to combine Thomason-Pacurariu with Watanabe. Pet. 82-83 (proposing that the combination "results in a system that achieves horizon-leveling of visual content while incorporating the advantages of Watanabe to generate natural looking horizon-leveled vide content.").

136. Thus, in my opinion, Voss, Derbanne, and Watanabe also fail to render obvious these claims for the same reasons I discussed above in Section V.B.

137. Specifically, Watanabe does not teach that the distortion remains in the image after horizon-leveling. Instead, Watanabe removes the barrel distortion caused by a fisheye lens, crops the image to remove image shake distortion, and then adds a significantly different barrel distortion that reduced by 70%. Ex. 1006, 11:9-39, 9:64-10:2. Since Watanabe's image processing is applied to undistorted images, and the re-added distortion is significantly different from the original distortion, it does not meet the claim requirement that the original distortion remain following the horizon-leveling.

138. In addition, a POSITA would not be motivated to combine Voss-Derbanne with Watanabe for the same reasons discussed for Ground 2. Watanabe's algorithm is directed to the specific problems caused by performing

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image shake correction on an image with a barrel distortion. Neither Voss nor Derbanne disclose barrel distortion or image shake correction.

139. And for claim 6, as in Ground 2, Petitioner's combination simply does not involve adding distortion prior to horizon leveling. Pet. 83.

C. Claims 1 and 11: Voss Does Not Disclose Determining a “Viewing Window”

140. In my opinion, for all challenged claims, Voss does not disclose determining a “viewing window” that “defin[es] extents of the visual content.”

141. Claim limitation 1[d][i] requires “determining a viewing window for the visual content as a function of progress through the progress length based on the rotational positions of the image capture device as the function of progress through the capture duration.” The next limitation goes on to recite that the “viewing window” must “defin[e] extents of the visual content to be included within horizon-leveled visual content as the function of progress through the progress length.” The limitation after that recites that the system must “generate the horizon-leveled visual content based on the viewing window,” and that the “horizon-leveled visual content” must “include[] a punchout of the extents of the visual content defined by the viewing window.” According to the claim, it is the inclusion of the extents of the visual content defined by the viewing window that “effectuates horizon leveling of the visual content.”

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142. The plain reading of these claims is that the “viewing window” must completely bound the content that is horizon-leveled. This is consistent with the function of the viewing window as discussed in the specification. Ex. 1001, 6:44-47 (“The portions of the visual content presented on the display/used to generate a video may include those portions of the visual content defined by (e.g., within) a viewing window.”), 21:7-10 (“Inclusion of the extent(s) of the visual content defined by the viewing windows in video may effectuate horizon leveling of the visual content via selective cropping.”), 28:1-3 (“At operation 204, the horizon-leveled visual content may be generated based on the viewing window and/or other information.”). This is also consistent with a POSITA’s understanding of the plain and ordinary meaning of the term “viewing window,” which implies a window for defining the extent of content that will ultimately be processed and available for viewing.

143. Finally, I note that this understanding is consistent with Petitioner’s claim construction in the ITC proceeding of “punchout,” where Petitioner proposed “a cropped portion of the visual content defined by the viewing window.” Ex. 2027, 8.

144. In view of this understanding of the nature of the “viewing window,” in my opinion, Voss does not disclose such a viewing window. Petitioner relies on

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“inset rectangle 225” in Voss. But Voss does not disclose that such an inset rectangle defines the extents of the visual content that is horizon-leveled. As Voss teaches, after the video is captured, “[t]he inscribed rectangle is sampled and then transformed to fit an optimal output dimension.” Ex. 1007, 10:16-17. In fact, Voss teaches that the “optimal output dimension” may be completely different from the aspect ratios of the inset rectangle during capture, requiring “cropping data as necessary.” *Id.*, 10:17-21.

145. Rather than using the “viewing window” to define the horizon-leveled content, Voss instead refers to a separate, post-capture “output rectangle” that may have a different size and shape, and may include different content, compared to the inset rectangle. *Id.*, 11:7-10 (“If a user records a video that is mostly portrait the opposite applies (the video will be portrait and fill the output optically, cropping any landscape content that falls outside the bounds of the **output rectangle**).”))

146. Thus, the inset rectangle is **not** a “viewing window” as required by claim 1, because it does not define the extents of the visual content to be included within horizon-leveled visual content and whatever horizon-leveled visual content may be output by Voss do not include a punchout of the extents of the visual content defined by the viewing window. The output content of Voss is generated

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only through the creation of an entirely separate output rectangle whose content does not correspond to the content of the viewing window.

147. Petitioner also relies on Derbanne for this limitation. However, Derbanne also does not disclose or suggest determining a “viewing window” that defines the horizon-leveled content. Derbanne’s “capture field of view” is determined for purposes of video stabilization, not horizon levelling. And, Derbanne’s determination of the “capture field of view” are based on completely different considerations, such as the minimization of a combination of rotational velocity and acceleration of the housing. Derbanne’s determination of a capture field of view would not render the ’832 patent’s determination of a viewing window obvious.

D. Claims 7 and 17: Thomason Fails to Disclose Determining a “Size” of the Viewing Window as Claimed

148. As I discussed above in Grounds 1 and 2, claim 7 requires that the determination of the viewing window “further includes determination of a size of the viewing window as a function of progress through the progress length based on the rotational positions of the image capture device as the function of progress through the capture duration.”

149. As I discussed for claim 1, Voss does not even determine a viewing window whose extends define the horizon-leveled content. But even if Voss’s

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inset rectangle could be the “viewing window,” in my opinion, Voss does not determine the size of this viewing window as claimed.

150. Petitioner’s analysis for this claim merely states that a POSITA would “understand” that the size of the viewing window would be determined as the function of progress through the progress length based on Figure 2. Pet. at 75-76. But, as I discussed above in Section VI.A.1, it is not clear that Figure 2 depicts a dynamically changing size for the inset rectangle, much less a preview of horizon-levelled visual content as the device rotates in the various images. Figure 2 does not appear to show this, and the accompanying written description in Voss is vague and contradictory as the World Patent Office found. At most, Voss appears to disclose an approach of interpolating between a portrait and a landscape aspect ratio for inset rectangle 225 as the device changes between the two orientations. Ex. 1007, 10:9-11. But the description and figure are vague as to how this is accomplished and what impact it has on the “size” of the inset rectangle throughout the video duration.

E. Claims 8 and 18: Voss Does Not Disclose Determining Viewing Window Size to “Simulate Changes in Zoom”

151. In my opinion, Voss does not disclose determining a viewing window size as a function of progress to “simulate changes in zoom,” as required by claims 8 and 18.

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152. Petitioner relies on Voss 13:10-16 for this limitation, but provides very little explanation. This passage makes a brief mention of “zooming,” but it describes the “**output box**” disclosed in Voss, *not* the purported “viewing window” (i.e. the inset or inscribed rectangle) that Petitioner relies upon for the previous limitations. As the cited passage states “the framing of the image inside the **output box** is maintained regardless of the aspect ratio.” Ex. 1007, 13:10-11. Voss teaches that this can be accomplished by zooming in on the scene or cropping the image to maintain size regardless of orientation or aspect ratio. As a POSITA recognizes, the zooming operation in Voss refers to a separate processing step *after* the viewing window has been determined.

153. As I discussed above in Section VI.B, Voss draws a distinction between its “inset rectangle” (e.g., 225 in figure 2) and the “output rectangle” (e.g., 260 in figure 2). Petitioner relies upon the “inset rectangle” as the purported viewing window, which I disagree with. But, even if Petitioner were correct, Voss still does not disclose that changes in size of the “inset” rectangle simulate changes in zoom. As Voss makes clear, any simulation of zoom is accomplished only through a post-capture process that involves determining a completely different “output box.”

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154. As I explained above in Section V.D, Petitioner’s analysis for claim 8 misunderstands the claim language, and this applies for its analysis in Ground 3 as well. Claim 8 requires more than just changing the size of the viewing window based on the rotation, which is all that Voss teaches with respect to its inset rectangle. A POSITA would understand that claim 8 includes a requirement for a resizing to accomplish a controlled zooming effect, and this is supported by the specification as I explained above. Ex. 1001, 18:32-37, 19:38-42, Fig. 6A, 6C.

155. Petitioner does not provide any analysis for how the size of the viewing window is changed for the purpose of simulating changes in zoom. Voss actually teaches that the change in the size of the purported viewing window (inset rectangle 225) is strictly a result of the change in rotation—*i.e.*, the “maximum available bounds of the overall sensor minus the padding,” which merely “provide[s] ‘breathing room’ for correction.” *Id.*, 10:4-9. No teaching is provided of modifying the size of the viewing window for the purpose of simulating changes in zoom.

F. Claims 10 and 20: Voss Does Not Disclose Determining a “Location” of the Viewing Window to Determine Framing

156. In my opinion, Voss does not disclose claims 10 and 20 because its inset rectangle is only ever located in the center of the frame.

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157. Petitioner’s argument that Voss discloses claims 10 and 20 is similar to its argument that Thomason discloses claims 10 and 20. In particular, Petitioner argues that as shown in the below figure (annotated by Petitioner), “the location of the inset rectangle within the field of view changes over time *based on different rotational positions* of the image capture device.” Pet. 77-78.

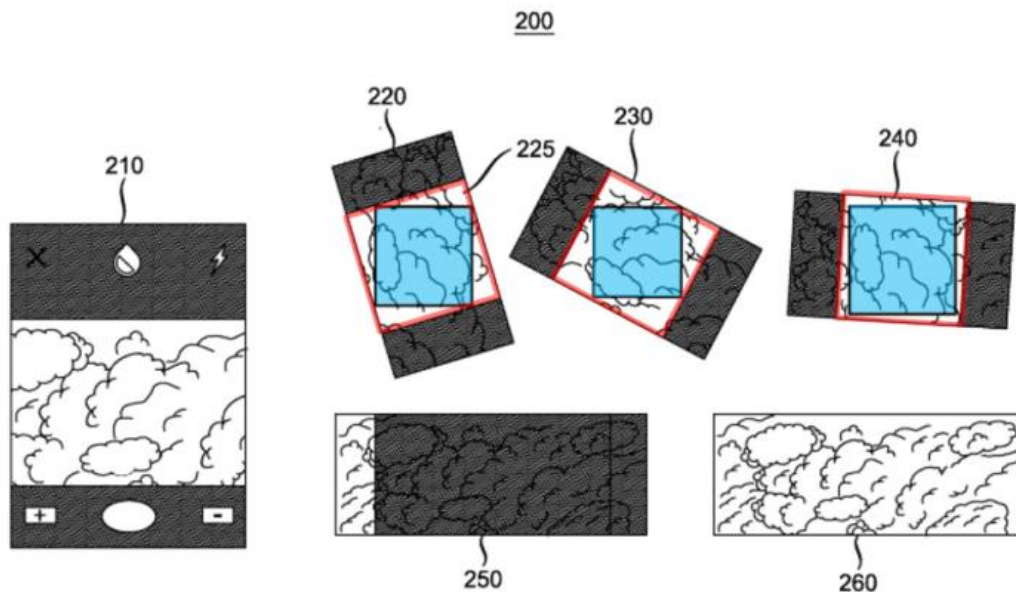


FIG. 2

158. Putting aside that I do not believe the inset rectangle is a “viewing window,” it is clear that the location of the inset rectangle is in the middle of the frame. What is different between them is their rotation, not their location. Dr. Katsaggelos agreed that viewing window is located in the center for all three

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images. Ex. 2022, 66:3-9 (“So 220, 230, 240 show different amounts of rotation of the original frame and this rectangle in the middle ... is shown 225.”).

159. In addition, Petitioner does not explain how the location of the viewing window in Voss determines the framing of the visual content. Petitioner argues that as shown in the above Figure 2, “different locations of the inset rectangle result in framing of different visual content.” Pet. 78. But the image clearly shows that the same portion of the cloud is framed despite the different rotations of the viewing window. Moreover, nothing in Voss teaches locating the viewing window such that a certain element within the image is framed. Voss’s algorithm simply uses the maximum-sized inset rectangle based on its rotation without concern of the content of the image.

G. All Claims: No Motivation to Combine Voss and Derbanne

160. Petitioner’s rationale to combine Voss and Derbanne is similar to its rationale for Ground 1, specifically:

The Voss-Derbanne combination results in a system in which data (captured video data, rotational position information) is captured, stored, and maintained in accordance with the teachings of Derbanne, and a punchout may be generated, yielding the predictable result of improving the video management and processing capabilities of Voss. (EX1002, ¶184.) A POSITA would be motivated to use the known techniques of Derbanne to improve Voss in the same way. (Id.) Further, it would have been obvious to try combining the teachings of Voss and Derbanne, as these technical features of Derbanne may be combined with the teachings of Voss without requiring much effort and with a reasonable expectation of success. (Id.)

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The known benefits of Derbanne would prompt the application of Derbanne in the same field based on design incentives and other market forces. (Id.)

Pet. 62. Dr. Katsagellos makes similar statements. Ex 1002, ¶184.

161. While Petitioner claims that the combination would “improve[] the video management and processing capabilities of Voss,” in my opinion, this is merely a generic allegation that amounts to saying that Voss would be improved. Petitioner does not explain how Derbanne’s teachings would actually improve anything. Petitioner also does not explain why a POSITA would think the combination has a reasonable expectation of success, and instead merely states the phrase. And Petitioner’s “obvious to try” argument is the same as in Ground 1, and similarly lacks specificity.

162. I also opine that Petitioner’s reasons for combining Derbanne and Voss are not directed to the specific teachings in Derbanne that Petitioner seeks to combine. For example, Petitioner relies on Derbanne’s disclosure of “defin[ing] visual content viewable as a function of progress through a progress length,” but fails to explain how that teaching in any way improves Voss. Pet. 61 (quoting Ex. 1008, 13:49-53). Nor does Petitioner explain a POSITA would be motivated to incorporate Derbanne’s disclosure of “rotational positions ... as a function of progress,” such as how it would improve Voss’s device. Pet. 67 (quoting Ex. 1008, 5:53-57).

PUBLIC VERSION**VII. SECONDARY CONSIDERATION OF NON-OBVIOUSNESS**

163. In my opinion, there is strong, objective evidence that the '832 patent is not obvious. Patent Owner GoPro, Inc. ("GoPro") successfully manufactured and sold wearable action cameras that include GoPro's novel Horizon Leveling functionality, which I understand GoPro asserts is an embodiment of the '832 patent. Ex. 2006 (Complaint), ¶23; *see also* Ex. 2005, 1 ("HERO9 Black has a new feature called in-camera Horizon Leveling.").

A. Horizon Leveling Practices the '832 Patent

164. I have reviewed certain GoPro documentation describing GoPro's novel Horizon Leveling functionality. In my opinion, when used on a GoPro camera, the Horizon Leveling functionality practices claims 1, 3, 7, and 8 of the '832 patent.

1. Claim 1

165. In my opinion, GoPro's cameras are a system for horizon leveling that practice Limitations 1[a] and 1[b] because they include physical processors and obtains the claimed video information defining a video. Ex. 2008 at 4 [REDACTED]

[REDACTED]

[REDACTED]. For Limitation 1[c] the Horizon Leveling functionality

[REDACTED]

[REDACTED]

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[REDACTED]

[REDACTED]

[REDACTED]

Ex. 2008, 7.

166. [REDACTED]

[REDACTED]

[REDACTED]

[REDACTED]

[REDACTED]

[REDACTED]

[REDACTED]

[REDACTED], GoPro’s Horizon Leveling functionality is able to perform Limitation

1[d]—“determin[ing] a viewing window ... as a function of progress ... based on the rotational positions”—[REDACTED]

[REDACTED]

[REDACTED]

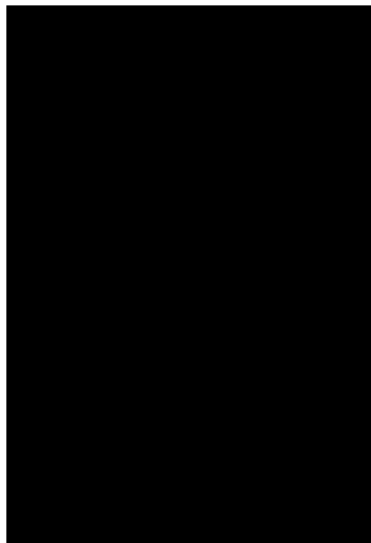
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167. [REDACTED]

[REDACTED]

[REDACTED]

[REDACTED]



2. Claims 3-4

168. GoPro's cameras also practice the additional limitations of Claims 3 and 4. GoPro's Horizon Leveling functionality can be used with GoPro's

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SuperView projection. Ex. 2028. Superview introduces a barrel distortion that can mask an off-axis horizon, as illustrated below:

Horizon Leveling – Distortion



3. Claims 7-8

169. [REDACTED]

[REDACTED]

[REDACTED]

[REDACTED]

[REDACTED]

B. Nexus

170. I have reviewed the declaration of Mr. Pablo Lema, who explains how Horizon Leveling is tied to the objective evidence of secondary considerations.

Ex. 2024.

PUBLIC VERSION**C. Copying**

171. I have seen evidence of copying, including by Petitioner.

172. Shortly after the release of GoPro’s horizon leveling technology, Petitioner began implementing its own “horizon lock” feature. Ex. 2031. [REDACTED]

[REDACTED]

[REDACTED]

[REDACTED]

[REDACTED]

[REDACTED]

[REDACTED]

[REDACTED]

[REDACTED]

[REDACTED]

[REDACTED]

[REDACTED]

[REDACTED]

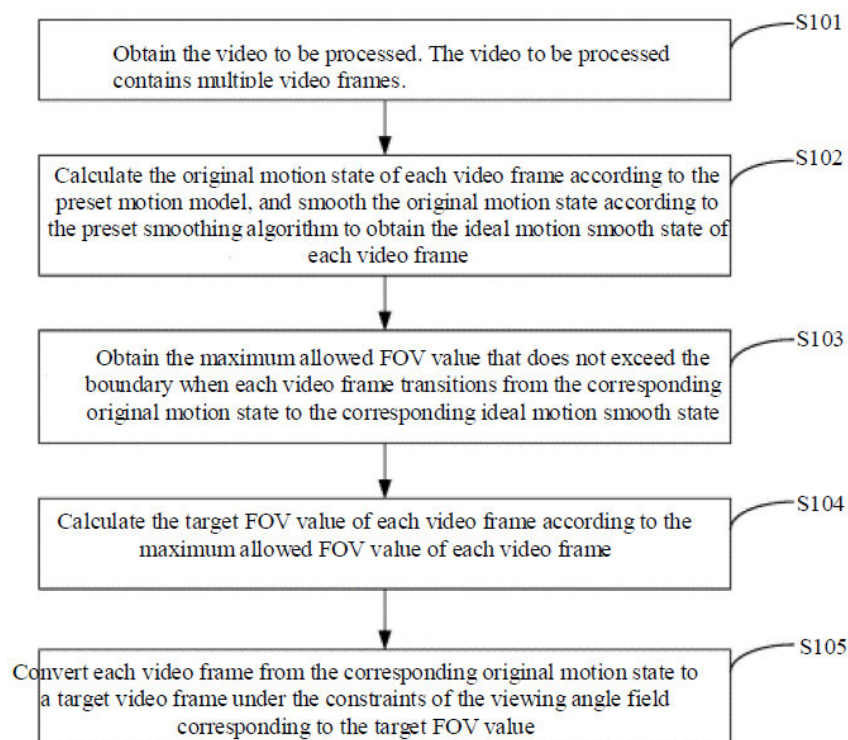
[REDACTED]

[REDACTED]

[REDACTED]

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173. Petitioner's '444 Chinese application describes what GoPro earlier claimed in the '832 patent and implemented in the Horizon Leveling functionality. The '444 application describes obtaining video information, obtains rotational position information captured as a function of progress through a capture duration, and then, based on the rotational position information and boundary constraints, determining a dynamic FoV for each frame with a adequate stabilization margin:



Ex. 2003, ¶¶27-44.

174. I understand that the Board gave little weight to the '444 application, stating that it does not relate to a “unique characteristic of a claim of the '832 patent.” ID, 53. But I note that the application is directed to changing the size of

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the viewing window to provide smooth zoom, which as I discussed above, is encompassed by claims 8 and 18. None of Petitioner's prior art references disclose such a feature.

175. [REDACTED]

[REDACTED]

[REDACTED]

[REDACTED]

D. Commercial Success

176. I have seen evidence of commercial success, specifically surveys indicating that Horizon Leveling was a driver of demand.

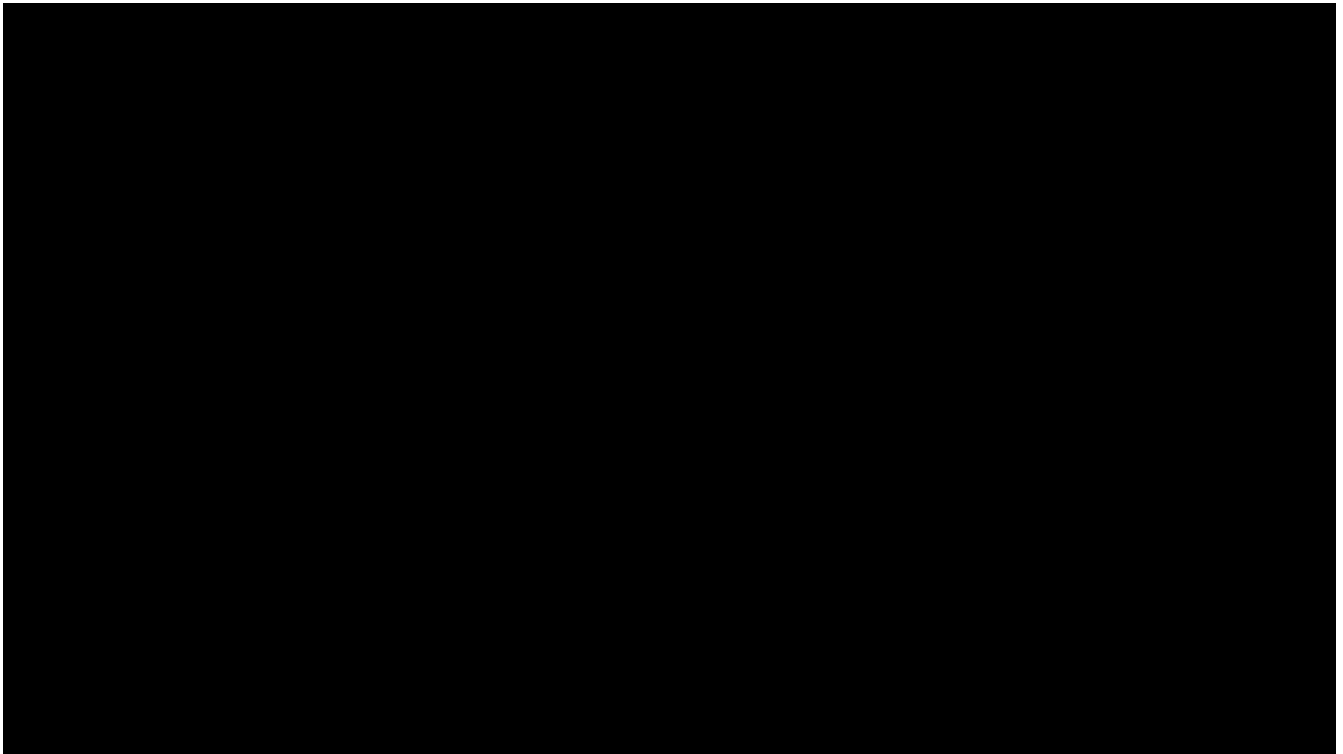
177. As Mr. Lema explained, objective surveys taken by GoPro in the course of business prove that Horizon Leveling consistently ranked highly amongst GoPro's top drivers of demand. Ex. 2024, ¶¶14-20; Ex. 2040, 10-14; Ex. 2019, 14.

178. For example, [REDACTED]

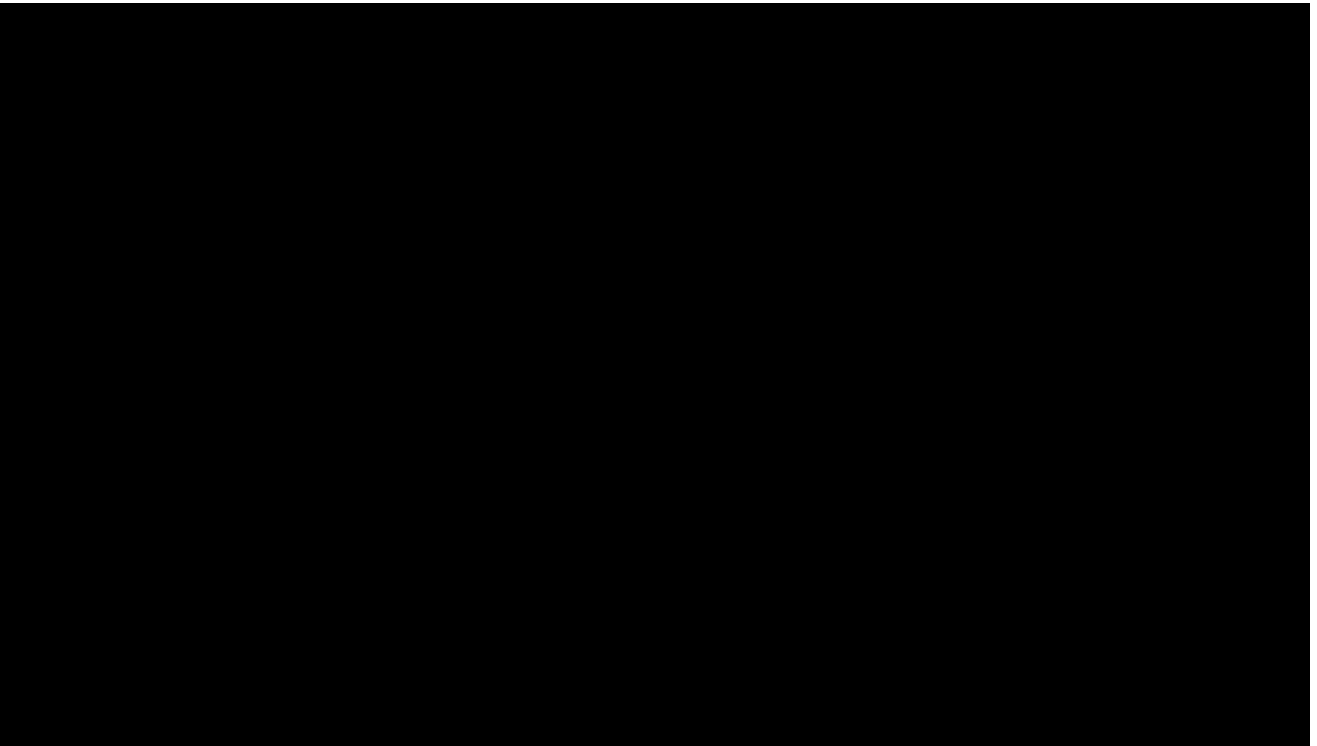
[REDACTED]

[REDACTED]

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179. Horizon Leveling was also a motivating factor for customers to purchase other lines of the Hero11 product:



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Ex. 2019, 14.

VIII. CONCLUSION

180. In signing this declaration, I recognize that the declaration will be filed as evidence in a contested case before the Patent Trial and Appeal Board of the United States Patent and Trademark Office. I also recognize that I may be subject to cross-examination in the case and that cross-examination will take place within the United States. If cross-examination is required of me, I will appear for cross-examination within the United States during the time allotted for cross-examination.

181. I hereby declare that all statements made herein of my own knowledge are true and that all statements made on the 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.

Executed: April 18, 2025

/s/ Hassan Foroosh
Hassan Foroosh, Ph.D.