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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 IPR2024-00984
U.S. Patent No. 10,015,413

DECLARATION OF HASSAN FOROOSH PH.D.
IN SUPPORT OF PATENT OWNER'S PRELIMINARY 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 Preliminary 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 IPR2024-00984, U.S. Patent No. 10,015,413 (“the ’413 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.

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, ¶33.

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 ’413 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 ’413 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. CLAIM CONSTRUCTION

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

IV. PROSECUTION HISTORY

35. Below I provide a summary of the prosecution history of the '413 patent.

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36. Prior to any office action, the '413 patent's claims read similarly to the allowed claims, with the notable exception that instead of reciting the step of "determin[ing] a portion within the input image, the portion including a subset of the pixels," the claim instead recited that "the input image includes a portion including a subset of the pixels." Ex. 1003, 135-36. In this set of claims, the claimed "portion" was still required to have less pixel shift than pixels outside of the portion. *Id.*

37. The examiner issued a single rejection, that the claims were obvious over U.S. Pat. 8,218, 895 ("Gleicher") in view of U.S. Pat. No. 7,496,243 ("Oosawa"). Ex. 1003, 46-50. The examiner stated that while Glecher did not show non-uniform pixel shifting, Oosawa "teaches an image display apparatus and method wherein the amount of shift ... is smaller in the center of the image than in the peripheral of the image." *Id.* at 48.

38. After this rejection, the applicant amended the independent claims to the current claims, specifically adding the step of "determin[ing] a portion within the input image, the portion including a subset of the pixels," and removing the language that "the input image includes a portion including a subset of the pixels." Ex. 1003, 32. The applicant then argued that, while Oosawaga may "show[] the amount of shifting to be applied to the center of the image is smaller than the

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peripheral of the image,” it does not disclose “determining a portion (including a subset of pixels) within an input image and non-uniformly shifting the pixels of the input image such that differences between input positions and output positions are less for the subset of the pixels than other pixels of the input image.” Ex. 1003, 39.

39. The examiner allowed the claims after this amendment. Ex. 1003, 13.

V. ALL GROUNDS: PETITIONER DOES NOT SHOW THAT ANY GROUND RENDERS OBVIOUS “DETERMINE A PORTION WITHIN THE INPUT IMAGE”

40. In my opinion, Petitioner has not shown that any of its challenged grounds render obvious the limitation “determine a portion within the input image” prior to the step of transforming the image based on the determined portion.

41. The challenged claims recite machine-readable instructions or a method step that “determine[s] a portion within the input image, the portion including a subset of the pixels” *prior* to transformation wherein following the application of a non-uniform shift transformation, pixels within the determined portion have less shift than pixels outside of the portion. For simplicity, I will refer to the claimed determined portion as the “less distorted portion” and the pixels outside of the determined portion as the “more distorted portion.” As I discussed above, the claims were amended to add this step of “determin[ing]” a less distorted

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portion prior to transformation, and remove the limitation that the image need simply contain such a portion when the transformation is applied.

42. It is my opinion that Petitioner has not shown how any of the references disclose or render obvious the “determine” limitation because Petitioner simply does not provide any explanation for how each reference determines a less distorted portion, after which non-uniform image transformations are performed. Instead, Petitioner only points to teachings of an alleged less distorted portion existing within the image when the image is transformed, not that the less distorted portion was determined by any machine-readable instruction or method step prior to transformation.

43. In my opinion, this contrasts with the disclosures of the ’413 patent. The ’413 patent provides numerous examples of the system determining the less distorted portion prior to transformation. For example, the less distorted portion can be “the center of the image ... chosen to be the region of interest that is most fully corrected and the distortion increases in each direction as the frame boundary is approached.” Ex. 1001, 4:19-22. For instance, a user-selected mode can configure a warping function so that less distortion occurs in a center portion, such as in GoPro’s commercial embodiments which allow a user to select between different modes (*e.g.*, Superview or Wide view) that results in a warping grid that

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determines different less distorted portions. '413 patent at Abstract (“In one embodiment, the output image is non-linearly warped relative to the input image such that a distortion in the output image relative to the input image is greater in a corner region of the output image than a center region of the output image.”), 2:15-20 (same). In addition, the portion “may dynamically change between images.” Ex. 1001, 4:32-36.

A. Grounds 1 and 2: Fleming

44. For Grounds 1 and 2, in my opinion, Petitioner has not shown how Fleming discloses or renders obvious the “determine” step.

45. For Ground 1, Petitioner relies on Fleming’s “graphics processing unit” and “central processing unit” as performing the claimed steps. Pet. 12. Yet for the “determine” step, Petitioner provides ***no explanation*** as to how the GPU or CPU “determine a portion within the input image” prior to transformation. Pet. 14-15.

46. Below is the entirety of Petitioner’s analysis:

Fleming discloses “maintain[ing] the original aspect ratio in an area of interest (e.g., at the center of the image).” (EX1004, 4:39-40.) In Figure 2 (below), for example, “a square region at the center of image 271 is mapped (or scaled).” (EX1004, 5:1-2, 5:17-66, Figs. 2, 3.) A POSITA would have understood that a region at the center of the image includes a subset of the pixels within the input image. (EX1002, ¶¶59-62.)

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47. In my opinion, what’s missing from Petitioner’s analysis is any discussion of how Fleming teaches that the GPU or CPU “determine[s]” the less distorted portion of the image prior to transformation. Although Fleming discloses that an “area of interest” or a “square region at the center” has minimal or no distortion, that simply describes the effect of the transformation. There is no explanation as to how that portion is determined by the CPU or GPU prior to transformation as recited in the claims, a limitation that was specifically added to overcome prior art during prosecution.

48. This contrasts with the ’413 patent’s specification, where based on numerous factors such as characteristics of the image and desired overall distortion, the system creates a “resolution remapping” where some portions are less distorted and other portions are more, and the “remapping” is then applied as a transformation to the image. Ex. 1001, 3:39-45.

49. Thus, in my opinion, Petitioner does not show that Fleming discloses or renders obvious the “determine” step.

B. Ground 3: Obara

50. For Ground 3, in my opinion, Petitioner has not shown how Obara discloses or renders obvious the “determine” step.

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51. Petitioner relies on Obara's "CPU" as performing the claimed steps. Pet. 51. Yet as with Ground 1, Petitioner does not provide any explanation as to how the CPU "determine[s] a portion within the input image." Pet. 55-58. Instead, Petitioner only quotes Obara's disclosure that the "non-linear scaling module 215 vertically divides the original image data (A) into, for example, eight image blocks" where "blocks 3, 4, 5 and 6 which belong to the central area." Pet. 56. Petitioner then asserts that "blocks 3-6 at the central area" is the claimed portion. Pet. 56. No discussion is given as to how Obara's CPU determines that those blocks are the claimed portion. I again note this is in contrast to the disclosures of the '413 patent wherein, based on a number of factors (e.g. location of an object within the input image, size of an object in the input image, or the motion of an object in video frames), the less distorted portion and the more distorted portion are determined as a "resolution remapping," which is performed by applying a transformation to the image. The less distorted portion and the more distorted portion, and therefore the resolution remapping can change depending on said factors. Ex. 1001, 3:39-45, 4:32-36, 4:37-46.

C. Ground 4: Meulen

52. For Ground 4, in my opinion, Petitioner has not shown how Obara discloses or renders obvious the "determine" step.

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53. Petitioner relies on Meulen’s “processors, controllers, encoder devices” of a mobile device as performing the claimed steps. Pet. 86-87. Yet Petitioner’s analysis for the “determine” step only quotes Meulen’s disclosure of “central display region 140-3” which “comprise[s] 200 pixels and require[s] the media source content to undergo no image compression.” Pet. 88 (quoting Ex. 1007, 6:27-31). It is my opinion that Petitioner fails to show how Meulen discloses that the CPU determines a less distorted portion versus a more distorted portion prior to image transformation. Again, this is unlike the ’413 patent where the system determines the less distorted and more distorted portions based on a number of factors, before “resolution remapping” transformations are applied to the image.

VI. ALL GROUNDS: PETITIONER DOES NOT SHOW THAT ANY GROUND RENDERS OBVIOUS PERFORMING NON-UNIFORM SHIFTING ON AN “IMAGE CAPTURE APPARATUS” OR “CAMERA”

54. Claims 1 and 6-7 require that the claimed machine-readable instructions be performed by “physical processors” within an “image capture apparatus” with an “image sensor” (claim 1) or “physical processors ... within a camera” (claims 6-7). I understand that Petitioner intends to disclaim all claims except claims 1 and 6-7.

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55. For all grounds, Petitioner focuses on claim 6 first, and then relies on its claim 6 analysis for claim 1’s limitations of “image capture apparatus” and “image sensor.” For Grounds 1 and 3, Petitioner asserts that it would have been obvious to incorporate the teachings of Fleming and Obara into a camera, yet provides no evidence that a digital camera in 2013 would output an image with a different aspect ratio. Petitioner’s “motivation” is also flawed for not being related to the teachings in Fleming or Obara. As for Ground 4, neither Meulen nor Chao disclose physical processors *within* a camera.

A. Ground 1: Fleming

56. In my opinion, Petitioner has not shown that Fleming renders obvious the performance of the claimed steps on “a camera” or an “image capture apparatus.”

57. Petitioner asserts “[i]t would have been obvious for Fleming’s data processing system (including its GPU and CPU) to be included within a camera.” Pet. 28. In particular, Petitioner asserts it would have been obvious to use Fleming’s non-linear distortion in order to convert the aspect ratio of the captured image to the aspect ratio of the image as a stored file or when displayed on an LCD included with the camera. *Id.*

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58. But, in my opinion, Petitioner’s analysis is flawed because (1) Petitioner provides no evidence that any camera in 2013 used a different aspect ratio to store images as files or display on an LCD, (2) Petitioner’s “motivation” is conclusory and is not a motivation to apply non-linear distortion in converting the aspect ratio—indeed, it was conventional to reduce as much distortion as possible, and (3) Petitioner does not contend that the combination would have a reasonable expectation of success.

59. First, Petitioner does not provide any evidence that any cameras in 2013, the earliest effective filing date of the ’413 patent, had an “aspect ratio of the captured image [that] was different than the aspect ratio of the stored file or the LCD display included in the camera.” Pet. 28. Without such a difference in aspect ratio, there would not be any reason to use Fleming’s system for converting aspect ratios within a camera. Yet it would be nonsensical to design a camera to capture images in one aspect ratio and store or display them in a different aspect ratio—it would, in fact, be “less burdensome, cheaper, and save[] time” to use the same aspect ratio.

60. Second, Petitioner’s “motivation” lacks any substance. Petitioner’s motivation is that “hav[ing] on-camera processing and display capabilities because it would have been less burdensome, cheaper, and saves time.” But this motivation

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is not tied to the specific teachings of Fleming Petitioner relies on, specifically its use of non-linear distortion to convert aspect ratios from an image on a camera to an external display device such as a television. Petitioner's generic motivation of "on-camera processing and display capabilities" is something any digital camera in 2013 already had. There is no further motivation to include non-linear distortion for converting aspect ratios on the camera. In my opinion, it would have been "less burdensome, cheaper, and save[more] time" to not perform any aspect ratio conversion, or if performing an aspect ratio conversion, not to perform a non-linear distortion.

61. In fact, in 2013, it was understood that non-linear distortion on an image was undesirable, especially for a still-image camera disclosed in Fleming. This is because non-linear distortion results in distortions that would make the scene look unnatural—especially if there are known objects or persons in the field of view. For example, Exhibit 2003, which is a discussion of the feature that is embodied by the '413 patent, GoPro SuperView, provides examples of how the distortion from SuperView can look unnatural for still images. For example, the first image below does not use non-linear distortion, whereas the second one does, which has highly visible and jarring distortions.

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62. The article concludes that this functionality is “not especially useful for ... any time that the highly distorted and compressed look is going to appear strange,” such as “standard people shots.” Ex. 2003, 6. Instead, the non-linear

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distortion is more appropriate for “body- and gear-mounted shots” where one may be “shooting in a tight space” or “want to make sure that your subject remains in the frame.” *Id.*

63. In my opinion, a POSITA would by contrast understand that it would be desirable to remove any distortion. For example, many cameras used fish-eye lenses to take wide angle shots, which resulted in distorted images. Numerous prior art references discuss processing such images to remove the distortions. *See, e.g.,* Ex. 2004, Abstract (“A wide angle lens system ***distorts the image*** and conveys it to an image sensor, which converts the image to an electronic signal and conveys it to image processing circuitry. The image processing circuitry ***corrects the distortion*** or transforms it to human recognizable image forms.”); Ex. 2005, Abstract (“A digital photographing apparatus for ***correcting image distortion*** performs an image distortion correcting method.”). Thus, a POSITA would have understood that distortions were undesirable.

64. Thus, not only would the claimed non-linear distortion not be “less burdensome, cheaper, and saves time” as Petitioner asserts, it would instead result in a highly distorted, unnatural look to the still photographs or video of scenery that Fleming contemplates.

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65. Third, Petitioner does not provide any evidence or even assert that the combination would have a reasonable expectation of success. I understand that an obviousness combination must include why a POSITA would have a reasonable expectation of success.

B. Ground 3: Obara

66. Petitioner's assertions for Obara are largely identical as its assertions for Fleming. Petitioner does not contend Obara discloses a "camera" or an "image capture apparatus." Pet. 71-72 (analyzing claim 6), 78-79 (relying on claim 6 analysis). Petitioner argues it would have been obvious "for Obara's image processing unit and CPU 111 to be included within a camera" for the same reasons as given for Fleming. Pet. 71-72. These arguments fail for the same reasons discussed for Ground 1—namely, that Petitioner does not provide any evidence of cameras that performed aspect ratio conversion on-camera, and that a POSITA would not find it desirable to perform non-linear distortion on the still images captured by Obara's device. And Petitioner again fails to assert that the combination would have a reasonable expectation of success. *Id.*

C. Ground 4: Meulen

67. In my opinion, neither Meulen nor Chao disclose that the claimed steps are performed by processors within a camera or image capture apparatus.

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68. For Meulen, it expressly describes a “wireless device 100” that “*comprise[s] ... a camera*” but does not state that the processors are *within* the camera. Pet. 97; Ex. 1007, 4:55-60. And for Chao, it merely describes outputting the image to a camera screen, but provides no disclosure of processors within a camera performing any scaling of images. Pet. 97; Ex. 1008, ¶32.

VII. GROUND 4: PETITIONER DOES NOT SHOW THAT THE COMBINATION OF MEULEN AND CHAO RENDERS OBVIOUS NON-UNIFORM PIXEL SHIFTING OR THAT THE COMBINATION WOULD HAVE A REASONABLE EXPECTATION OF SUCCESS

69. The challenged claims recite a transformation that “non-uniformly shifts the pixels” between the input and output image. For Ground 4, Petitioner alleges that the combination of Meulen and Chao would render obvious this claimed non-uniform pixel shifting. But neither reference actually describes pixel shifting, and so the combination cannot render obvious the limitation. I also note that Petitioner and Dr. Katsaggelos assert reasonable expectation of success using conclusory statements, and provide no explanation.

70. Meulen describes a method for non-uniformly compressing an image, wherein a central region is not compressed, whereas the periphery of the image has increasingly higher compression ratios. Ex. 1007, 6:27-37; Tables 2-4. Thus, in the embodiment relied on by Petitioner, a central region of 200 pixels is not

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compressed, whereas the edge regions of 40 pixels are compressed into 10 pixels.

Pet. 89-90 (annotating Table 1, reproduced below).

TABLE 1

	Region					Total
	1	2	3	4	5	
Pixels/Region	10	50	200	50	10	320
Compression Ratio	4:1	2:1	none	2:1	4:1	
Source Pixels	40	100	200	100	40	480

71. As Petitioner explains it, Meulen does not describe how to perform this compression—it certainly does not mention pixel shifting. Pet. 91. Petitioner instead makes two arguments: (1) obviousness in view of the knowledge of a POSITA, and (2) obviousness when Meulen is combined with Chao.

72. For the first argument, Petitioner only states that “[i]t would have been obvious that when performing image scaling, pixels from the input to output positions are shifted based on a scaling factor” and that a POSITA would have known about shifting pixel positions for scaling. Pet. 91. However, Petitioner does not provide any motivation or reasonable expectation of success, nor does Petitioner cite to any evidence regarding the knowledge of a POSITA beyond its own expert’s say-so. *Id.*

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73. As for the combination of Meulen and Chao, Petitioner relies on Chao's disclosure that a "background element [of an image] is re-sized by stretching or shrinking" which "mean[s] the resizing of an element without regard to the original aspect ratio of the image." Pet. 91-92 (quoting Ex. 1008, ¶¶28, 63). Petitioner then asserts that "[a] POSITA would understand that stretching/shrinking means shifting the pixels' positions." Pet. 92. However, Chao never discusses shifting pixels, and Petitioner does not cite to anything beyond its expert's conclusory opinion. In addition, Chao does not disclose non-uniform pixel shifting, nor does Petitioner allege that it does. Thus, the combination cannot disclose non-uniform pixel shifting.

74. Another problem with Petitioner's combination is that neither Petitioner nor either of the references provides an explanation for how to perform pixel shifting when compressing portions of an image as required by Meulen's teachings. For example, Petitioner does not explain how compressing four pixels into one pixel would involve a shift of pixels. Neither Meulen or Chao explain which pixel if any is shifted, and which pixels are not, when performing compression.

75. It is also my opinion that Petitioner's reasons for combining Meulen and Chao are lacking in substance. For motivation to combine, Petitioner only

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asserts that the combination “involves combining prior art elements and known techniques.” Pet. 92. Petitioner also does not discuss how the combination would have a reasonable expectation of success, which I understand is required to show obviousness.

VIII. SECONDARY CONSIDERATION OF NON-OBVIOUSNESS

76. In my opinion, there is strong, objective evidence that the ’413 patent is not obvious. Patent Owner GoPro, Inc. (“GoPro”) successfully manufactured and sold wearable action cameras that include the SuperView functionality, which I understand GoPro asserts is an embodiment of the ’413 patent. Ex. 2006 (Complaint), ¶20; *see also* Ex. 2007.

77. I have seen possible evidence of copying, including by Petitioner. Petitioner’s products use a feature called ActionView, whose description and name is quite similar to SuperView. Ex. 2009. Petitioner describes ActionView as “optimized specifically for action PoV shots, with a taller height” and that it should be used for shots that have an “immersive first-person view, ideal for skiing, cycling and more.” *Id.* This description is quite similar to how GoPro describes the SuperView functionality, such as advertising that it is optimized for immersive first-person views, such as for skiing and biking: “When to use Superview... Activities with the camera mounted on your head or chest, such as biking, skiing,

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motocross, etc., all work great—anything without a lot of important focal items around the edges of the frame.” Ex. 2010, 1.

78. I understand that SuperView functionality has been in GoPro cameras since at least 2014 if not earlier. By contrast, I also understand that Patent Owner was not founded until 2015, and that ActionView does not appear to have been released until after 2020.

79. I have also seen evidence of others who have copied SuperView. For example, a “superview” project is described as “[a] small program that takes a 4:3 aspect ratio video file, and transforms it to a 16:9 video using the GoPro SuperView method.” Ex. 2011. Another called “SuperViou” is similarly described. Ex. 2012.

80. I have seen evidence of industry praise for SuperView. In a review by New Atlas on October 5, 2014, it characterizes SuperView as a “clever” feature that “is designed to capture a more immersive wide angle perspective.” Ex. 2013. I understand that New Atlas has a significant presence in the industry, having a readership of “approximately four million unique visitors a month” and covers “advances in technology, science, transportation, architecture, design, and many other disciplines.” Ex. 2014.

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81. Others have also praised SuperView. One reviewer described “GoPro’s unique Superview lens” which provides “a ridiculously wide angle which allowed even a selfie taken from just arms reach to capture all six of our family!” Ex. 2015.

82. User posts from the forum of a competitor called DJI have also praised SuperView and expressed a desire for DJI’s products to have a similar feature. Below are a few examples of such praise. Ex. 2016.

- “Hello, is there **any chance on getting a Superview-like mode** like the one in the Hero 7? Asking this because i bought the Osmo Action but since i'm a biker i think **it's a very important feature** and now i feel like i want to send the osmo back and buy a Hero 7.” (Post #1)
- “Hi, thank you for bringing this query for us. **As of the moment, we don't have this feature for the DJI Osmo Action.**” (Post #2)
- “Can you explain what ‘superview mode’ is?” (Post #4)
- “**It's the famous GoPro mode** that enable the camera to record video in 4:3 to gain FOV and then stretch the image to reach the 16:9 ratio.” (Post #5)
- “Thanks very much for the info and links. **Technology is amazing** - they stretch out the sides or edges to fill the frame - **neat trick.**” (Post #7)
- “**2020 already, please for Superview Mode**” (Post #19)
- “**Any updates of when the superview like feature for Osmo action might land?** That would be a **game changer** and many of **my friends want to buy Osmo action but are retreating** because of this missing feature” (Post #21)

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- “Hi, **wondering if this was ever considered?** I ended up buying a few of the original Osmo Action cameras and **this would be an awesome feature.** Converting in post is just torture. **A superview for motovlogging is a must.**” (Post #26)

83. Another post from the same forum describes SuperView as “essential” for DJI to add to the next firmware for their products. Ex. 2017 (post #28 and 30).

84. I have also seen evidence of commercial success, specifically surveys indicating that SuperView was a driver of demand. [REDACTED]

[REDACTED]

[REDACTED]

[REDACTED]

[REDACTED]

Ex. 2018, 23.

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85. [REDACTED]

[REDACTED]

[REDACTED]

Ex. 2019, 14.

86. I have also seen evidence of a long-felt need and unexpected results with respect to SuperView. The '413 patent states that prior to its invention “[c]onverting between aspect ratios [was] a common problem in the field of image and video processing.” Ex. 1001 at 1:6-7. “Conventional conversion techniques such as cropping, linearly scaling, and padding each result[ed] in a perceivable reduction in the quality of an image or video.” *Id.* at 1:11-13. For example, cropping would “remove[] content from the image and reduce[] the field of view of the image.” *Id.* at 1:14-15. “Linear scaling,” on the other hand could “maintain[]

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the full field of view” but would “introduce[] perceivable distortion into the image.” *Id.* at 1:16-18.

87. At the time of the ’413 patent, conventional wisdom was that introducing distortion into images was undesirable. For instance, distortion, particularly geometric distortion, can stretch or compress parts of the image in an uneven way, making faces or bodies look elongated, squished, or warped. This effect is especially undesirable in personal or group photos, where people expect to see a realistic representation of themselves. Because of these reasons, photographers and camera designers traditionally seek to avoid or minimize distortion to maintain the integrity, realism, and appeal of their photos. Indeed, GoPro explains on its website that Superview should not be used in conventional camera settings: “Avoid using SuperView when people are on the edges of the frame since they will be stretched a bit.” Ex. 2010, 1.

88. Given these challenges, a user of a camera was generally limited to capturing images with an output field of view having the same aspect ratio of the intended display or if aspect ratio conversion was performed it was done so as to avoid distortion. For instance, in the ITC litigation, Petitioner relies on the Nikon D5200 Digital Camera as prior art. The D5200 manual is consistent with the ’413 patent’s description of the art. It applies conventional cropping based on user

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selection to create an associated image for a preview function (for video files), or a rote aspect ratio change (for image file). Ex. 2020, 120-21 (“Rotate the command dial to switch between aspect ratios of ratio 3:2, 4:3, 5:4, 1:1, and 16:9.”; “Use multi selector to position the crop.”). In other words, the D5200 reflects the conventional understanding of how cameras should perform aspect ratio conversion when displaying images on the camera by teaching the type of conventional cropping that the specification of the ’413 patent improves upon. Ex. 1001 at Abstract, 1:7-25, 5:9-13.

89. While conventional cameras seeks to eliminate distortion when displaying on the preview screen, GoPro took a 180-degree approach: introducing distortion when displaying on the screen. In particular, GoPro’s SuperView invention utilizes a sensor that captured an image in one aspect ratio (4:3) so that the image can be “taller,” and then allowed it to be displayed and previewed on the screen in aspect ratios that are more commonly used in video settings (*e.g.*, 16:9). To do this, however, GoPro had to intentionally introduce distortion into the image. SuperView thus applies a warping function that distorts the edges while eliminating distortion in the center. GoPro’s unconventional approach arises from the fact that GoPro’s cameras are directed at action sports, not conventional photography. GoPro recognized that video for certain action sport scenes, like

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skiing, surfing and bicycling, result in persons being centered in the middle of the shot, with no persons on the edges. This means that the periphery can be distorted in an acceptable manner.

90. Consider surfing as one example. A surfer capturing himself in a “barrel” benefits from a taller image because he or she can see more of the wave, and the distortion at the periphery is acceptable because the focus of the capture is in the middle where the action takes place, instead of the periphery, as can be seen in the image below taken with SuperView:



Ex. 2021.

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91. Thus, in my opinion, the SuperView functionality met the long-felt need of producing high-quality, wide-angle video for wearable action cameras through the use of non-linear distortion, which was an unexpected result.

IX. CONCLUSION

92. 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.

93. 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: October 16, 2024

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