

PUBLIC VERSION

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 IPR2024-01186
U.S. Patent No. 10,574,894

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

PUBLIC VERSION

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 IPR2024-01186, U.S. Patent No. 10,574,894 (“the ’894 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

PUBLIC VERSION

(“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

PUBLIC VERSION

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

PUBLIC VERSION

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 industry partners, with total funding exceeding \$14M since joining UCF, and ongoing funded projects for an 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.

PUBLIC VERSION

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 Arts – 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.

PUBLIC VERSION

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

PUBLIC VERSION

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*

PUBLIC VERSION

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.

PUBLIC VERSION

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, ¶¶36-37.

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 May 2018 provisional application priority date of the ’894 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 ’894 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

PUBLIC VERSION

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

PUBLIC VERSION

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

PUBLIC VERSION

“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.

I. OVERVIEW OF THE '894 PATENT

35. The '894 Patent, titled “Systems and Methods for Stabilizing Videos,” discloses an advanced system designed to stabilize video content by minimizing the effects of jerky or shaky camera movements. The system achieves this by

PUBLIC VERSION

generating a capture trajectory that differs from the observed trajectory of the camera, which represents the actual path followed during video capture. It utilizes position sensors, such as gyroscopes and accelerometers, Ex. 1001, 2:5-14, to detect camera movements and create a smoothed path based on the camera's yaw, pitch, and roll angles. *Id.*, 10:61-11:22. By minimizing both rotational velocity and rotational acceleration, the system ensures smoother changes in the camera's position and orientation, resulting in a more stable video output. *Id.*

36. The '894 Patent further explains how the system generates stabilized video content by selecting portions of the captured images, referred to as punch-outs, based on the smoothed trajectory. *Id.*, 8:1-37. These punch-outs are used to produce a final video that avoids the shakiness associated with the observed camera movements. *Id.*, 10:11-25. The stabilization method operates to “minimize[] 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 [a] set of constraints.” *Id.*, 11:2-15.

37. The '894 Patent represents a significant advance over the prior art by minimizing rotational velocity, rotational acceleration, and/or other time derivative(s), and introducing the capability to balance and weigh these components differently, depending on the stabilization requirements. *Id.*, 11:15-

PUBLIC VERSION

22. These advancements offer fine-tuned control over the stabilization process to take into account a wide variety of motion characteristics (e.g., large or small, Ex. 1001, 11:53-61, 12:23-33), something the prior art failed to provide. The prior art did not fully appreciate the importance of addressing a variety of rotational motion characteristics, nor did it enable simultaneous control of their tradeoff to optimize stabilization by applying different weights to rotational velocity and acceleration, and other derivatives.

38. This breakthrough—allowing the weighing and balancing of rotational dynamics, coupled with the overall system’s innovative approach to video stabilization—was pivotal to GoPro’s Emmy award-winning success. As discussed in greater detail below, the commercial success of GoPro’s cameras, the industry praise for its innovative stabilization, and the long-felt need for this advanced technique further validate the non-obviousness and impact of the patented technology.

II. OVERVIEW OF CERTAIN CITED ART

39. The petition challenges the ’894 Patent’s claims 1 to 20 on two grounds. Ground 1 asserts that the combination of Zhou and Kwatra renders the claims obvious. Ground 2 asserts that the combination of Zhou, Kwatra, and Shi also renders the claims obvious. Below are short summaries of these references.

PUBLIC VERSION**B. Ground 1 Cited Art****1. Zhou (Ex. 1004)**

40. The Examiner issued the '894 Patent over Zhou. See Appl. No.: 16/548,453, List of references cited by examiner (Sept. 13, 2019).

41. Zhou discloses a system aimed at smoothing camera motion during video capture by adjusting a “stabilization metric” in response to motion data derived from gyroscopes or accelerometers. Ex. 1004, Abstract, 3:47-4:19. This system focuses on motion smoothing of a handheld camera in low-light conditions based on estimating the motion blur in each frame but lacks specific treatment for rotational dynamics such as velocity and acceleration along yaw, pitch, and roll, which are critical to the '894 Patent's approach to stabilization.

42. In contrast, the '894 Patent introduces a system that minimizes a tradeoff of both rotational velocity and rotational acceleration, allowing these factors to be weighed equally or differently for greater control over stabilization. This flexibility in handling rotational dynamics is not disclosed by Zhou.

2. Kwatra (Ex. 1005)

43. Kwatra discloses techniques for generating smooth camera paths by minimizing derivatives of the camera's trajectory, including velocity and acceleration. Ex. 1005, 13:23-14:52. However, Kwatra teaches that velocity and acceleration are “substantially constant” along both the “original path” and the

PUBLIC VERSION

“smoothed path” of the camera, except for some points in time that the camera makes transitions, e.g. from static to panning. (Ex. 1005, 1:48-57, 2:6-14, 6:13-14, 6:20-28, 6:40-42, 13:41-42, 13:49-54). In other words, Kwatra limits to a **narrow** setting of piecewise or “segment”-wise “substantially constant velocity and acceleration.” Moreover, Kwatra does not provide a specific method for balancing and weighing *rotational* velocity and rotational acceleration, particularly across the yaw, pitch, and roll angles of the camera, as required by the ’894 Patent.

44. The ’894 Patent introduces a more advanced approach by specifically applying the derivatives to the camera’s yaw, pitch, and roll angle positions, allowing for precise control over rotational velocity and rotational acceleration along these rotational axes. See ’894 Patent, Equation 54, 11:2-15. This allows for targeted stabilization of the camera’s rotational dynamics along each axis, a feature that is absent in Kwatra’s broader discussion of camera movement.

45. Although Kwatra mentions that a segment of path may have more complex camera motions, such as parabolic movement, Ex. 1005, 14:23-37, such movement is still substantially smooth (i.e. with substantially constant velocity or acceleration). Kwatra does not disclose the detailed treatment of rotational dynamics, such as minimizing rotational velocity and acceleration along specific rotational axes (yaw, pitch, and roll). The ability to adjust weights on these first,

PUBLIC VERSION

second, and higher order derivatives for rotational stabilization, as disclosed in the '894 Patent, allows for a level of control and fine-tuning that is simply not present in Kwatra's approach to motion stabilization.

46. The '894 Patent's emphasis on minimizing rotational velocity and acceleration across yaw, pitch, and roll angles, and the ability to weigh these components differently or equally, provides a more refined and flexible method for stabilization. This distinction makes the '894 Patent more versatile in terms of being able to handle a wide variety of rotational dynamics, and a significant advancement over Kwatra, and hence establishes the non-obviousness of the claimed invention.

C. Ground 2 Cited Art**1. Shi (Ex. 1006)**

47. Shi focuses on trajectory estimation and correction to stabilize videos through a series of transformations that adjust the camera's position and rotation based on motion data. The system applies a first transformation using optical image stabilization (OIS) data and then calculates a second transformation based on additional positional data collected after the capture of the frame. Ex. 1006, 3:52-4:11. This second transformation generates a stabilized version of the frame by correcting for both translational and rotational movements, but Shi does not specifically address the minimization or balancing of rotational velocity and

PUBLIC VERSION

acceleration or higher order derivatives. Shi's approach relies on broader trajectory estimation and correction models that do not focus on the detailed handling of rotational dynamics, such as applying different weights to rotational velocity and acceleration or other derivatives, as claimed in the '894 Patent.

48. The '894 Patent advances beyond Shi by focusing on rotational stabilization and providing a precise method for minimizing rotational velocity and acceleration, either independently or together. This results in a more tailored stabilization approach, crucial for more versatile and high-precision video capture, which is absent from Shi.

III. GROUND 1: PETITIONER FAILS TO ESTABLISH THAT ZHOU AND KWATRA RENDER CLAIMS 1-20 OBVIOUS

A. Claims 1 and 11: Zhou in View of Kwatra Does Not Render Obvious the Limitation “Capture Trajectory Is Determined To Include A Path That Minimizes A Combination of Rotational Velocity And Rotational Acceleration Of The Housing, The Combination Of The Rotational Velocity And The Rotational Acceleration Weighing Them Equally Or Differently”

49. Claims 1 and 11 require that the “capture trajectory is determined to include a path that minimizes a combination of rotational velocity and rotational acceleration of the housing, the combination of the rotational velocity and the rotational acceleration weighing them equally or differently.”

50. Zhou discloses a system that smooths camera motion during video capture by adjusting a “video stabilization strength metric” to account for motion

PUBLIC VERSION

data. Ex. 1004, 3:47-4:3. While Zhou relies on motion data from gyroscopes or accelerometers, it focuses on motion smoothing based on estimated motion blur of the current frame from adjacent frames in low-light conditions, and does not address rotational dynamics, such as yaw, pitch, and roll. *Id.*, 3:47-4:19. In my opinion, the rotational aspects of camera movement are critical to the '894 Patent but are not contemplated by Zhou.

51. While Kwatra allows for applying different weights to velocity and acceleration (Ex. 1005, 14:14-22), it teaches that velocity and acceleration are “substantially constant” along both the “original path” and the “smoothed path” of the camera, except for some points in time that the camera makes transitions, e.g. from static to panning. (Ex. 1005, 1:48-57, 2:6-14, 6:13-14, 6:20-28, 6:40-42, 13:41-42, 13:49-54). In my opinion, Kwatra does not provide a method for balancing and weighing *rotational* velocity and *rotational* acceleration, particularly across the yaw, pitch, and roll angles of the camera, as required by the '894 Patent.

52. In my opinion, the '894 Patent introduces a more advanced approach by specifically applying combined optimization to first, second, and higher order derivatives of the camera's yaw, pitch, and roll angle positions, allowing for precise control over rotational velocity and rotational acceleration along these

PUBLIC VERSION

rotational axes. *See, e.g.*, '894 Patent, Equation 54, 11:2-15. This allows for targeted stabilization of the camera's rotational dynamics, a feature that is absent in Kwatra's broader discussion of camera movement.

53. Although Kwatra mentions a more complex camera motion along a camera path segment, such as parabolic movement, Ex. 1005, 14:23-37, such movement is still substantially smooth (i.e. with substantially constant velocity or acceleration). In my opinion, Kwatra does not disclose the detailed treatment of rotational dynamics, such as minimizing rotational velocity and acceleration along specific rotational axes (yaw, pitch, and roll). The ability to adjust weights on these derivatives for rotational stabilization, as disclosed in the '894 Patent, allows for a level of control and fine-tuning that is not present in Kwatra's general approach to motion stabilization.

54. In my opinion, the '894 Patent advances beyond Kwatra by emphasizing minimizing rotational velocity and acceleration across yaw, pitch, and roll angles, and by allowing these components to be weighed differently or equally. This refined and flexible method for stabilization makes the '894 Patent more versatile in terms of being able to handle a wide variety of rotational dynamics, and a significant improvement over Kwatra, and hence establishes the non-obviousness of the claimed invention.

PUBLIC VERSION

55. In my opinion, Petitioner has failed to identify references that disclose this key limitation of the independent claims of the '894 Patent.

B. A POSITA Would Not Have Been Motivated to Combine Zhou and Kwatra

56. In my opinion, Petitioner has also failed to identify a motivation to combine Zhou and Kwatra to arrive at the claimed invention of the '894 Patent. In my opinion, the combination of these two references would not lead a POSITA to the versatile and precise stabilization method disclosed in the '894 Patent.

57. In my opinion, Zhou's method of trajectory smoothing based on motion blur and adjacent frames is fundamentally different from the fine-tuned rotational stabilization required by the claims. While Kwatra emphasizes the minimization of motion path derivatives, it is only teaching the limited case of segment-wise substantially constant velocity or acceleration, without recognizing the need for differential weighting of *rotational* velocity and *rotational* acceleration.

58. Therefore, in my opinion, a POSITA would not have been motivated to combine the teachings of Zhou and Kwatra, as these references address fundamentally different stabilization approaches. Petitioner's attempt to combine Zhou and Kwatra is based on improper hindsight reasoning with the Petitioner guided by the teachings of the '894 Patent rather than the prior art.

PUBLIC VERSION**IV. GROUND 2 FAILS ON THE MERITS**

59. Petitioner asserts that the combination of Zhou, Kwatra, and Shi renders claims 2, 3, 7, 12, 13, and 17 of the '894 Patent obvious. However, in my opinion, this combination fails for the same reason as Ground 1, as Shi does not (and is not even alleged to) cure the deficiencies of Zhou and Kwatra with respect to the requirements of independent claims 1 and 11 that a “capture trajectory is determined to include a path that minimizes a combination of rotational velocity and rotational acceleration of the housing, the combination of the rotational velocity and the rotational acceleration weighing them equally or differently.”

V. PETITIONER FAILS TO PROVIDE A REASONABLE EXPECTATION OF SUCCESS OR ADEQUATE MOTIVATION TO COMBINE

60. In my opinion, none of Petitioner’s grounds of challenge have adequately explained why a POSITA would combine the references or reasonably expect the combination to succeed. It is my understanding that it is Petitioner’s burden to provide a non-conclusory, articulate explanation as to why a Petitioner would combine references, and how they would reasonably expect success.

61. Petitioner’s expert claims that combining Zhou and Kwatra would succeed because both references focus on stabilizing video against camera shake (Ex. 1002, ¶¶115-117). However, in my opinion, this reasoning is superficial and

PUBLIC VERSION

conclusory and ignores the deeper differences in the approaches of Zhou and Kwatra.

62. In my opinion, Zhou’s video stabilization method focuses on a strength parameter based on estimated motion blur without addressing the specific rotational dynamics of velocity and acceleration, especially along the yaw, pitch, and roll axes as required by the ’894 Patent. On the other hand, while Kwatra discusses minimizing derivatives of camera motion, it teaches the limited case where velocity and acceleration are “substantially constant” along both the “original path” and the “smoothed path” of the camera, except for transition points, e.g. from static to panning. (Ex. 1005, 1:48-57, 2:6-14, 6:13-14, 6:20-28, 6:40-42, 13:41-42, 13:49-54). In my opinion, Kwatra does not address the unique weighting of rotational velocity and acceleration, nor does it consider the specific rotational axes of the camera’s housing. The ’894 Patent introduces a novel approach by weighing these derivatives equally or differently across the yaw, pitch, and roll axes, which neither Zhou nor Kwatra discloses.

63. Furthermore, while Petitioner’s expert suggests that a POSITA would reasonably expect success in combining Zhou and Kwatra (Ex. 1002, ¶¶115-117), this reasoning is conclusory. There is no detailed explanation as to why a POSITA would expect that combining Zhou’s trajectory smoothing based on estimated

PUBLIC VERSION

motion blur with Kwatra's segment-wise smoothing of motion path with substantially constant velocity or acceleration would result in the fine-tuned rotational stabilization required by the '894 Patent across the yaw, pitch, and roll axes. Without specific analysis, Petitioner's case rests on conclusory statements, which I understand is insufficient to establish a reasonable expectation of success.

VI. SECONDARY CONSIDERATIONS CONFIRM THE NON-OBVIOUSNESS OF THE '894 PATENT

64. In my opinion, there is strong, objective evidence that the '894 Patent is not obvious. Patent Owner GoPro, Inc. ("GoPro") successfully manufactured and sold wearable action cameras that include GoPro's novel HyperSmooth technology, which I understand GoPro asserts is an embodiment of the '894 Patent. Ex. 2006 (Complaint), ¶22.

65. I have reviewed GoPro documents [REDACTED]

[REDACTED]

[REDACTED]

[REDACTED]

[REDACTED]

[REDACTED]

[REDACTED]

PUBLIC VERSION

66. I have seen evidence of commercial success, specifically a press release indicating GoPro has sold over 50 million action cameras since 2009, with its HERO series cameras, featuring HyperSmooth stabilization, at the forefront of this success. *See* Ex. 2003 (“GoPro Celebrates Surpassing 50 Million Cameras Sold”). For example, the HERO7, which introduced HyperSmooth as a flagship feature, [REDACTED]

[REDACTED]

[REDACTED]

[REDACTED]

67. GoPro’s dominant position in the U.S. action camera market, holding a larger share than all competitors combined, further illustrates the commercial strength of its patented technologies. GoPro’s partnerships with leading brands like Red Bull, NHL, and Adobe reflect the substantial demand for and market confidence in GoPro’s products, driven in large part by its stabilization technologies. *See* Ex. 2005 (NHL Senior VP of Programming and Production said, “[O]nly GoPro has the technology to help us and our media partners showcase the beauty and intensity of hockey in new and deeper ways.”); Ex. 2008 (GoPro “named the exclusive action camera of Red Bull” mountain bike competition; GoPro athletes will capture their runs wearing HERO11 featuring “GoPro’s Emmy

PUBLIC VERSION

Award-winning HyperSmooth video stabilization”); Ex. 2009 (Vice President of Adobe Stock said, “Adding GoPro’s unique footage to Adobe Stock gives our community access to a library of immersive ‘wow’ moments that will take their audience to new places and deliver an additional level of depth and perspective to their creations”).

68. This success is closely linked to specific features of GoPro’s patented technologies, such as the minimization of rotational velocity and rotational acceleration approach described in the ’894 Patent.

69. I have seen evidence of industry praise and recognition, specifically GoPro’s HyperSmooth technology has garnered widespread industry recognition. For example, it earned a CES Innovation Award in 2019 and a Technology and Engineering Emmy in 2022, further confirming the value and non-obviousness of GoPro’s patented stabilization methods. *See* Ex. 2010 (“73th Annual Technology & Engineering Emmys” . . . “In Camera Sensor and Software Stabilization – Awarded to GoPro and Socionext” . . . “The technology has created the ability for camera operators and producers to obtain stabilized action footage when a subject is rapidly moving easily and economically in unstable situation.”); Ex. 2011 (“GoPro Showcases Award-Winning HERO7 Cameras at CES 2019”); Ex. 2012 (“GoPro Wins Second Emmy® Award for Groundbreaking Digital Imaging

PUBLIC VERSION

Technology”; “This Emmy is in recognition of the technology powering GoPro’s industry-leading HyperSmooth video stabilization”).

70. Third-party reviews consistently highlight HyperSmooth as a groundbreaking feature that sets GoPro apart from competitors, with praise for its ability to deliver stable, smooth video footage in challenging conditions. Ex. 2013 (analysts at JP Morgan stating GoPro’s “gimbal like hypersmooth stabilization (developed in-house software and hardware)” was “a significant upgrade” when introduced and was the “key selling point” in the HERO7 camera); Ex. 2014 at 5 (“GoPro’s HyperSmooth image stabilization is the best we’ve seen on any action camera”).

71. I have seen evidence of long-felt, but unmet need. For example, before the introduction of HyperSmooth, users of action cameras faced persistent challenges in capturing stable footage during high-vibration activities like mountain biking, hiking, or surfing. Mechanical gimbals, while used for stabilization, were bulky, fragile, and unsuitable for dynamic environments of such applications.

72. [REDACTED]
[REDACTED]
[REDACTED]

PUBLIC VERSION

[REDACTED]

[REDACTED]

[REDACTED]

[REDACTED]

[REDACTED]

73. I have seen evidence of unexpected results. For example, GoPro's system consistently outperformed traditional stabilization techniques, which often failed to maintain stabilization under rapidly changing motion characteristics, showcasing the unexpected success of the HyperSmooth system over prior technologies. Ex. 2014 ("GoPro's HyperSmooth image stabilization is the best we've seen on any action camera"); [REDACTED]

[REDACTED]

74. I have seen evidence of possible copying, as I understand in an ITC investigation, Insta360, a direct competitor, is accused of copying GoPro's HyperSmooth technology.

IV. CONCLUSION

75. 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

PUBLIC VERSION

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.

76. 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 31, 2024

/s/ Hassan Foroosh

Hassan Foroosh, Ph.D.