

UNITED STATES PATENT AND TRADEMARK OFFICE

BEFORE THE PATENT TRIAL AND APPEAL BOARD

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

v.

GOPRO, INC.,
Patent Owner.

Patent No. 10,958,840

Inter Partes Review No. IPR2024-01165

PETITIONER'S REPLY TO PATENT OWNER RESPONSE

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Expert Declaration of Aggelos Katsaggelos	1003
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U.S. Patent Application Publication No. US2015/0022677A1 to Guo <i>et al.</i>	1008
U.S. Patent No. 10,158,802 to Cai <i>et al.</i>	1009
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Excerpts from the Deposition Transcript of Pablo Lema, September 11, 2024 (RX-0322C) PROTECTIVE ORDER MATERIAL	1020 [NEW]
Provisional Patent Application No. 62/733237	1021 [NEW]

I. INTRODUCTION

GoPro's response confirms that all claims of the '840 patent are obvious in view of the prior art and thus invalid.

GoPro does not dispute that Zhou discloses a parameter that controls the amount or strength of smoothing used in motion blur compensation. Instead, its arguments rest entirely on a narrow construction that contradicts both the intrinsic record and a POSITA's understanding.

GoPro's arguments regarding "stickiness parameter" contradicts its own acknowledgment of the term's plain and ordinary meaning. The term requires neither that the parameter be independent nor that it reflect a preference for past frames.

GoPro mischaracterizes Cai in arguing that it does not disclose a "temporal horizon enabling approximation of intentional motion." Cai teaches using future frames to approximate intentional motion, whether the camera is stationary or in motion.

Finally, GoPro ignores Bell Paper's disclosures regarding minimizing rotational velocity and rotational acceleration. Bell Paper discourages considering translational acceleration, not rotational acceleration.

II. CLAIM CONSTRUCTION

The Board should reject GoPro’s narrow construction of “low-light high-pass parameter.” It should instead adopt its preliminary construction: “a parameter that controls the amount or strength of smoothing used in motion blur compensation.”

A. “Low-light high-pass parameter” is a “coined” term

“Low-light high-pass parameter” is not a term used in the field of video stabilization. (EX1017, ¶ 11.) The ’840 patent’s inventor agreed. (EX1019, 221:13-17.) Because this is “a coined term that has no ordinary meaning in the industry,” one must look to the “specification, [and] the prosecution history, to determine [its] meaning.” *Iridescent Networks, Inc. v. AT&T Mobility, LLC*, 933 F.3d 1345, 1351 (Fed. Cir. 2019).

B. The specification supports Insta360’s construction

The specification describes that a “low-light high-pass parameter may refer to a parameter that controls the amount/strength of smoothing performed to generate the smoothed trajectory.” (EX1001, 21:59–22:21.) It explains that a “low-light high-pass parameter of 0 may result in the observed motion being fully attenuated” and a “parameter of 1 may result in the smoothed trajectory being same as the (observed) trajectory during the exposure periods.” (*Id.*, 22:10-18.) The specification further describes that a “low-light high-pass parameter may range

between 0 and 1, with 0 corresponding to no motion blur compensation and 1 corresponding to full motion blur compensation.” (EX1001, 22:8-10.)

Thus, when the “low-light high-pass parameter” is 0, there is no motion blur compensation, and the observed motion is fully attenuated — *i.e.*, maximum smoothing. Conversely, when the “low-light high-pass parameter” is 1, there is full motion blur compensation, and the smoothed trajectory is the same as the (observed) trajectory — *i.e.*, no smoothing. (EX1017, ¶¶13-18.) The specification describes a trade-off between motion smoothing and blur compensation and that the “low-light high-pass parameter” is a mechanism to address this trade-off. (*Id.*)

The specification provides further explanations of this trade-off. It explains that motion blur is caused by “[i]ntra-frame motion,” *i.e.*, “motion of the image capture device during an exposure period of individual video frames.” (EX1001, 18:1-24, 21:66-22:7.) The blur is the intra-frame motion “encrusted” in the video frame. (*Id.*) Because the “encrusted” motion cannot be “removed,” “[b]etter visual characteristics (e.g., impression) may be provided when the intra-frame motion is taken into account.” (*Id.*, 18:10-24.) To reduce the blur thus requires less smoothing — by “having the smoothed trajectory follow the (observed) trajectory during the exposure periods.” (*Id.*, 22:5-7; EX1017, ¶¶15-16.)

Motion blur is a known issue in stabilization. A POSITA would have been aware of this trade-off between smoothing and blur compensation. Upon

reviewing the specification, they would understand that the claimed parameter leverages this trade-off to address motion blur by controlling the amount or strength of smoothing. (EX1017, ¶¶13-19.)

C. GoPro’s narrow construction lacks support

GoPro proposes a construction: A parameter that controls the amount or strength of smoothing used in motion blur compensation by allowing more high frequencies to pass through based on low-light conditions. (POR, 28.) GoPro improperly requires that this parameter perform blur compensation only (1) based on low-light conditions and (2) by allowing more high frequencies to pass through. Neither requirement has support.

Low light. The claimed parameter does not “selectively address[] blur based on ‘low-light’ conditions” (POR, 28). Rather, it addresses the general problem of motion blur. (EX1001, 22:8-21.)

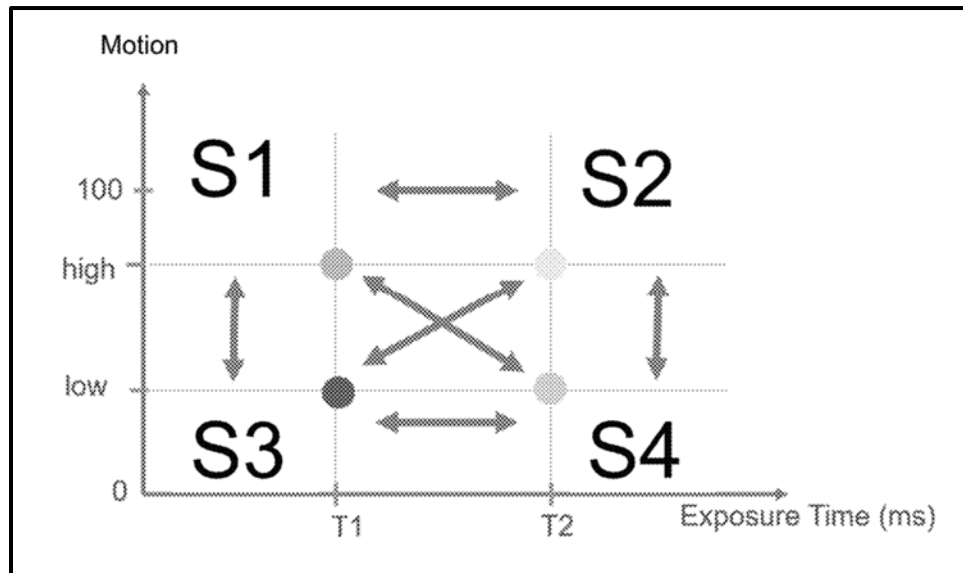
The specification explains that motion blur is caused by “[i]ntra-frame motion” encrusted in the video frame. (*Id.*, 21:65-22:5.) Intra-frame motion refers to “motion of the image capture device during an exposure period of individual video frames.” (*Id.*) The specification further explains that either (1) “higher exposure time” or (2) “larger amount of image capture device []motion” can “result in greater amount of motion blur.” (*Id.*, 19:25-26, 18:37-39.)

This aligns with a POSITA's understanding. As motion blur is caused by the motion of the device during the exposure time of a single frame, increasing either the exposure time or the device's motion results in increased intra-frame motion, and consequently, greater blur. (EX1017, ¶¶25-27.)

The specification makes clear that low light is simply one condition requiring higher exposure time. (EX1001, 19:18-25 (“[L]onger exposure time may be used with low light conditions”).) Nowhere does the specification limit the parameter to address blur solely caused by low light. Nor does GoPro identify any such description. Apart from references to the term itself, the specification mentions low light only three times. (EX1017, ¶¶22-24.) The specification discusses low light only in the context of it being one possible cause of motion blur. (*Id.*; EX1001, 19:18-25, 18:1-19.)

Although GoPro contends that the '840 patent “selectively addresses blur based on ‘low-light’ conditions while otherwise maintaining smoothing strength” (POR, 28), the specification plainly says otherwise. It makes clear that the '840 patent's technique adjusts the smoothing strength to compensate for blur based on different factors. (EX1001, 18:62-19:12.) These factors include the length of the exposure time and the image capture device's motion. (*Id.*) GoPro's expert concedes as much. (EX2018, ¶39.)

Figure 7 shows that even when the exposure time (affected by lighting conditions) is the same, the smoothing strengths (*e.g.*, S1, S2, S3, and S4) vary. In fact, in “high light conditions” (corresponding to “shorter exposure time” such as “less than T1”), the smoothing strength changes based on the amount of motion of the device. (EX1001, 19:18-25.) A POSITA would have understood that this demonstrates that the “low-light high-pass parameter” does not maintain the same smoothing strength in non-low-light conditions. (EX1017, ¶¶27-28.)



(EX1001, Fig. 7.)

High frequencies. Nor does the specification require the “low-light high-pass parameter” to allow more high frequencies to pass through. The ’840 patent makes clear that its technique compensates for motion blur by “tak[ing] into account” and “preserving the intra-frame motion,” so that the motion of the

“smoothed trajectory” is “aligned with the motion blur in the image.” (EX1001, 18:1-24; EX1017, ¶¶34-35.)

The specification discusses high-frequency motion as part of the intra-frame motion preserved by the ’840 patent’s blur compensation technique. It explains that the “intra-frame motion [] may contain the high frequencies.” (EX1001, 18:1-9.) It further states that “full motion blur compensation” (“low-light high-pass parameter of 1”) “result[s] in the smoothed trajectory being same as the (observed) trajectory during the exposure periods.” (*Id.*, 22:14-18.) As a result, “the output motion may include high frequencies that mask motion blur within the visual content.” (*Id.*, 22:17-20.)

The specification does not control smoothing in a “targeted” manner such that only high frequencies pass through (POR, 28-31). GoPro identifies no such limitation in the specification. By contrast, a POSITA would have understood that the intra-frame motion may include both high- and low-frequency motion. When preserving the intra-frame motion, the ’840 patent’s technique allows not only high frequencies, but also low frequencies, to pass through. (EX1017, ¶¶35-36.)

D. The prosecution history refutes GoPro’s construction

The provisional patent application for the ’840 patent provides further support for Insta360’s construction. It mentions “low-light high-pass” only in the below excerpted portion:

(2) Low-light high-pass (motion blur masking control)

Taking into account the exposure time of every frame, Hypersmooth decomposes the observable camera motion in two categories.

- **Inter-frame motion** is the motion between frame exposure periods. This motion can be attenuated completely up to the cropping constraint.
- **Intra-frame motion** is the motion underwent by the camera during the exposure period of every frame. This motion is already encrusted in the image through the motion blur, and its attenuation causes motion blur pulsations producing a bad visual impression.

Arguably the only way to deal with the latter is to render the trajectory representing the same motion during the exposure periods, i.e., in a way that the camera always moves in the same direction and with the same speed during the exposure phase of every frame, and might then stand still between consecutive frames.

There is a positive scalar parameter controlling the gain of the corresponding high-pass filter.

- When set to 0, no motion blur compensation is done; the observed motion is fully attenuated and no camera motion during the exposure periods is taken into account. The output motion is fully smooth. This would end with a similar result as early Chopes.
- When set to 1, the entire camera displacement during the exposure periods is preserved. The output motion contains high frequencies that mask motion blur.

This parameter does not need to evolve in function of the exposure time.

- When a highly illuminated scene is being shot, the exposure time is short enough to render the intra-frame displacement negligible.
- When the camera does not move much, the intra-frame displacement is limited regardless the exposure time.

Default value: 1.0 for MP, updated to 0.8 for Launch.

(EX1021, 22.)

As this disclosure makes clear, the “low-light high-pass parameter” is for “motion blur masking control.” (*Id.*) It does not mitigate blur only in or based on low-light conditions. The disclosure in fact does not mention low light at all.

(EX1017, ¶¶40-42.) Critically, the provisional application states that “[t]his parameter does not need to evolve in function of the exposure time.” (EX1021, 22; EX1017, ¶¶40-42.) In other words, no matter the exposure time — and thus regardless of the lighting condition — the parameter stays the same and performs blur compensation. (*Id.*)

Nor does this disclosure limit the claimed parameter to high-frequency motion only. Consistent with the ’840 patent’s specification, it states that the solution for “intra-frame motion” is to “render the [smoothed] trajectory representing the same [intra-frame] motion.” (EX1021, 22; EX1017, ¶41.)

E. Extrinsic evidence does not support GoPro’s construction

Unable to find support in the specification and prosecution history, GoPro argues that its construction is necessary to give meaning to the terms “low-light” and “high-pass.” (POR, 28.) But it ignores that “the inventor’s intention, as expressed in the specification, is regarded as dispositive.” *Phillips v. AWH Corp.*, 415 F.3d 1303, 1316 (Fed. Cir. 2005). Nor is it proper to rely “on single words . . . as opposed to the limitation[] as a whole.” *Apex Inc. v. Raritan Computer, Inc.*, 325 F.3d 1364, 1372 (Fed. Cir. 2003).

GoPro’s reliance on Dr. Katsaggelos’s testimony (the so-called “extrinsic evidence”) is unavailing. (POR, 30-31.) That low light is one potential cause of blur does not suggest that the claimed parameter addresses only blur resulting from low light. In fact, the claimed technique cannot accomplish such selective targeting. (EX1017, ¶¶30-31.) As GoPro acknowledges, the ’840 patent’s blur compensation technique “mask[s] motion blur.” (POR, 29 (citing EX1001, 22:16-21).) It attempts to compensate for blur only after it has already formed—in other words, once the “intra-frame” motion is already “encrusted” in the video frame, as the specification describes. (EX1001, 18:1-24, 21:66-22:7.) Because this parameter performs blur compensation after the blur’s formation, it is agnostic as to the cause of the blur. (EX1017, ¶¶30-31.) Nor is there any software-only technique that mitigates blur based on light conditions alone. (*Id.*)

F. GoPro’s expert’s opinion contradicts its construction

Finally, GoPro’s expert, Dr. Foroosh, offers an analysis of GoPro’s allegedly practicing product that undermines GoPro’s proposed construction. Although he asserts that GoPro’s HERO7 camera includes the claimed “low-light high-pass parameter,” he does not mention low light conditions or high frequency movement. (EX2018, ¶148.) Instead, he opines that HERO7’s [REDACTED] feature meets this limitation because it “adjusts smoothing strength based on motion blur considerations.” (*Id.*) This is consistent with Insta360’s construction — not GoPro’s. (EX1017, ¶43.)

III. GROUND 1: ZHOU AND CAI RENDER CLAIMS 1-3, 5-11, 14-16, 18, 19, AND 21 OBVIOUS¹

A. Zhou discloses a “low-light high-pass parameter”

GoPro’s argument that Zhou lacks the claimed parameter rests entirely on its flawed claim construction. GoPro does not contend that Zhou fails to disclose this limitation under the Board’s preliminary construction, which is the same as Insta360’s construction.

Applying the wrong construction, GoPro argues that Zhou fails to disclose this parameter because it “adjusts its stabilization strength parameter in response to

¹ In the related ITC proceeding, the initial determination found claims 1 and 14 anticipated and claim 13 not obvious under the clear and convincing standard.

[an] estimate of the amount of blur incurred” — instead of low-light conditions. (POR, 33 (citing EX1006, 6:38-7:16, 7:57-70).) But it ignores that the ’840 patent similarly adjusts its smoothing based on the blur (*e.g.*, such that the smoothed “motion is aligned with the motion blur in the image”). (EX1001, 18:21-24; EX1017, ¶¶50-51.) Regardless, Zhou’s blur compensation technique addresses videos taken in low-light conditions. (EX1006, 4:5-8 (“***low light*** video image stabilization strength modulation techniques”)²; *id.*, 2:59-61; EX1017, ¶58.)

Nor must Zhou’s system function as a “high-pass” system in order to include the claimed parameter. Regardless, Zhou discloses that to mitigate blur, its technique allows high-frequency motion to pass. Zhou teaches that “[i]f the amount of blur in the image is larger (typically found in darker images with longer integration times), smaller stabilization strengths may be employed.” (EX1006, 6:45-54.) Accordingly, Zhou’s technique “let[s] the image sequence ***jitter slightly***, rather than holding it perfectly stable.” (*Id.*) Jitter refers to high-frequency motion. (EX1017, ¶54; EX1001, 17:62-64 (“high frequencies (jitters)”).)

GoPro’s argument that the alleged differences between Zhou’s and the ’840 patent’s blur mitigation techniques “have real world implications” does not pass muster. (POR 36-38.) Citing only to its expert Dr. Foroosh, GoPro contends that

² Unless specified, emphasis in quoted language is added.

the '840 patent is limited to cameras for fast-moving sports. (POR, 36.) But Dr. Foroosh's bald assertion has no support. Instead, the specification expressly contemplates broader applications, including standalone cameras, smartphones, and other devices. (EX1001, 6:20-29; EX1017, ¶62.)

Similarly, GoPro and Dr. Foroosh provide no basis for claiming "Zhou (an Apple patent) is directed at a solution where camera shake is less of an issue than clarity of the images." (POR, 36; EX2018, ¶93.) Zhou, like the '840 patent, is directed to electronic devices broadly, including mobile phones, cameras, and computers. (EX1006, 11:55-60; EX2017, ¶63.)

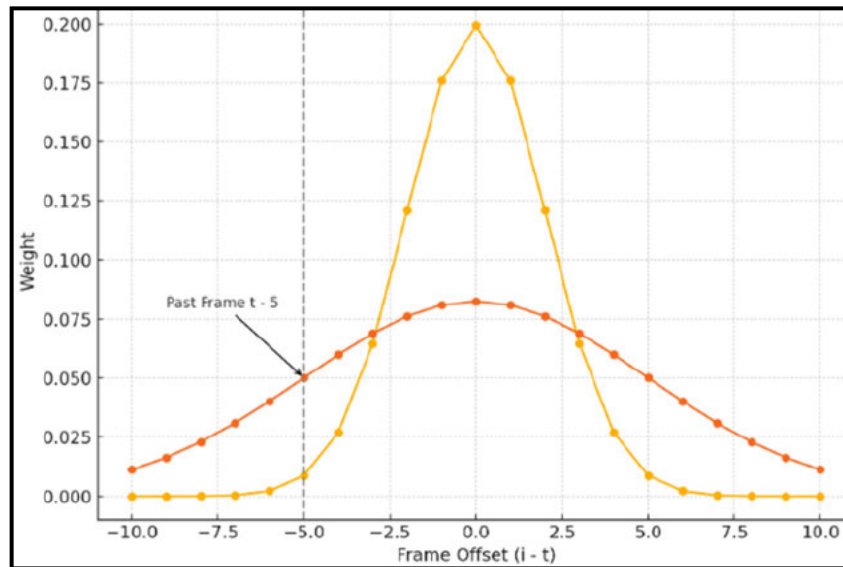
GoPro's alleged practical differences are unfounded. It claims that the '840 patent prioritizes smoothing over blur compensation, while Zhou does the opposite. But the '840 patent describes a trade-off between motion blur and motion smoothing. A POSITA would have understood that the purpose of applying a "low-light high-pass parameter" is that the system can choose between prioritizing smoothing or motion blur compensation. (EX1017, ¶65; EX1001, 22:8-10.) Nor does Zhou prioritize blur correction over smoothing. Its teaching is about "[t]echniques to *improve a digital image capture device's ability to stabilize* a video stream in low light capture conditions." (EX1006, Abstract.)

B. Zhou discloses a “stickiness parameter”

GoPro agrees that a “stickiness parameter” is a parameter that control[s] the extent by which preceding portion(s) of the (observed) trajectory impacts determination of the smoothed trajectory.” (POR, 38.) It, however, incorrectly argues that Zhou lacks such a parameter because Zhou’s weighting functions are not “independent” and do not prefer past frames.

1. GoPro’s argument about “independent” parameter fails

There is no requirement that a “stickiness parameter” be independent. A POSITA would have understood that the plain meaning of “parameter” includes both dependent and independent variables. (EX1017, ¶69.) Zhou’s weighting function determines how much past motion data affects the smoothed trajectory. (EX1006, 7:24-31.) As Dr. Katsaggelos’s illustration shows, different weighting functions (represented by a red curve and a yellow curve) result in different weights for a particular past frame.



(EX1017, ¶¶71-73.) Thus, the weighting function controls the extent by which preceding portions of an observed trajectory (*e.g.*, past frame -5) impacts determination of the smoothed trajectory.

Contrary to GoPro’s contention (POR, 40), Zhou’s weighting function is adjustable. (*See, e.g.*, EX1006, 7:24-8:3.) By varying the curves, different functions produce different weights for past frames, demonstrating that the weighting function is a tunable parameter. (EX1017, ¶75.)

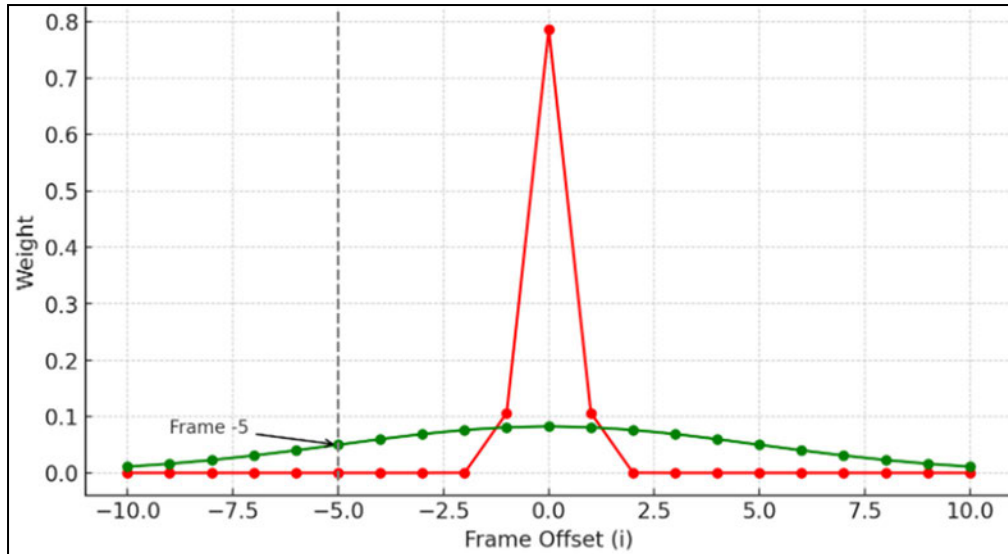
GoPro further errs in claiming Zhou’s weighting functions merely “implement[] Zhou’s blur mitigation technique.” (POR, 39.) Zhou teaches that a given stabilization strength *S* can be “*optionally* limited by the calculated ‘target max strength’ for the current frame.” (EX1006, 8:4-9.) This “target max strength” is used for motion compensation. (EX1017, ¶74; EX1006, 7:2-16.) Because Zhou’s weighting function is calculated based on the stabilization strength *S*, when

that value is not capped by a target max strength, the weighting function operates independently of blur compensation. (EX1017, ¶74; EX1006, 7:57-64.)

2. The claim does not require preferring past frames

Also unavailing is GoPro's insistence that the "stickiness parameter" must "express[] a preference for past frames." (POR, 41.) The plain meaning of this term does not impose such a requirement. A POSITA would have understood that the claimed parameter controls how much past motion influences smoothing. It is agnostic as to the future motion. (EX1017, ¶¶76-78.) It does not require applying different weights to a future frame and a past frame. Nor does GoPro identify any support from the specification. (EX1017, ¶¶78-82.) The specification merely describes that a "stickiness parameter" adjusts how much prior motion impacts smoothing, ranging from full influence to none. (EX1001, 22:22-41.)

As Dr. Katsaggelos's illustration shows, Zhou's weighting function can assign zero weight (red curve) or significant weight (green curve) to a past frame like frame -5. (EX1017, ¶83.) It constitutes the claimed "stickiness parameter."



C. Zhou in view of Cai disclose “temporal horizon enabling approximation of intentional motion”

GoPro’s three reasons for why Zhou and Cai do not disclose this limitation all fail.

1. Cai discloses “approximation of intentional motion”

GoPro is wrong that Cai cannot distinguish intentional movements once “the camera is deemed [] non-stationery.” (POR, 50.) To the contrary, Cai discloses mechanisms to enable approximation of intentional motion in both stationary and moving camera scenarios.

Cai teaches a zero-motion detection technique. It discloses that in a zero-motion case, the user’s intention is for the camera to stay still; “the only motion is due to unintended camera movement.” (EX1009, 5:37-42.; EX1017, ¶¶91-93.)

Cai also teaches approximation of intentional motion when the camera is moving (*i.e.*, non-zero motion). It discloses distinguishing zero motion from

“intended motion.” (EX1009, 3:58-59.) When Cai determines non-zero motion, it adjusts its trajectory “to follow the camera’s intended motion.” (*Id.*, 6:20-24.) It further discloses that its “trajectory smoothing block” ensures that “primarily only intended movements remain in the sequence of video frames.” (*Id.*, 7:11-19; *see also id.*, 4:4-11, 2:24-28; EX1017, ¶¶87-88.)

Thus, Cai teaches distinguishing and preserving the following types of movement:

- **True zero motion.** Cai discloses a variety of ways to detect zero motion. In that scenario, the user intended for the camera to stay still.
- **Unintended motion.** When Cai determines a true zero motion, all movement is unintended. The unintended motion, or jitter, is removed.
- **Intended motion.** When Cai determines non-zero motion, it adjusts its trajectory “to follow the camera’s intended motion.”

(*See also* EX1017, ¶¶93-97; EX1009, 11:53-58, 6:12-22.)

Cai thus approximates intentional motion — whether the camera is in motion or not.

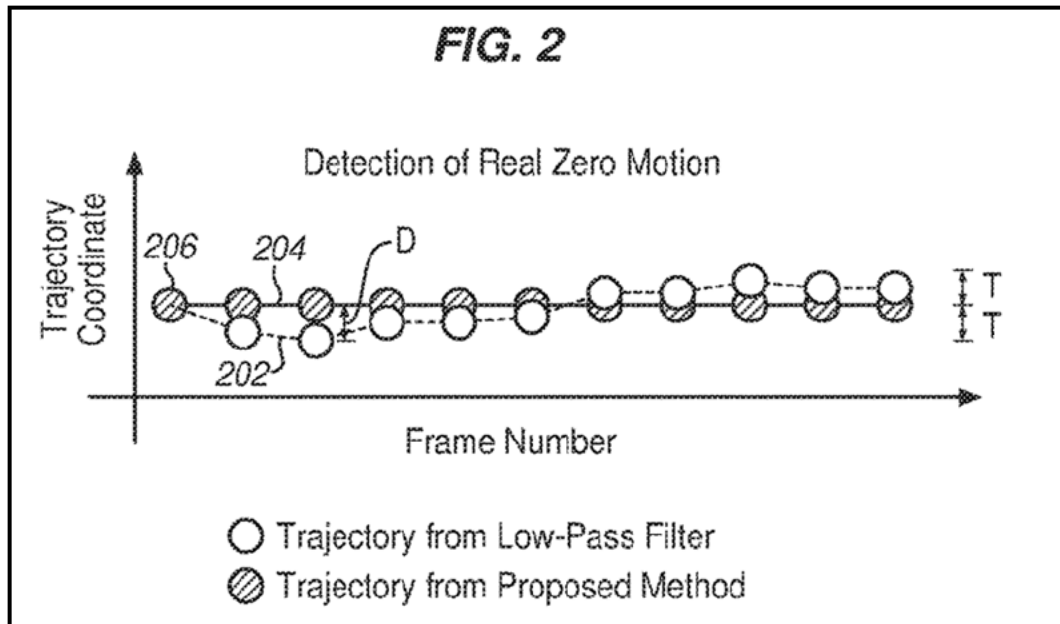
2. Cai discloses “use of a temporal horizon of motion ...”

a) Cai’s zero-motion detection considers future frames

GoPro erroneously argues that Cai fails to disclose the claimed “temporal horizon” because it does not consider future frames. The record shows otherwise.

Cai teaches using future frames when determining zero motion. Its technique first comput[es] “two lines of successive dots.” (EX1009, 4:14-16.)

Figure 2 is an example.

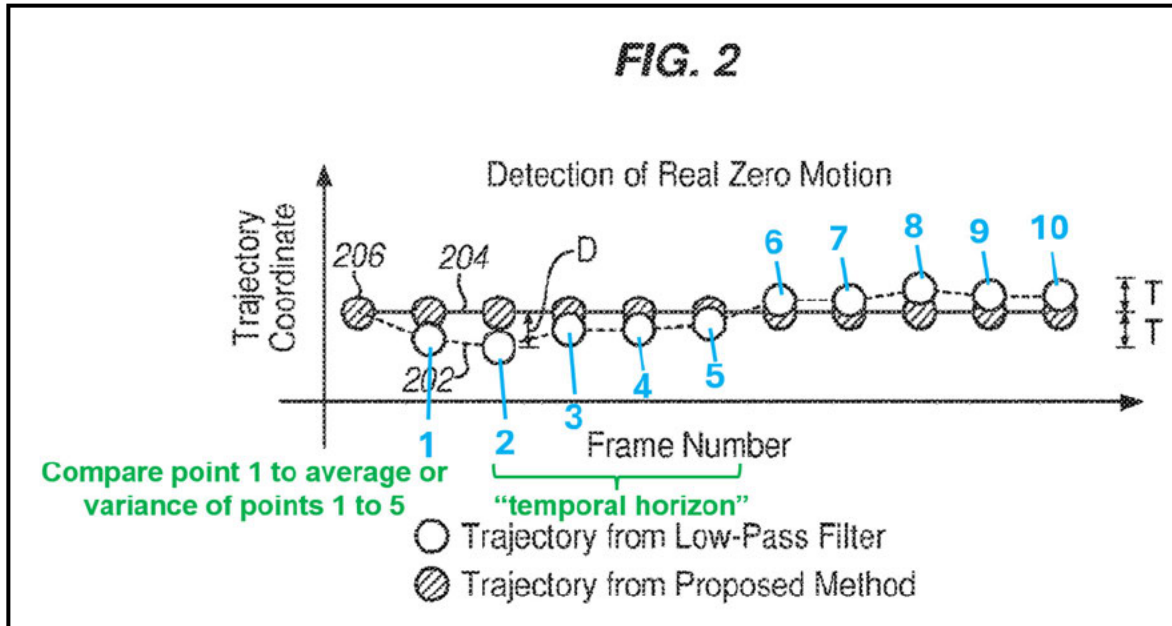


(EX1009, Fig. 2.)

According to Cai, line 202, the “predicted trajectory,” “shows trajectory coordinates that result from the raw input video after a low-pass filter.” (EX1009, 4:16-19.) Line 204, the “refined or planned trajectory,” “shows what the trajectory coordinates would be if there were no motion.” (*Id.*, 4:19-25.)

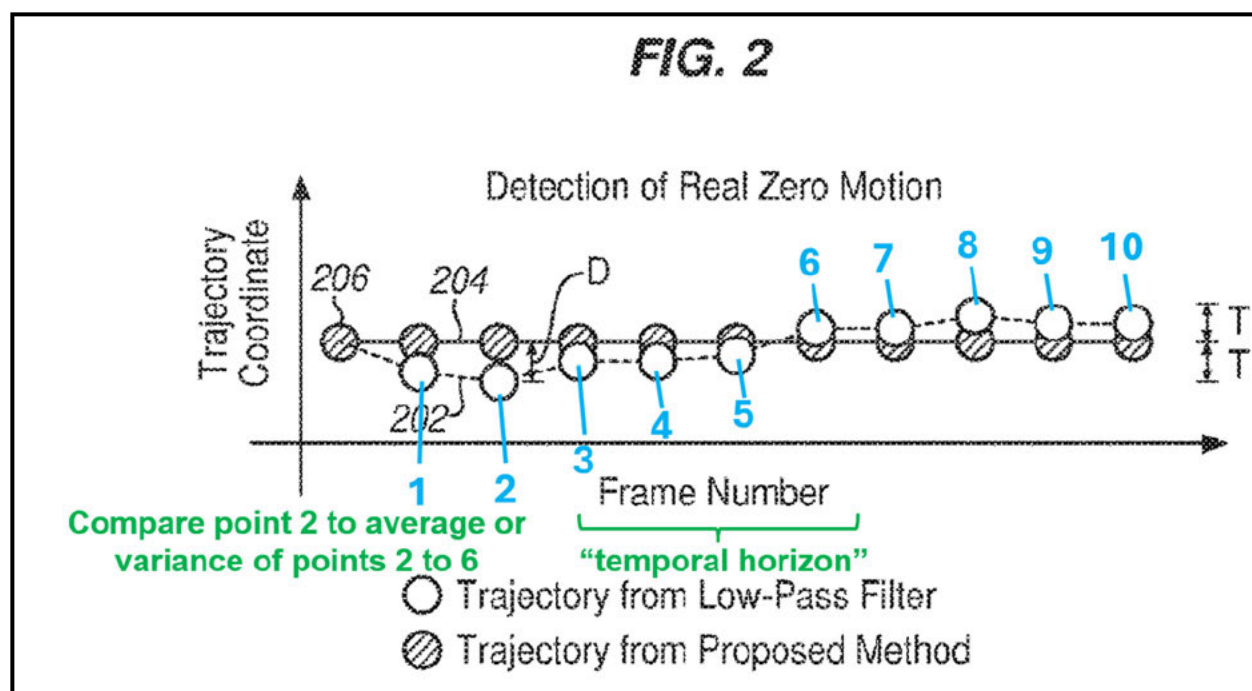
Cai teaches various ways to detect zero motion. One approach uses “a mean or a variance or both of the coordinate values for a short set of frames, e.g. five or ten of the low-pass filtered predicted trajectory frames.” (EX1009, 5:16-19.) The mean, or variance, or both, are compared to each frame in the set of frames. (*Id.*)

This approach involves using future motion. (EX1017, ¶¶103-107.) Specifically, as the below annotated figure shows, to analyze frame 1, Cai compares it to, for example, the mean or variance of frames 1 to 5.



Compared to the analyzed frame (*i.e.*, frame 1), frames 2 to 5 are future frames. Their corresponding camera motion constitutes “temporal horizon of motion experienced.” (EX1017, ¶¶105-106.)

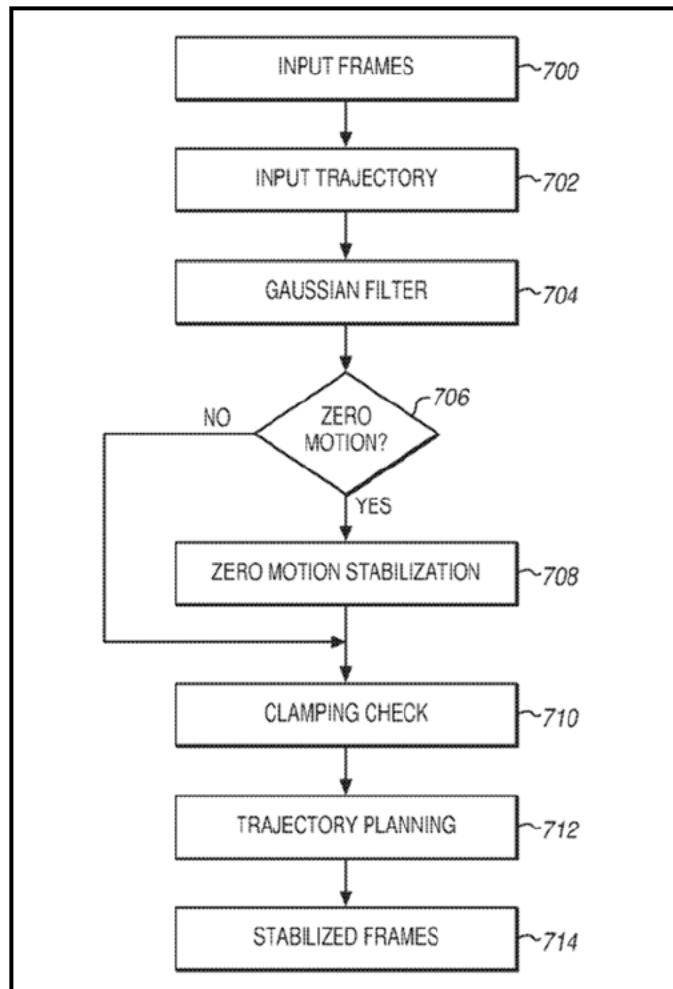
The same logic applies to later analyzed frames. For example, to analyze frame 2, Cai compares it to the mean or variance of frames 2 to 6. There, “temporal horizon” corresponding to future frames 3 to 6 is used. (*Id.*, ¶107.)



b) GoPro misreads Cai

Cai specifically discloses that its technique considers future frames. It teaches that in Figure 7, at step 700, "input frames" are "buffered so that present and *future frames* are available to the various processes described herein."

(EX1009, 8:66-9:1.)



(EX1009, Fig. 7.) It further discloses that “[a]t 702, the input trajectory is determined based on analyzing the received frames. This may be done using coordinates as shown in the example trajectories of FIGS. 2, 3, 4, and 6.”

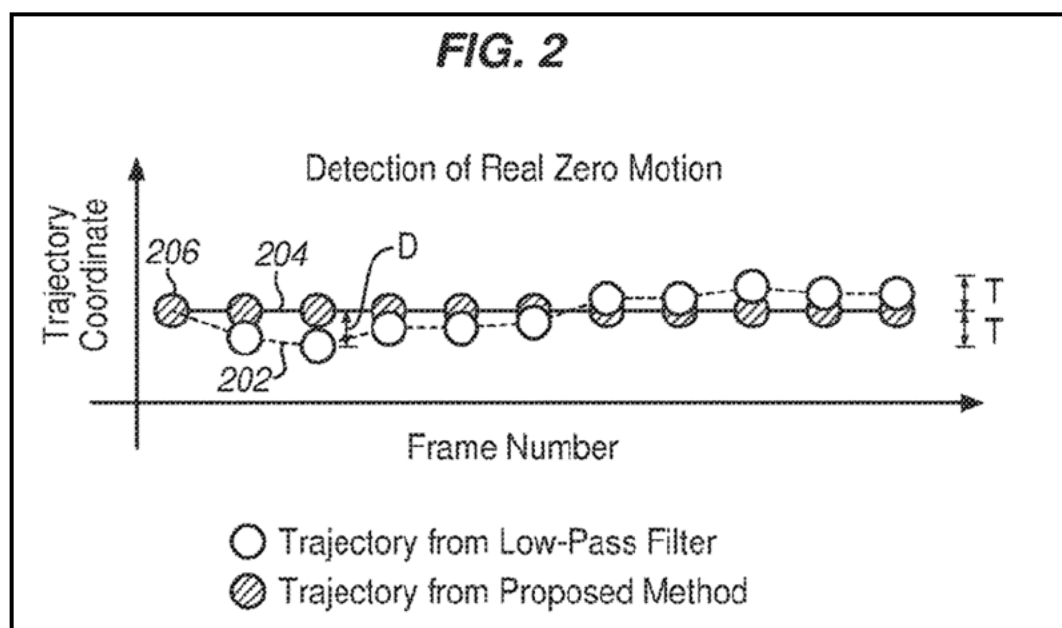
(EX1009, 9:1-7.) Because the input trajectory is determined based on the received frames—which include present and future frames—the input trajectory includes future camera motion. (EX1017, ¶¶112-114.)

Cai explicitly states that its zero-motion detection technique considers future frames:

The filtered video frames are then supplied to zero motion detection 706. If the video is determined to be a zero motion video, then the frames are further stabilized 708 based on a selected anchor point. This eliminates even small movements that the Gaussian filter cannot remove. As an example, the smoothed trajectory from the zero motion stabilization is projected into future frames, for example, the next five frames. ***This is compared to the Gaussian filtered next five frames to characterize the video as zero motion or not.***

(*Id.*, 9:12-17.)

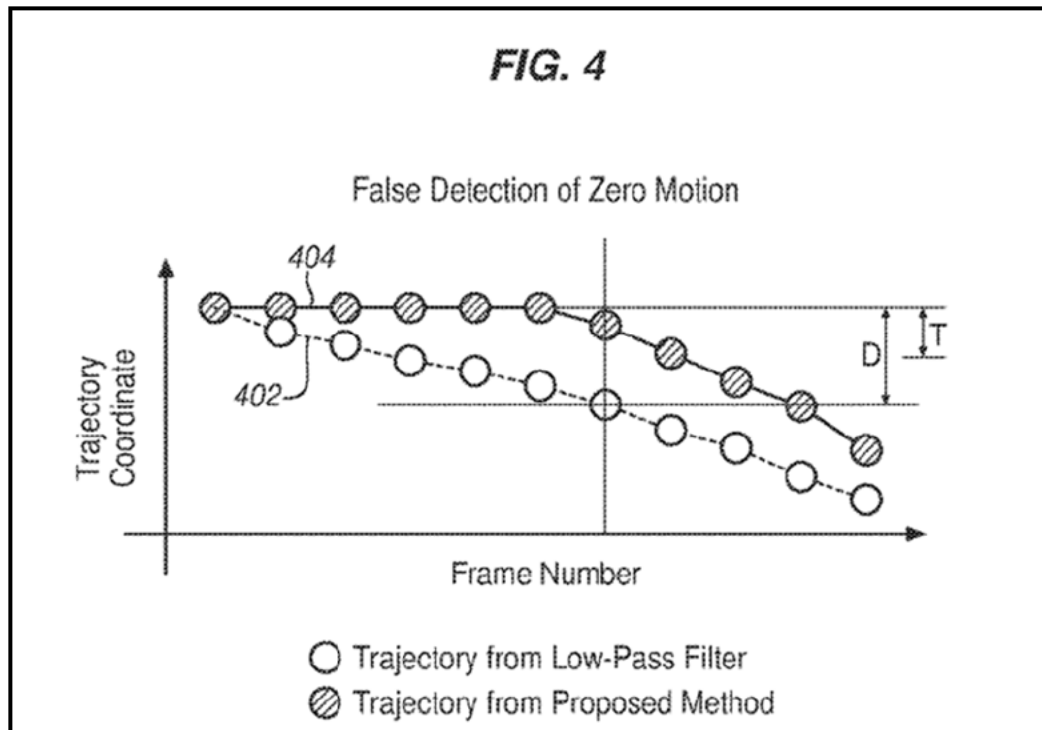
GoPro misreads this disclosure. Contrary to its claim, the consideration of the “next five frames” is not for the subsequent and separate “zero motion stabilization process.” (POR, 47.) Cai instead teaches that the “smoothed trajectory” (*i.e.*, the planned trajectory in Cai) is compared against the Gaussian filtered future frames (*i.e.*, the low-pass filtered predicted trajectory) — to characterize “zero motion or not.” (EX1009, 9:12-17.) This corresponds to the comparison of the predicted trajectory and planned trajectory in Figure 2 — which is for zero motion detection. (EX1017, ¶¶116-117.)



(EX1009, Fig. 2.)

Also unavailing is GoPro’s reliance on Figure 5 in arguing that Cai excludes future frames. (POR, 44.) Cai makes clear that Figure 5 is only one embodiment. (EX1009, 2:4–5; EX1017, ¶118.)

Finally, GoPro misreads Figure 4 in arguing that Zhou’s system “suffers from a lag in detecting intentional motion.” (POR, 48-50.) Like Figure 2, Figure 4 shows two lines: line 402 (“predicted trajectory”) that is obtained through low-pass filtering, and line 404 (“planned trajectory”) that is based on zero motion. (EX1009, 6:25-29.)



(EX1009, Fig. 4.)

Cai teaches comparing these two trajectories to detect non-zero motion. If the predicted trajectory deviates significantly from the planned trajectory, non-zero motion is detected. (EX1009, 6:37-52; EX1017, ¶¶120-124.)

Misunderstanding Figure 4, GoPro contends that Zhou has a “lag period,” during which “the planned trajectory fails to follow the actual intended camera motion.” (POR, 48.) It argues that the “predicted trajectory³ initially appears to

³ Insta360 assumes GoPro meant “planned trajectory.” The planned trajectory 404, not the predicted trajectory 402, initially follows a straight path and later transitions to a sloped trajectory.

follow a straight path,” and “only after several frames,” does it transition to “a sloped trajectory.” (*Id.*) But GoPro erroneously characterizes (1) the predicted trajectory (line 402) as the intended path, and (2) the planned trajectory (line 404) as the final trajectory used for video stabilization. (EX1017, ¶125.)

Instead, Cai discloses that when zero motion is detected, the planned trajectory (404) is utilized for video stabilization. (EX1009, 4:51-56.) When non-zero motion is detected, Cai adopts the predicted trajectory (402) for stabilization. (EX1017, ¶126; EX1009, 9:58-64, 12:31-33.)

Contrary to GoPro’s mischaracterization, Zhou does not suffer any lag. Like the ’840 patent, Cai’s final stabilized trajectory (corresponding to ’840 patent’s “smoothed trajectory”) immediately follows the intended path of motion. When there is zero motion, it stays still; when there is motion, it adopts the intended motion, *i.e.*, the predicted trajectory. (EX1017, ¶¶122-127; EX1009, 9:58-64, 12:31-33.)

3. A POSITA Would Have Been Motivated to Combine Cai with Zhou

Contrary to GoPro’s mischaracterization, Cai does not use a “maximalist” approach that conflicts with Zhou’s blur management. (POR, 52.) Cai only removes all motion when it identifies true zero motion. When there is motion, it adopts the low-pass filtered, predicted trajectory. (EX1009, 12:31-33.)

Zhou in fact discloses a similar zero-motion detection technique. (EX1006, 3:51-53 (“if no motion is detected, it may be possible to classify the ‘type of motion’ as stationary and, as a result, apply very strict stabilization.”); EX1017, ¶133.) GoPro also is wrong that Zhou’s stabilization strength parameter is always bounded by a maximum value. (POR, 52-53.) As discussed, Zhou’s system only *optionally* limits its stabilization strength by the “target max strength” used for motion compensation. (EX1017, ¶74; EX1006, 7:2-16; 8:4-9.)

A POSITA combining Zhou and Cai would have understood to apply less stabilization strength when motion is detected, in order to address blur. (EX1017, ¶¶132-134.) When zero motion is detected, a POSITA would apply Zhou and Cai’s approach to classify the motion as stationary and apply “very strict stabilization.” (*Id.*; EX1006, 3:51-53.)

A POSITA would have been motivated to use Cai’s technique to approximate intentional motion to improve Zhou’s stabilization technique with reasonable expectation of success. (EX1017, ¶¶141-148.) GoPro is wrong that “Zhou expresses no motivation for distinguishing between intentional and unintentional motion.” (POR, 54.) Zhou discloses distinguishing between different motion types (e.g., stationery, strolling). (EX1003, ¶¶131, 133; EX1006, 3:47-62.) Zhou also discloses “look[ing] into the ‘future’” to “anticipate abrupt movements in the future.” (EX1006, 10:1-5.)

Nor does Zhou discourage “‘sufficiently long’ temporal horizon.” (POR, 54.) First, claim 1 does not require a “sufficiently long” temporal horizon, just “a temporal horizon.” (EX1017, ¶136.) Second, although Zhou states that “buffering frames can be expensive in terms of memory,” its technique nevertheless buffers frames. (EX1006, 4:62-63.) Specifically, Zhou’s buffer — which can store 32 frames — can accommodate Cai’s “short set of frames, e.g. five or ten [] frames,” (EX1006, 4:60-61; EX1009, 4:67-5:1, 5:9-10, 5:17-18; EX1017, ¶¶138-140.)

IV. GROUNDS 2-3: CLAIMS 4, 12, AND 20 ARE OBVIOUS

GoPro raises no independent arguments for grounds 2-3. (POR, 55.) Its validity arguments for grounds 2 to 3 fail.

V. GROUND 4: ZHOU, CAI, AND BELL PAPER RENDER CLAIMS 13 AND 17 OBVIOUS

Bell Paper discloses a “weight-balance parameter” that controls the minimization of rotational velocity and rotational acceleration. GoPro concedes that Bell Paper discloses angular velocity. (POR, 55-56.) It instead argues that Bell Paper does not minimize rotational velocity.

But GoPro ignores that Bell Paper discloses “[w]hen the camera is nearly still, [its] virtual camera is fixed, removing all jitter.” (EX1004, 296.) It similarly discloses that its “smoothing algorithm creates a new camera path that keeps the virtual camera static” when “the actual intention is to keep the camera static.”

(EX1004, 299.) When a camera is still, it has no rotational velocity — and thus rotational velocity is minimized. (EX1017, ¶¶151-152.)

GoPro incorrectly asserts that Bell Paper does not reference rotational acceleration. (POR, 56-67.) As it concedes, Bell Paper explicitly states that its method “removes most of the ***angular acceleration***, producing an output video which is pleasing to view.” (EX1004, 304; POR, 57.) GoPro does not explain how removing most of the angular acceleration is not minimizing rotational acceleration. Its only argument that Bell Paper lacks a “rigorous method” is irrelevant. Neither the claims nor the specification requires a rigorous or quantitative optimization method—only minimization. (EX1017, ¶157.)

GoPro also ignores that Bell Paper discloses a “method for video stabilization” that “dramatically reduces the jitter in angular velocity, and even removes it when possible, thus producing smoother results.” (EX1004, 304.) Reducing and removing jitter in angular velocity is minimizing rotational acceleration. (EX1017, ¶¶158-159.) Contrary to GoPro’s contention that Bell Paper does not provide any method for minimizing rotational acceleration, it teaches exactly how to do so — by removing the jitter in rotational velocity. (EX1017, ¶160.)

Nor does Bell Paper “discourage[] the use of acceleration measurements.” (POR, 56.) GoPro relies on Bell Paper’s discussion of ***translational*** acceleration

measured by the accelerometer — not *rotational* acceleration. (EX1004, 297; EX1017, ¶¶154-155.) Rotational acceleration can be derived from changes in rotational velocity measured by the gyroscope, as confirmed by the '840 patent's inventor. (EX1019, 73:7-16; EX1017, ¶156.)

Finally, GoPro's criticism that Bell Paper "discloses no weight-balance parameter" is misplaced. (POR, 58.) Insta360's Petition relies on Zhou's stabilization strength parameter as the claimed "weight-balance parameter." (Paper 2, 71-72.) GoPro does not argue that it would not have been obvious to combine Zhou, Cai, and Bell Paper. (EX1017, ¶¶161-164.)

VI. THE OBJECTIVE EVIDENCE DOES NOT SUPPORT NON-OBVIOUSNESS

A. HERO7 does not practice the '840 patent

GoPro does not argue that the allegedly practicing product, HERO7, practices any claim other than claims 1, 13, and 14. It also fails to show that HERO7 practices claims 1, 13, or 14.

GoPro relies on its expert Dr. Foroosh's analysis as its only affirmative support. (POR, 60.) For certain limitations (e.g., 1[g](ii), 1[h]), Dr. Foroosh cites only source code header files for support. For example, for 1[g](ii), he cites two .hpp files, and for 1[h], he cites a single .h file. (EX2018, ¶¶152, 158.)

But Dr. Foroosh's sole reliance on .hpp or .h files cannot establish that HERO7 implements the claimed features. Both a .hpp and a .h file are header files

that do not implement the code's runtime behavior. (EX1017, ¶171.) In other words, it does not contain the algorithms that execute the claimed functionality. Actual, executable code that runs as part of a program's logic resides in implementation files (e.g., .cpp file). (*Id.*) Because Dr. Foroosh fails to cite any implementation file for these limitations, he cannot establish that any feature is implemented in HERO7, let alone the claimed features. (*Id.*)

GoPro also fails to show that HERO7 meets limitation 1[g(iii)]. Dr. Foroosh conclusorily asserts that "the relevant functionality is implemented in source code files." (EX2018, ¶154.) But he does not explain how the cited source code files include the functionality "enabling approximation of intentional motion." He relies only on a GoPro internal technical documentation [REDACTED]

[REDACTED] (*Id.*) But Dr.

Foroosh does not show that this documentation describes technology implemented in HERO7; nor does he link the description to the cited code. (EX1017, ¶172.)

GoPro fails to show that HERO7 practices claim 13. Although claim 13 requires minimizing "rotational velocity" and "rotational acceleration," Dr. Foroosh does not state that the cited code considers "*rotational* velocity" or "*rotational* acceleration," let alone minimize them. (EX2018, ¶¶161-162; EX1017, ¶173.)

Finally, GoPro fails to show that HERO7 practices claim 14. As discussed, its expert's analysis does not apply GoPro's proposed construction for "low-light high-pass parameter." (EX2018, ¶¶163-164.) Dr. Foroosh also cites no implementation file, only header files. (*Id.*; EX1017, ¶174.) He cannot show that HERO7 includes and implements the claimed "low-light high-pass feature."

B. No nexus to the purported novel features

Nexus requires the "identified objective indicia" be directed to "what was not known in the prior art"). *Novartis AG v. Torrent Pharms. Ltd.*, 853 F.3d 1316, 1331 (Fed. Cir. 2017). GoPro claims that the '840 patent introduced novel features: (1) a "weight-balance parameter," (2) a "low-light high-pass parameter," and (3) a "temporal horizon to approximate intentional motion." (POR, 59-60.) But none was not known. As discussed, prior art including Zhou, Cai, and Bell Paper already taught one or more of these features.

Even assuming HERO7 practices the '840 patent, GoPro fails to identify any nexus between the objective evidence and the purported novel features. GoPro does not argue presumption of nexus. It makes no attempt to show how HERO7, which includes many other features, are coextensive with the challenged claims.

No commercial success or industry praise. At most, GoPro shows that its stabilization technology, HyperSmooth in general, has allegedly driven

commercial success and received industry praise. But other features—not the purported novel ones—are responsible for those outcomes.

The '840 patent's inventor, Mr. Derbanne, acknowledged that the way HyperSmooth [REDACTED]
[REDACTED]
[REDACTED] (EX1019, 243:2-16, 143:11-13, 242:16-19, 336:11-14.) GoPro concedes that “patented technologies” in other patents, including the “'894, []'832, and '413 patents,” “were directly responsible for GoPro’s sustained commercial success.” (POR, 39-40.) As the Federal Circuit has held, “[s]uch unclaimed features cannot establish objective indicia of nonobviousness of what is claimed.” *In re Li*, No. 2024-1209, 2025 WL 1040066, at *7 (Fed. Cir. Apr. 8, 2025).

Moreover, GoPro’s alleged industry praise is not attributable to the '840 patent. EX2010 concerns an award for “EIS technology in 2015,” which predates the '840 patent’s priority date of September 19, 2018. EX 2011 and EX 2012 are GoPro’s own press releases: EX2011 does not specify any award or accolade; EX2012 concerns HERO10, not the allegedly practicing HERO7. (EX1017, ¶181.) GoPro has “failed to offer proof that the commercial success” or industry praise is “the direct result of a unique characteristic of the claimed invention.” *SightSound Techs., LLC v. Apple Inc.*, 809 F.3d 1307, 1319 (Fed. Cir. 2015).

No long-felt but unmet need. GoPro has offered no evidence that the two features have solved any unmet need. Its own witnesses, including the lead inventor, [REDACTED] (EX1019, 83:16-21; EX1020, 150:20-151:2.) Digital stabilization techniques had been widely used long before the '840 patent. (EX1017, ¶182.)

No unexpected results/failure of others. The claimed inventions did not yield any unexpected results. GoPro relies on two documents. One is an internal study (EX2043), but GoPro engineers' belief that their developed technology outperformed other solutions does not establish unexpected results. (EX1017, ¶183.) GoPro also cites a public document reviewing its products, but that document concerns HERO9 and HERO8—not the allegedly practicing product, HERO7. (*Id.*; EX2014.) Inventor Mr. Derbanne was also [REDACTED] [REDACTED]. (EX1019, 83:16-21.)

No copying. GoPro has presented no copying evidence. It relies on a few Insta360 engineering documents comparing Insta360's products' performance with GoPro's. (POR, 68-70.) But none of these documents mention the purported novel features.

These documents at best show benchmarking against GoPro's products, not copying. (EX1017, ¶184.) [REDACTED]

[REDACTED]
[REDACTED] (*Id.*; EX1020, 160:5-161:6.)

VII. CONCLUSION

The Board should cancel all claims of the '840 patent.

Dated: July 18, 2025

Respectfully submitted,

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Certification of Word Count (37 C.F.R. § 42.24)

I hereby certify that this PETITIONER’S REPLY TO PATENT OWNER RESPONSE has 5,593 words (as counted by the “Word Count” feature of the Microsoft Word™ word-processing system), exclusive of “a table of contents, a table of authorities, a listing of facts which are admitted, denied, or cannot be admitted or denied, a certificate of service or word count, or appendix of exhibits.”

Dated: July 18, 2025

By / Lily Yue Li /
Lily Yue Li

Certificate of Service (37 C.F.R. § 42.6(e)(4))

I hereby certify that the attached PETITIONER'S REPLY TO PATENT OWNER'S RESPONSE was served as of the below date on the Patent Owner via e-mail (by agreement) to the following counsel of record:

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