

UNITED STATES PATENT AND TRADEMARK OFFICE

BEFORE THE PATENT TRIAL AND APPEAL BOARD

Axon Enterprise, Inc., Dedrone Holdings, Inc., and Skydio, Inc.

Petitioners,

v.

Airspace Systems, Inc.

Patent Owner

Case No. IPR2025-00629

U.S. Patent No. 10,514,711

PATENT OWNER PRELIMINARY RESPONSE

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List of Patent Owner Exhibits

Exhibit No.	Description
EX2001	U.S. Army Contract No. W15QKN-17-9-1022
EX2002	Smithsonian, National Air and Space Museum Letter to Mr. Banga dated March 13, 2024
EX2003	Z. Yang and R. Sinnott, “Snake Detection and Classification using Deep Learning,” in Proceedings of Hawaii International Conference on System Sciences (2021), https://scholarspace.manoa.hawaii.edu/server/api/core/bitstreams/f9f2de4d-ddaa-4984-9fc3-9bbca4e27247/content
EX2004	Q. Ji, “Object Detection and Recognition,” https://sites.ecse.rpi.edu/~qji/CV/ObjectDetRecog2.pdf
EX2005	The National Science Foundation, “How to Radars Work?,” https://www.eol.ucar.edu/content/how-do-radars-work
EX2006	Principles of Doppler Radar, http://ww2010.atmos.uiuc.edu/(Gh)/guides/rs/rad/basics/dpmod.rxml
EX2007	https://developer.apple.com/documentation/corelocation/configuring-your-app-to-use-location-services
EX2008	https://developer.apple.com/documentation/corelocation/cllocation
EX2009	https://developer.android.com/develop/sensors-and-location/location/retrieve-current
EX2010	https://developer.android.com/reference/android/location/Location
EX2011	https://www.merriam-webster.com/dictionary/autonomous

Exhibit No.	Description
EX2012	https://dictionary.cambridge.org/us/dictionary/english/-autonomous
EX2013	Declaration of Noah Moore
EX2014	Airspace Interceptor, Fully Autonomous Physical Mitigation System Designed to Detect, Capture or Ram Drone, https://www.airspace.co/airspace-interceptor/
EX2015	Smithsonian National Air and Space Museum, Donate a Personal Item, https://airandspace.si.edu/donate-item
EX2016	Smithsonian National Air and Space Museum, Roger Connor Bio, https://airandspace.si.edu/people/staff/roger-connor
EX2017	Smithsonian National Air and Space Museum, About the Collection, available at https://airandspace.si.edu/collections/about-collection (last visited July 14, 2025)

I. INTRODUCTION

Petitioners have challenged claims 1-20 of U.S. Patent No. 10,514,711 (the “’711 Patent”) on 22 Grounds. The inventions claimed in the ’711 Patent enable an interceptor unmanned aerial vehicle (UAV) to perform flight control operations based on the relative location of an airborne target such as another UAV, without human guidance, and without being controlled by a ground-based navigation system.

Each of the 22 Grounds asserted by Petitioners fail for not disclosing, *inter alia*, an interceptor UAV that itself detects a target by applying on-board a machine learning model to an image taken by a UAV camera to identify a portion of the image that includes the target. As explained below, this on-board target detection step and on-board autonomous navigation enable an interceptor UAV to perform flight control operations based on the relative location of the detected target without human guidance, and without being connected to ground-based navigation systems.

Various asserted Grounds also fail because their constituent references are not directed to detecting, and performing flight control operations based on the relative location of *airborne* targets. These other grounds instead deal with the simpler scenario of detecting and performing flight control operations relative to the location of targets that are on the ground. Thus, Petitioners have

not shown a reasonable likelihood of showing unpatentability of any of the challenged Claims 1-20, and hence, it is respectfully submitted that the Petition be denied.

II. THE '711 PATENT

A. Administrative Overview

The '711 Patent issued from U.S. Patent Application No. 16/142,452 (the '452 Application"), that was filed on September 26, 2018. EX1001, face page. The '452 Application is a continuation-in-part of U.S. Patent Application No. 15/729,581 (the '581 Application), filed on October 10, 2017. The '452 Application also claims priority to U.S. Provisional Patent Application No. 62/566,449, filed on October 1, 2017, and to U.S. Provisional Patent Application No. 62/405,972, filed on October 9, 2016. *See* EX1001, 1:7-23.

B. Prosecution History

During the prosecution of the '452 Application, in the first Non-Final Office Action mailed on November 23, 2018, Claims 1-11, 14, 19, and 20 were rejected under 35 U.S.C. § 103 over several prior art references. Claims 12, 13, and 15-18 were indicated as reciting allowable subject matter. *See* EX1002 at 104-115. In a response filed on February 20, 2019, Applicant amended various Claims, including Claim 1. *See id.* at 158-163.

A Final Office Action was mailed on March 12, 2019, in which Claims 1-11, 14, 17, 19, and 20 were rejected under 35 U.S.C. § 103 over some previously cited and some new prior art references. Claims 12, 13, and 15, 16, 18 were indicated as reciting allowable subject matter. *See* EX1002 at 165-177. In a response filed on July 11, 2019, Applicant incorporated the subject matter recited in Claim 12, that was indicated as allowable, into independent Claims 1, 19, and 20. *See id.* at 215-221.

The Notice of Allowance issued thereafter on August 2, 2019. *See id.* at 222-229. In the reasons for allowance, the Examiner stated that the limitations recited in original Claim 12, now incorporated into Claims 1, 19, and 20, were not taught or suggested by the prior art of the record. *See id.* at 227. These limitations include, *inter alia*, “*determining a speed adjustment factor based on a magnitude of deviation of a direction of the three-dimensional relative location with respect to a current flight direction of the reference aerial vehicle.*” *See id.*

C. Subject Matter

The '711 Patent discloses and claims techniques for “performing a flight control operation of a reference aerial vehicle” based on the three dimensional (3D) relative location of a target that it detects using machine learning. *See* EX1001, Abstract, 31:10-33:2. In particular, the '711 Patent notes that as the use of UAVs, also known as drones, would proliferate, some UAVs may be “used to

carry contraband,” “to perform unauthorized surveillance,” and even to commit acts of terrorism. *See id.*, 3:3-11. To mitigate such risks by malicious UAVs, the ’711 Patent explains, that it may be necessary to deploy an interceptor UAV to interdict a malicious UAV (i.e., a target), e.g., “intercept, capture, and transport away a UAV that has entered a restricted area.” *Id.*, 3:11-21.

Typically, however, because such interceptor UAVs were controlled by human flight controllers, a number of problems arose when attempting to have the UAV intercept a target. First, the human had to “have a visual sight” of the target to capture it. *Id.*, 1:27-31. Second, “challenges arose in circumstances where a trained human user is unavailable or unable to react quickly enough to perform a desired flight maneuver.” Additionally, “if communication between the [interceptor UAV] and the flight controller is lost or becomes unreliable, the [interceptor UAV] may be unable to perform a desired flight operation.” *Id.*, 1:31-36. An additional challenge is manually controlling a UAV when the target, such as another UAV, is also moving. *See id.*, 3:21-25. For these reasons, the Patent explains “it may not be desirable to manually control the interceptor [UAV.]” *Id.*, 3:25-26.

Patent Owner Airspace not only recognized this critical problem, but also devised an ingenious and multi-faceted solution—an “interceptor aerial vehicle [that] is able to autonomously track and fly to the target UAV using machine vision

based on images captured by a camera of the interceptor aerial vehicle.” *Id.*, 3:27-30., Airspace not only conceived and patented this solution; it also built an embodiment of this invention that it supplied to the United States Army in 2018, as a first-of-its-kind, fully autonomous interceptor UAV. To build this revolutionary autonomous interceptor UAV, Patent Owner entered into an agreement with the U.S. Army under which it received over \$3.5 million in funding from the U.S. Army’s “Defense Innovation Unit – Experimental (DIUs) Commercial Solutions Offering (CSO).” EX2001, Article 1, § A. This agreement described Patent Owner’s technology as “**cutting edge** counter unmanned aerial system (cUAS) robotic ‘interceptor drone.’” *Id.* The Airspace UAV was accepted for inclusion in the Smithsonian National Air and Space Museum’s collection of historically significant aircraft in March 2024. EX2002.

Airspace’s ingenious and multi-faceted solution, as disclosed and claimed in the ’711 Patent and as embodied in the UAV interceptor delivered to the US Army and accepted into the Smithsonian’s collection, has a number of important features. The first one is the **machine-learning based detection** of a target from the images captured by a UAV used for interdiction, referred to in the ’711 Patent as the “reference UAV.” *See* EX1001, 17:25-27; *see also, id.*, 13:26-35, FIG. 3A. Machine-learning based detection of an object/target is not limited to mere object/target classification. *See* EX2003 at 1212, col. 2; EX2004 at 1. Machine-

learning based detection, according to the '711 Patent, comprises determining that a target is present in the captured image and identifying that target, e.g., by placing a bounding box around the target. *See* EX1001, 17:25-38. The '711 Patent's machine-learning based target detection additionally includes detecting or identifying one or more features of a target, e.g., the "type, model, class, manufacturer, size, etc. of the detected target." *See id.*, 17:31-38.

The second important feature of the '711 Patent's concerns the determination/estimation of the three-dimensional relative location of the target with respect to the interceptor ("reference UAV"), including the distance between the reference UAV and the target. *See id.*, 17:39-49. The Patent teaches performing such distance estimation by comparing the size of the target within the captured image to the size of the image, because a "target that is further away will appear smaller in the image as compared to the target that is closer and thus the size of the target within the image can be used as a proxy for distance to the target." *Id.*, 17:42-49.

A significant challenge is presented, however, when the target size is not known *a priori*. This is likely the case when the target is another UAV, because UAVs can vary in shapes and sizes significantly. *See id.* 17:49-53. To address this problem, the '711 Patent teaches using a "*machine learning model* [that] has been trained using different examples of types of aerial vehicles (e.g., different models,

types, manufacturers, sizes, etc.) to be able to classify and identify the specific type of the detected target aerial vehicle and a corresponding size profile corresponding to the specific type.” *Id.*, 17:53-58. Then, “a measurement of the target within the image,” e.g., one or more size parameters of a bounding box associated with the target, “can be mapped to a distance value based on a determined size corresponding to the *detected type/classification* of the target.” *Id.*, 17:61-67.

A third important feature of the ’711 Patent’s pertains to its automated navigation. In particular, when a target is detected, “a flight direction and/or speed of an interceptor aerial vehicle are automatically and autonomously adjusted.” *Id.*, 16:49-55, FIG. 4. A unique aspect of the speed adjustment described and claimed in the ’711 Patent is that the speed is not adjusted solely based on how far the target is, *see id.*, 18:54-59, but is based on the *magnitude of directional deviation* of the target relative to the current heading of the reference UAV. *See id.*, 19:4-8, 19:14-20.

Before the invention of the ’711 Patent, UAVs that may track ground-based objects were known. *See, e.g.*, EX1009, 1:46-62, FIG. 1; EX1005, ¶[0018], FIG.

1. Due to the rapid, three-dimensional, and continuing UAV motion and vibrations, the images captured by a camera on-board a UAV tend to be substantially less in quality and highly noisy compared to those captured by a fixed camera. Before the invention of the ’711 Patent, the traditional signal/image

processing techniques were well-developed to analyze such images. Machine-learning-based techniques, on the other hand, were often not trained using such images, and as such, often did not perform as well as the image-processing systems. The signal/image processing techniques also took advantage of the fact that ground-based targets, such as humans and vehicles, often moved relatively slowly compared to the UAVs, and that while the distance between a UAV and a target was not known, the UAV would know its own distance from the ground. Use of machine-learning-based systems aboard a UAV for image analysis was therefore rare, if at all known, before the invention of the '711 Patent.

The need for the detection and tracking of a wide range of airborne objects including birds, helicopters, small planes, large planes, and different types of UAVs, presented a new challenge. Unlike ground-based targets, these airborne targets moved as rapidly or even faster than a UAV, and in a three-dimensional space. Moreover, a UAV had no relevant information about the distances to targets, and based on such distances, a bird, another UAV, and a helicopter could all appear substantially the same in a captured image. These aspects required refinements to the signal/image-processing techniques. The inventors of the '711 Patent recognized and verified that machine learning can be used effectively for image analysis, in light of the unique challenges associated with the detection and recognition of aerial targets. They even employed machine-learning models

specifically trained using images obtained from a UAV-based camera. *See* EX1001, 8:48-65, 13:30-35, 17:27-38. As noted above, the inventors of the '711 Patent also recognized the need for and provided for autonomous navigation based on the results provided by the on-board machine-learning models. *See id.* 4:7-26, 9:38-51, 16:11-60. Independent Claims 1, 19, and 20 recite limitations directed to these features.

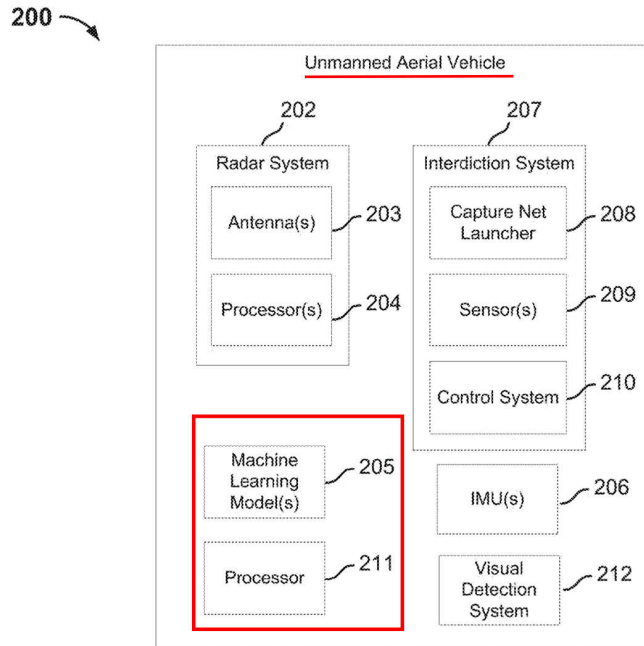
III. CLAIM CONSTRUCTION

In the Petition, “Petitioners do not present any [claim] constructions and indicate that all claim terms be “construed according to their ‘ordinary and customary meaning.” Pet. at 8-9. According to Patent Owner, however, certain Claim terms are properly interpreted as discussed below. Parties thus dispute the interpretation of the above-stated claim terms, and they must therefore be construed. *See Vivid Technologies, Inc. v. American Science*, 200 F. 3d 795, 803 (Fed. Cir. 2000).

“[C]laims are viewed and understood in the context of the specification and the prosecution history.” *Nature Simulation Systems Inc. v. Autodesk, Inc.*, 50 F. 4th 1358, 1363 (Fed. Cir. 2022); *see also, Nautilus, Inc. v. Biosig Instruments, Inc.*, 572 U.S. 898, 910 (2014); *Hockerson-Halberstadt, Inc. v. Converse Inc.*, 183 F. 3d 1369, 1375 (Fed. Cir. 1999); *Phillips v. AWH Corp.*, 415 F.3d 1303, 1314 (Fed. Cir. 2005) (*en banc*).

Claims 1 and 20 recite “*detecting a target in the image including by applying a machine learning model to the image,*” and Claim 19 recites “*detect a target in the image.*” As explained below, these terms are properly interpreted as “applying aboard the reference UAV a machine learning model to the captured image for: (i) identifying a target in the captured image, (ii) identifying a bounding box for the identified target, and (iii) classifying the identified target, including identifying a type of the target.”

Claims 1 and 20 additionally recite “*receiving an image captured by an image sensor of the reference aerial vehicle,*” and “*applying a machine learning model to the image.*” Claim 19 additionally recites a “reference aerial vehicle, comprising: an image sensor configured to capture an image [and] and a processor configured to: detect a target in the image.” The only target detection within an image captured aboard a reference UAV that the ’711 Patent discloses is by applying a machine learning model aboard the reference UAV. *See* EX1001, 8:48-54 (UAV “200 may include a camera system 212 ... used to visually detect a [target] UAV” by “provid[ing] visual data (e.g., pixel data) to one of the ... machine learning models 205”), FIG. 2.



Id., FIG. 2 (annotated) (depicting machine learning model(s) aboard a UAV).

The '711 Patent also discloses a UAV 301 “comprising computing chassis 302” that includes a CPU coupled to “an image processing module” that is “configured to process images acquired by visual detection system 311” and that “may include a plurality of machine learning models that are trained to label a detected object based on the visual data. *Id.*, 7:59, FIG. 3A; *see id.*, 16:11-41, 17:20-30. As such, the above-identified claim terms are properly interpreted, in part, as “applying aboard the reference UAV a machine learning model to the captured image for: (i) identifying a target in the captured image.”

Furthermore, Claims 1 and 20 recite “a size of the target detected within the image.” Thus, the “size of the target” must be “detected within the image.” A POSITA would have understood that such a size can be detected from the size of

the target's bounding box that per the '711 Patent is identified by the machine learning model, as discussed below. Claim 7, which depends from Claim 1, recites "*a physical size corresponding to an identified type for the target.*" Per the '711 Patent, the machine learning model also classifies the detected target, so as to identify its type, model, class, etc.

Specifically, regarding the detection of a target within a captured image, the '711 Patent states that the "*detection of the target* in the captured image may be performed ... *using a machine learning model* trained ... *to identify the target* aerial vehicle in the image" where the "*the machine learning model*" outputs "a bounding box" "outlin[ing] the *minimum sized box* that includes detected features of the target) and/or a *classification of the detected target* (e.g., *type*, model, class, manufacturer, **size**, etc. of the detected target)." *Id.*, 17:17-18, 17:25-38, FIG. 5.

Thus, the machine-learning-based detection of a target in an image, per the '711 Patent, includes both the determination of a "bounding box" for the target and a "classification" that includes the identification of the type of the target. Both the bounding box and the classification, that includes the target type, are used to determine the relative distance to the target. *See id.* 17:39-49, 17:61-66. The '711 Patent also describes a particular advantage of its machine-learning-based classification and identification of target type. *See id.*, 17:49-67. Specifically, autonomous navigation of the reference UAV towards a target requires accurate

determination of the distance to the target from the UAV. *See id.*, 18:54-59. The *aerial targets* vary substantially, however, and as such their physical sizes can also vary substantially. Such sizes can be determined accurately via a “size profile” by recognizing the target “models, types, manufacturers,” etc., which can be accomplished using a suitably trained machine learning model. *Id.*, 17:39-58.

Thus, “*detecting a target ... by applying a machine learning model to the image*” (Claims 1, 20) and “*detect a target*” (Claim 19), as properly construed, mean not only “applying aboard the reference UAV a machine learning model to the captured image for: (i) identifying a target in the captured image” but also “(ii) identifying a bounding box for the identified target, and (iii) classifying the identified target, including identifying a type of the target.”

Additionally, “*a size of the target detected within the image*” (Claims 1 and 20) and “*a size of the target within the image*” (Claim 7) are properly interpreted as “a size of the bounding box for the target that is provided by the machine learning model.” *See id.*, 17:61-67 (disclosing dimension, area, and/or number of pixels in a bounding box as “a measurement of the target within the image”). Moreover, “*identifying a model type of the target*” (Claim 4) and “*an identified type for the target*” (Claim 7) are properly interpreted as “identifying a type of the target / a target type that is identified by the machine learning model.” This is because the

specification teaches no other way of identifying a type besides by using a machine learning model.

Claims 1 and 20 and Claim 19 also recite a “[*performing / perform a*] *flight control operation*.” These claim terms are properly interpreted as “[performing / perform a] flight control operation by the reference aerial vehicle” because those are the only flight control operations that the ’711 Patent discloses. *See generally, id.* This is not surprising because the ’711 Patent identifies a significant drawback of ground-based flight control. *Id.*, 1:34-37 (“if communication between the [UAV] and the flight controller is lost ... the [UAV] may be unable to complete a desired flight operation”).

Although the ’711 Patent’s interceptor UAV may receive commands/data from a ground-based system for interdicting a target, *see id.*, 3:59-61, for flight control operation the ’711 Patent discloses autonomous navigation systems only. *See id.*, 5:25-27, 14:5-20, FIGS. 3A, 3B. For interdicting a target, the ’711 Patent discloses that a ground station may detect a target and provide the “detected location of target” “to interceptor [UAV]” so that it can “*automatically and autonomously* fly towards the direction of the detected location.” *Id.*, 4:7-17. Moreover, “once interceptor aerial vehicle [] is near target aerial vehicle” the “[i]nterceptor aerial vehicle” may “dynamically detect the unauthorized aerial vehicle and “*autonomously navigate* interceptor aerial vehicle 102 towards the

target aerial vehicle.” *Id.*, 4:17-26. Therefore, “[performing / perform a] flight control operation” is properly interpreted as “[performing / perform a] flight control operation by the reference aerial vehicle.”

Finally Claims 1, 19, and 20 recite a “target.” This claim term is properly interpreted as “an object capable of flight, that is targeted.” There are several reasons why a “target” in the ’711 Patent is essentially a flying object. The problem addressed by the ’711 Patent exclusively pertains to flying objects. *See id.*, 3:5-14. The only target that is illustrated in the ’711 Patent is described as “a vehicle capable of flight.” *Id.*, 4:7-13 (“An example of the unauthorized aerial vehicle is target aerial vehicle 110 (e.g., a drone, a multicopter aircraft, an airplane, a UAV, a helicopter, or any other vehicle capable of flight)”). An overwhelming majority of references to a “target” are in fact references to a “target UAV,” “target drone,” or “target aerial vehicle,” and the target is never described as an object that is not capable of flight. *See generally, id.* Even the potential targets that are disclosed, and those used to train machine-learning models, such as birds and balloons, are capable of flight. *See id.*, 7:20-41, 9:56-64, 24:49-56. Thus, a “target” is properly interpreted as “an object capable of flight, that is targeted.”

IV. EACH OF GROUNDS 1-22 FAILS TO DEMONSTRATE UNPATENTABILITY OF THE CHALLENGED CLAIMS BY A PREPONDERANCE OF THE EVIDENCE

A. Ground 1

Ground 1 uses the combination of Beard and Laufer (hereinafter the “Beard-Laufer combination”) in alleging invalidity of independent claims 1, 19, and 20, and certain dependent claims. *See* Pet. at 7, 10. Contrary to the allegations in Petition, *see id.* at 10-13, a person of ordinary skill in the art (“POSITA”) would not be motivated to combine Beard and Laufer. Furthermore, Beard-Laufer fails to show several limitations recited in Claims 1, 19, and 20 and in various dependent Claims.

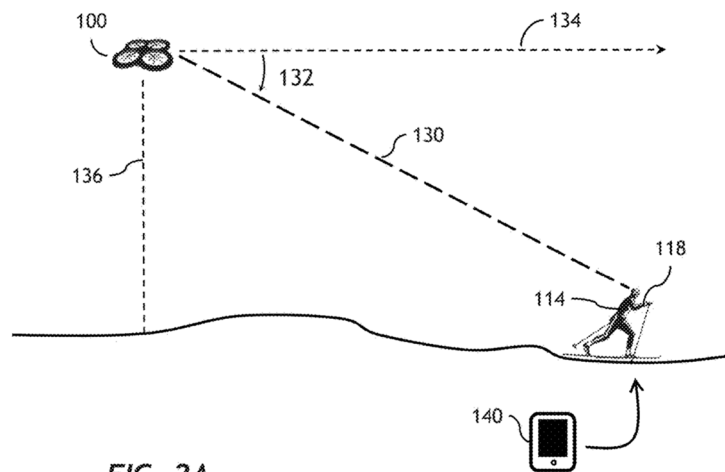
1. A POSITA Would Not Combine Beard and Laufer

A POSITA would not combine Beard and Laufer because, *inter alia*, (i) Petitioners have not shown that a POSITA would have been motivated to make the substitution that Petitioners propose, *Virtek Vision Int’l ULC v. Assembly Guidance Sys.*, 97 F. 4th 882, 886-87 (Fed. Cir. 2024); (ii) the proposed combination (“Beard-Laufer”) “would produce an inoperative result,” *DePuy Spine, Inc. v. Medtronic Sofamor Danek, Inc.*, 567 F. 3d 1314, 1326 (Fed. Cir. 2009), and (iii) the proposed combination does not provide a reasonable expectation of achieving the claimed invention. *Intelligent Bio-Systems v. Illumina Cambridge*, 821 F. 3d 1359, 1367 (Fed. Cir. 2016); *Personal Web Technologies, LLC v. Apple, Inc.*, 848 F.

3d 987, 993-94 (Fed. Cir. 2017); *Belden Inc. v. Berk-Tek LLC*, 805 F.3d 1064, 1073 (Fed. Cir. 2015).

Regarding motivation to combine Beard and Laufer, Petitioners state: “Beard describes automatically detecting targets within images and using additional recognition techniques to determine a target” and that “Laufer furthers these aspects, specifying an automated technique of using machine learning to detect aircraft targets in images.” *Id.* at 12 (internal quotation marks omitted). This argument is flawed for at least three reasons.

First, without hindsight bias, it is hard to understand why any POSITA would think of combining a UAV that is “a useful platform for cyclists, skiers, snowboarders, or other sporting enthusiasts who wish to record their exploits under extreme conditions, *see* EX1009, 1:46-49, with a drone interdiction system for mitigation of threats from unmanned aircraft” using “one or more of radar, fixed cameras and interceptor aircraft.” EX1010, ¶[0002].



EX1009, FIG. 2A.

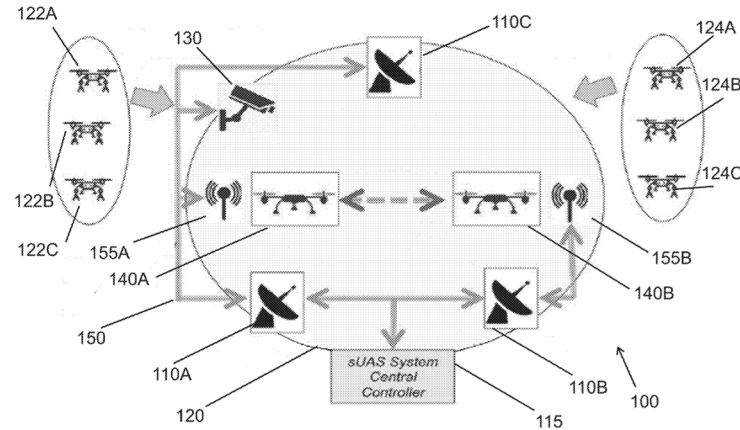


FIGURE 1

EX1010, FIG. 1.

One system focuses on grounded objects while the other on aerial objects. One system tracks a cooperative object that may own/employ the entire tracking system, while the other targets uncooperative objects. One system aims to provide “a continuous video feed of a target subject in motion” while the other system aims for target “mitigation.” Compare EX1009, 1:46-62 with EX1010, ¶¶[0002].

Moreover, it is even harder to understand how any POSITA would combine Beard and Laufer to arrive *at the claimed invention of the ‘711 patent*, given that neither Beard nor Laufer teaches: (i) using machine-learning for target detection, let alone such use aboard an interceptor UAV itself, and (ii) on-board autonomous flight operations, e.g., beyond an operator’s visual line of sight. Beard is silent on machine-learning, *see generally*, EX1009, and Laufer only describes that “[m]achine learning algorithms ... can be used to classify whether a target is a

threat or not... whether a target is a drone, and if the target is a drone, whether it is a threat.” EX1010, ¶[0031], and thus an important inventive concept of the ‘711 Patent of “detecting a target in the image [] by applying a machine learning model to the image,” as Claim 1 recites.

Beard is also silent on “performing the flight control operation,” according to a proper construction thereof, i.e., autonomous navigation. *See supra* § III. Laufer discloses that a “[c]entral controller 115 can generate commands to pilot the interceptor aircraft to an expected interception location.” EX1010, ¶[0036]. But Laufer’s central controller can be “connected to *stationary* components of interdiction system 100 by a *wired connection*” and “to interceptor aircraft [] through a wireless connection.” *Id.*, ¶[0030], FIG. 1. A central controller having wired connections to stationary components, such as “Doppler radars” and “fixed cameras,” *see id.*, ¶[0029], must be ground based and cannot be aboard a UAV. Therefore, Laufer describes the very sort of conventional interceptor UAV operation that the ‘711 inventors had in mind as being inoperable “if communication between the [interceptor UAV] and the flight controller is lost or becomes unreliable.” EX1001, 1:31-35. Beard-Laufer does not solve this problem.

The second reason Petitioners’ assumption of a motivation to combine Beard and Laufer is flawed, is because Petitioners’ selective quotations of Beard omit

crucial context which when taken into account informs that a POSITA would have had no reason to substitute Beard’s “*visual* recognition techniques” with Laufer’s machine learning. Specifically, Beard discloses “a *face detection system 238*” for detecting targets that “may utilize Viola-Jones or other facial recognition algorithms, pixel analysis, vote-matching, cascade recognition, or *other visual recognition techniques* to isolate a human target.” EX1009, 7:39-50, FIG. 5. Thus, Beard’s “additional ‘recognition techniques’” to which Petitioners refer, *see* Pet. at 12, are “visual” techniques for face / target detection. Laufer’s machine learning technique however, is not a target *detection* technique, but a classification technique, as Laufer states explicitly. EX101, ¶[0031] (“*classify* whether a target is a threat or not ... whether a target is a drone, and if the target is a drone, whether it is a threat”). Thus, Laufer’s machine learning *classification* not even a feasible alternative to Beard’s visual recognition *detection* techniques.

Even if it is assumed that the proposed substitution is feasible, “[t]here was no argument in the petition” or in Dr. Singhose’s declaration “regarding *why* a skilled artisan would make this substitution,” for example, a discussion of advantages of using machine learning instead of visual recognition. *See* Pet. at 8-36; EX1003, ¶¶107-150. Therefore, Petitioners fail to provide adequate motivation to combine, if any. *See Virtek Vision*, 97 F. 4th at 886-87.

Third, because Laufer’s machine learning technique cannot actually *detect* a face or a human target within an image, employing that technique in Beard’s system would render it inoperable. As noted above, Laufer’s “[m]achine learning” is expressly “used to classify” targets and not for target detection. *See* EX1010, ¶[0031]. Dr. Singhose’s argument that Laufer’s machine learning can nevertheless be applied to Beard’s target detection, EX1003, ¶118, is wrong, because it erroneously conflates target detection and classification. *See* EX2003 at 1212, col. 2 (distinguishing object detection and classification); EX2004 at 1 (same).

Therefore, substituting Beard’s visual recognition / face *detection* techniques, *see* EX1009, 7:39-50, with Laufer’s machine leaning, a classification and not a detection technique, would render Beard’s system inoperable for its intended purpose of performing face *detection*. *DePuy Spine, Inc. v. Medtronic Sofamor Danek, Inc.*, 567 F. 3d 1314, 1326 (Fed. Cir. 2009); *see* EX1009, 3:9-12, 3:64-67, 6:4-7.

For the same reason, a POSITA would have understood that Beard-Laufer provided no reasonable expectation of achieving the claimed invention. *Intelligent Bio-Systems*, 821 F. 3d at 1367; *Personal Web Technologies*, 848 F. 3d at 993-94; *Belden Inc.*, 805 F.3d at 1073. To the contrary, a POSITA would have understood that Beard-Laufer would not perform the task of “detecting a target in the image ... by applying a machine learning model” that Claim 1 recites.

Petitioners also argue that “Laufer enhances Beard by providing a way of establishing visual contact with a target without smartphone data – i.e., by using data from a doppler radar to determine an interception location.” Pet. at 12-13. This argument fails because it would make Beard’s system unnecessarily complex if not unworkable. A doppler radar, by itself, may be used to determine a target’s velocity, but cannot be used to determine the target’s location. *See* EX2005; EX2006. It is therefore unclear how Laufer’s Doppler radio could be substituted for Beard’s smartphones, which readily share their precise locations. *See* EX2007; EX2008; EX2009; EX2010. Therefore, a POSITA would find it unnecessary to substitute Beard’s smartphone-based location determination with Laufer’s substantially more complex system requiring doppler radars and radar trackers. *See Virtek Vision*, 97 F. 4th at 886-87.

For the foregoing reasons, a POSITA would not have combined Beard and Laufer. Notwithstanding the lack of motivation to combine, and in fact, a strong motivation not to combine, Beard-Laufer fails to teach or suggest certain limitations of Claims 1, 19, and 20, and of various dependent claims, as discussed below.

2. Claims 1, 19, and 20

- a “Detecting a Target in the Image Including by Applying a Machine Learning Model ... to Identify a Portion of the Image that Includes the Target” (Claims 1 and 20) and “Detect a Target” (Claim 19)*

Petitioners argue that Beard-Laufer teaches the above-quoted limitation of Claims 1 and 20 because Beard allegedly teaches identifying potential targets via bounding boxes, and that Laufer allegedly teaches applying machine learning to achieve the same objective. Pet. at 15. Beard does not teach, and in fact, does not even mention machine learning. *See generally*, EX1009. Petitioners do not cite any particular disclosure from Laufer to support its allegation, and instead, refers to the motivation to combine Beard and Laufer and cites the Declaration of Dr. Singhose. *See id.* (citing EX1003 ¶¶117-118). Thus, as a threshold matter, Petitioners fail to meet the requirements of 35 U.S.C. § 312(a)(3) for Beard-Laufer. *Harmonic Inc. v. Avid Technology, Inc.*, 815 F. 3d 1356, 1363 (Fed. Cir. 2016) (stating that the statute requires “IPR petitions to identify ‘with particularity... the evidence that supports the grounds for the challenge to each claim’”); *see Acceleration Bay, LLC v. Activision Blizzard Inc.*, 908 F. 3d 765, 775 (Fed. Cir. 2028) (“Board did not abuse its discretion in declining to consider the cited paragraphs in [Expert] declaration”). Notwithstanding this flaw, Dr. Singhose’s analysis and Petitioners’ arguments are substantially wrong, as discussed below.

The Claim terms “*detecting a target ... by applying a machine learning model*” and “*detect a target*” are properly interpreted as “applying aboard the reference UAV a machine learning model to the captured image for: (i) identifying a target in the captured image, (ii) identifying a bounding box for the identified target, and (iii) classifying the identified target, including identifying a type of the target.” *See supra* § III. Likewise, a proper interpretation of “*a size of the target detected within the image*” is a size of the bounding box for the target that is provided by the machine learning model. *See id.*

As noted before, Beard is silent on machine learning. Likewise, Laufer is silent on a bounding box, its size, and/or a type of a target using machine learning or even otherwise. *See generally*, EX1010. Moreover, Laufer’s “machine learning algorithms” may be included within a “[d]rone identification module 220” that is part of Laufer’s central controller 115. *See id.*, ¶[0031], FIG. 2. As discussed below, Laufer’s central controller is based on the ground and is not aboard a UAV. *See infra* § IV.A.5. As such, Beard-Laufer does not teach or suggest the above-identified limitations recited in Claims 1, 19, and 20.

To the extent “*detecting a target ... by applying a machine learning model*” is not interpreted per Patent Owner’s construction, Beard-Laufer nevertheless does not meet this Claim limitation. This is because Laufer describes that “[m]achine learning algorithms ... can be used to classify whether a target is a threat or not”

and that “machine learning algorithms can determine whether a target is a drone, and if the target is a drone whether it is a threat.” EX1010, ¶[0031]. Quoting this disclosure of Laufer, Dr. Singhose concludes: “Laufer therefore specifies to detect a target in Beard’s reference image frame by applying a machine learning algorithm to the image frame, to identify the portion of the frame including the target object.” EX1003, ¶118.

This is wrong because Dr. Singhose’s analysis erroneously conflates object / target detection with object / target recognition, which are not the same, but rather are two different tasks of computer vision. EX2003 at 1212, col. 2 (In “[c]omputer vision” [c]ommon tasks include **object detection** and **object classification**” where “[o]bject detection aims to rapidly locate the region of an image where an object of interest may appear”) (emphasis in original). “Object determination and recognition are two,” i.e., different and “important computer visions tasks.” EX2004 at 1. “**Object detection determines the presence of an object** and/or its scope, **and locations in the image**” and in contrast, “[o]bject recognition **identifies the object class** in the training database.” *Id.*

Determining “whether a target is a drone” and “whether it is threat” is performing classification. Laufer thus appears to teach using machine learning to **recognize or classify** and already detected object / or target. In fact, Laufer’s paragraph [0031] that Dr. Singhose cites states so explicitly. EX1010, ¶[0031]

(“Machine learning algorithms ... can be used to **classify** whether a target is a threat or not”); *see* EX1003, ¶118. Thus, contrary to Dr. Singhose’s conclusion, Laufer does not teach or suggest using machine learning to perform the prerequisite, different task of **detecting an object / target within an image**.

Accordingly, neither Beard nor Laufer, individually or in combination, teaches using machine learning for target detection, i.e., “[*detecting / detect*] a *target*,” as Claims 1, 19, and 20 recite.

In summary, Beard-Laufer does not teach or suggest each and every limitation of Claims 1, 19, and 20. Therefore, these Claims are patentable over Beard-Laufer.

3. Claims 2-3, 9, 10, 14-16, 18

Each of these Claims directly or indirectly depends from Claim 1, and as such, is patentable at least because Claim 1 is patentable, as discussed above for Ground 1.

4. Claims 5 and 6

Claim 5 depends from Claim 1 and Claim 6 depends from Claim 5, and as such, these Claims are patentable at least because Claim 1 is patentable, as discussed above. Moreover, claim 5 recites “*detecting the target in the image includes identifying a bounding box outlining a portion of the image that includes detected features of the target.*” Per claim 1, “*detecting a target in the image*”

includes “*applying a machine learning model to the image to identify a portion of the image that includes the target.*” It is also discussed in Claim Construction in connection with Claim 7, that the bounding box is identified using a machine learning model. *See supra* § II.A. As such, “*identifying a bounding box*” as part of “*detecting the target in the image*” includes “*applying a machine learning model to the image.*” Neither Beard nor Laufer teaches “*applying a machine learning model*” for “*identifying a bounding box.*”

To the extent Beard teaches “*identify[ing] a portion of the image that includes the target*” and “*identifying a bounding box,*” *see, e.g.,* EX1009, 3:64-4:4, 4:32-48, FIGS. 1A-1D, Beard does not teach or even mention “*applying a machine learning model.*” *See generally,* EX1009. To the contrary, Beard teaches using “**visual recognition techniques.**” EX1009, 7:39-50 (disclosing “**a face detection system 238**” that “may utilize Viola-Jones or other facial recognition algorithms, pixel analysis, vote-matching, cascade recognition, or **other visual recognition techniques** to isolate a human target 118 from its surroundings”), FIG. 5.

Laufer discloses using machine learning, *see, e.g.,* EX1010, ¶[0031] but Laufer is silent on “*bounding box.*” *See generally,* EX1010. Therefore, Laufer also does not teach or suggest “*applying a machine learning model*” for “*identifying a bounding box.*” Moreover, as discussed above for claim 1, Laufer expressly teaches using learning for object classification only and not for object

detection, e.g., for “*identify[ing] a portion of the image that includes the target*” and for “*identifying a bounding box*,” as claim 5 recites. *See supra* at 26-28; Ex1010, ¶[0031] (stating that “[m]achine learning algorithms ... can be used to classify”).

Therefore, Beard-Laufer does not and cannot teach the above-quoted limitation of claim 5 and claim 6, because it depends from claim 5.

5. Claim 12

Claim 12 depends from Claim 1 and is therefore patentable at least because Claim 1 is patentable, as discussed above. Moreover, claim 12 recites “*receiving a geographical location associated with the target*” and “*autonomously navigating the reference aerial vehicle towards the received geographical location.*” EX1001, 32:1-7. In the context of Claims 1 and 12, a POSITA would readily understand that all the recited method steps are performed by a reference aerial vehicle / reference UAV. *See generally*, EX1001. Thus, per Claim 12, the reference UAV “*receive[s] a geographical location*” of the target. Also per Claim 12, the plain, ordinary, and customary meaning of “*autonomously navigating*” is performing navigation by the reference UAV itself. *See* EX2011 (defining “autonomous” as “undertaken or carried on without outside control”); EX2012 (defining autonomous as “independent and having the power to make your own decisions”).

The specification of the '711 Patent also informs that it is the reference vehicle that “*receive[s] a geographic location*” of a target. EX1001, 15:27-43 (“the process of FIG. 4 is performed by interceptor aerial vehicle[s]” and that at step 402 “a location of a target is received” from a “ground station 104 via a wireless communication to interceptor aerial vehicle”), FIGS. 1, 4.

Moreover, the '711 Patent also discloses a UAV 310 “comprising a computing chassis 302” that “protect[s] the CPU of UAV 301.” *Id.*, 9:7-26, FIG. 3A. “The CPU may be configured to perform one or more **flight decisions** for the UAV” and to “provide one or more flight commands to a flight controller module.” *Id.*, 9:38-41. The “CPU is configured to autonomously fly UAV 301.” *Id.*, 9:49-51. Thus, a POSITA would have understood that “autonomously navigating” the reference UAV means making flight decisions by a component of the reference UAV itself, so as to direct the reference UAV towards a “*geographic location*” “*received*” by the reference UAV.

Laufer does not teach or suggest this limitation. In contrast, Laufer describes that a “[c]entral controller 115 can generate commands to pilot the interceptor aircraft to an expected interception location,” EX1010, ¶[0036]; see Pet. at 34, but Laufer’s central controller is not on-board the interceptor aircraft and is ground-based. This is because, the central controller can be “connected to

stationary components of interdiction system 100 by a **wired connection**” and “to interceptor aircraft [] through a wireless connection.” *Id.*, ¶[[0030], FIG. 1.

A central controller that can have a “wired connection” to certain stationary components is not and cannot be on-board a UAV. As such, providing commands for flight control by the central controller does not teach or suggest “*autonomously navigating*” the reference UAV. Additionally, Laufer does not teach or suggest that its interceptor aircraft receives a geographical location of a target, because that location is generated by the ground-based central controller. *See* EX1010, ¶[[0039] (“[c]entral controller 115 can ... determine ... [the] interception location”). Petitioners and Dr. Singhose do not suggest that Beard teaches or suggests the limitations recited in Claim 12. *See* Pet. at 34; EX1003, ¶138. Accordingly, Beard-Laufer does not teach or suggest the limitations recited in Claim 12.

In summary, Beard-Laufer does not teach or suggest each and every limitation of claims challenged under Ground 1, and hence, these claims are patentable.

B. Ground 2, 4, and 6

In challenging Claims 4, 11, and 17 under these Grounds, Petitioners rely on Khan (EX1021), Malecki (EX1024), and Hogasten (EX1022), in addition to relying on Beard-Laufer. *See* Pet. at 36-38, 43-45, 48-50. Claims 4, 11, and 17

depend directly or indirectly from Claim 1. EX1001, 31:38-32:26. These dependent Claims are patentable at least because Claim 1 is patentable, as discussed above for Ground 1, and because Khan, Malecki, and Hogasten do not cure the above-discussed defects in Beard-Laufer. *See generally*, EX1021; EX1022; EX1024. Petitioners and Dr. Singhose do not contend that Khan, Malecki, and Hogasten cure these defects. *See* Pet. at 36-38, 43-45, 48-50; EX1003, ¶¶151-156, 165-170, 176-181.

C. Ground 3

1. A POSITA Would Not Combine Beard, Laufer, and Kumar

The discussion for Ground 1 explains that a POSITA would in fact not be motivated to combine Beard and Laufer. That reasoning applies to this Ground and is not negated by adding Kumar. A POSITA would not further combine Beard, Laufer, and Kumar because, *inter alia*, that combination (“Beard-Laufer-Kumar”) does not provide a reasonable expectation of achieving the claimed invention. *See Intelligent Bio-Systems*, 821 F. 3d at 1367; *Personal Web Technologies*, 848 F. 3d at 993-94; *Belden Inc.*, 805 F.3d at 1073. The reason is, Claim 7 recites “determining the distance to the target based on ... a physical size corresponding to an identified type for the target.” EX1001, 31:48-52. As discussed below, Kumar does not teach or suggest this limitation according to its proper interpretation. *See infra* at 35-37; *supra* § II.A. In the alternative, Kumar’s

disclosure pertaining to the claim limitation “*physical size corresponding to an identified type for the target*” is not enabling. *See infra* at 36-43.

Therefore, opposite to a reasonable expectation of achieving the above-identified feature as part of the claimed invention, a POSITA would have understood that significant experimentation would be necessary to incorporate Kumar’s teachings into Beard-Laufer. *See Elan Pharmaceuticals v. Mayo Foundation*, 346 F. 3d 1051, 1054 (Fed. Cir. 2003); *In re Wands*, 858 F.2d 731 (Fed. Cir. 1988); *Raytheon Technologies v. General Electric Co.*, 993 F. 3d 1374, 1380 (Fed. Cir. 2021). Therefore, a POSITA would not have been motivated to combine Beard, Laufer, and Kumar.

2. Claims 7 and 8

Claim 7 depends from Claim 1 and Claim 8 depends from Claim 7. EX1001, 31:48-55. Therefore, Claims 7 and 8 are patentable at least because Claim 1 is patentable, as discussed above for Ground 1 and because Kumar does not cure the defects in Beard-Laufer. *See supra* § IV.A.2; *infra* § IV.E.

Moreover, the Beard-Laufer-Kumar combination does not teach or suggest “*determining the distance to the target based on a size of the target within the image and a physical size corresponding to an identified type for the target*,” that Claim 7 recites. Petitioners do not contend that Beard-Laufer discloses the claim limitation “*a physical size corresponding to an identified type for the target*” but

argue that Kumar does. *See* Pet. at 38-43. As discussed below, Kumar also does not teach or suggest this claim limitation according to a proper interpretation thereof. Additionally, or in the alternative, Kumar, in combination with Beard and Laufer, does not provide an enabling disclosure of the above-identified claim limitation.

As discussed in Claim Construction, the claim term “*an identified type for the target*” is properly interpreted as “a target type that is identified by the machine learning model.” *See supra* § III. Therefore, “*a physical size corresponding to an identified type for the target*” is a physical target size corresponding to the target type identified by a machine learning model. For its part, Kumar appears to describe “estimating the physical distance and velocities of objects within a sequence of images relative to the camera which took the sequence of images.” EX1007, ¶[0019]. To this end, Kumar describes that for an “object within [an] image for which “the bounding box[] that [is] given,” “produc[ing] a noisy estimate of the relative physical position (relative to the camera)” of the object, based on, in part, “the size of the [bounding] box within the image, and the **known** physical box size of that type of object.” *Id.*, ¶[0021]; *see id.*, ¶[0037] (“calculating the noisy estimate 309 may include using the following values: ... the size of the bounding box within the image, a **known** physical box size of the object of interests type of object”), FIG. 3A.

Regarding the bounding box, Kumar discloses that a “neural network 200 outputs ... the smallest bounding box around the object of interest.” *Id.*, ¶[0035], FIG. 2. Kumar also states that the “[n]eural network 200 may be an example of a neural network detection system as described in” certain identified patent applications. *See id.*, ¶¶[0019], [0032], [0035].

Regarding the physical size of the object, however, Kumar only states that “the system may [] be **informed** of the approximate physical, diagonal size of the objects within the boxes,” *id.*, ¶[0019], and that the physical box size is “known.” *Id.*, ¶¶[0021], [0037], FIG. 3A. Kumar does not describe how the system may be informed of the physical size of a type of an object of interest and/or how such physical size may become known. *See generally, id.* Kumar is also silent on how the prerequisite type of the object of interest may be determined. *See generally, id.* Kumar-Provisional also does not provide any additional information on how the physical size for a particular type of an object of interest may be informed or may become known, or how the object type is determined. *See* EX1008, ¶¶[0019], [0032], FIG. 3A; *see generally, id.*

Thus, Kumar (including Kumar provisional) does not teach or suggest applying a machine learning model to an image to identify: (i) the type for the target, and (ii) the physical size corresponding to the identified type. Rather, Kumar simply assumes that the physical size is known, and is silent on

determining both the type of an identified object and the size corresponding to the type. Therefore, Kumar does not teach or suggest “*a physical size corresponding to an identified type for the target,*” according to a proper interpretation of the claim term “*an identified type for the target.*” Because Beard and Laufer also do not disclose this claim limitation, *see generally*, EX1009; EX1010, the Beard-Laufer-Kumar combination fails to teach or suggest “*determining the distance to the target based on a size of the target within the image and a physical size corresponding to an identified type for the target,*” as Claim 7 recites.

To the extent “*an identified type for the target*” is not interpreted as discussed above, Kumar nevertheless fails to teach or suggest “*determining the distance to the target based on ... a physical size corresponding to an identified type for the target,*” because Kumar’s disclosure for this claim limitation is not enabling. “Enablement requires that ‘the prior art reference must teach one of ordinary skill in the art to make or carry out the claimed invention **without undue experimentation.**’” *Elan Pharmaceuticals*, 346 F. 3d at 1054 (quoting *Minnesota Mining and Manufacturing Co. v. Chemque, Inc.*, 303 F.3d 1294, 1301 (Fed. Cir. 2002)). “[W]hat constitutes undue experimentation” regarding the disclosure of a prior art reference can be determined using the eight factors described in *In re Wands*.” *Id.* at 1054-55 (citing *In re Wands*, 858 F.2d 731 (Fed. Cir. 1988)).

As discussed below, an analysis of the eight *In re Wands* factors demonstrates that based on the disclosure of Kumar, “*determining the distance to the target based on ... a physical size corresponding to an identified type for the target,*” would require substantial, undue experimentation. As a threshold matter, Kumar (including Kumar-Provisional) only states that “the system may [] be **informed** of the approximate physical, diagonal size of the objects within the boxes,” *id.*, ¶[0019], and that the physical box size is “known.” *Id.*, ¶¶[0021], [0037], FIG. 3A; EX1008, ¶¶[0019], [0032], FIG. 3A. Kumar does not describe how its system may know or be informed of the physical size of a type of an object of interest, and how the prerequisite type of the object of interest may be determined, let alone how all this can be done quickly enough in the context of a UAV interdiction scenario, and how such a system can be provided on a UAV. *See generally*, EX1007; EX1008; *see also* EX1001, 17:17-67 (describing and providing a solution to the above-discussed problem).

Factor 1, “quantity of experimentation necessary,” *In re Wands*, 858 F.2d at 737, is high. The reason is both the type of a detected object and a size corresponding to the identified type must be available to a UAV in order for the UAV to “*determine the distance to the target.*” Because the UAV must operate autonomously, this information must be available to the UAV even when there is

no communication between the UAV and an operator, and when the UAV operator may not be available. *See* EX1001, 1:31-37, 3:27-30.

As such, a POSITA would need to consider several design choices, such as which process / algorithm to use to determine the type of a detected target; whether a reference database of frequently encountered target types is needed, e.g., if the algorithm selected uses pattern matching; the optimized size of the database to balance speed of type determination and accuracy; and whether and how frequently the database should be updated, when possible, to improve the type determination accuracy. If a reference database of target types is not needed, a database of sizes corresponding to the identified types would nevertheless be needed, where an optimized size and update frequency of that database must be determined. And of course, as mentioned above, a POSITA would need to figure out how to implement all of the required computing and data transfers quickly enough in the context of a UAV interdiction scenario, and with the compute, communication bandwidth, and storage constraints of a UAV with limited hardware resources. A POSITA would understand that these choices cannot be made and optimized without substantial experimentation.

Regarding Factors 2 and 3, “the amount of direction or guidance presented” and “the presence or absence of working examples,” *In re Wands*, 858 F.2d at 737, as discussed above, Kumar provides no guidance at all and discloses no working

examples as to how its system may know or be informed of the physical size of a type of an object of interest, and how the prerequisite type of the object of interest may be determined. *See generally*, EX1007; EX1008. As such, significant experimentation would be necessary.

Factor 4, “the nature of the invention,” *In re Wands*, 858 F.2d at 737, is complex. In particular, detecting by a reference UAV targets that may be other UAVs, and performing autonomous flight operations to intercept the target by determining a distance to the target, as described and claimed in the ’711 Patent, is a complex operation. One of the reasons, as the ’711 Patent describes, is that the target UAVs can be of different kinds and may have different sizes, which makes the computation of the distance to the target a complex operation. *See* EX1001, 17:49-58; *see also, id.*, 16:35-41, 17:27-38. The complexity of this claimed operation suggests that substantial experimentation would be necessary.

Factors 5 and 7, “the state of the prior art” and “the predictability or unpredictability of the art,” *In re Wands*, 858 F.2d at 737, also suggest that undue experimentation would be needed. This is because, before the invention of the ’711 Patent, the use of UAVs to track commonly known targets such as humans and aircraft in a formation, may have been known. *See, e.g.*, EX1009, Abstract; EX1005, Abstract; EX1025, Abstract. Prior art did not contemplate, however, the

claimed invention that includes detecting and tracking or intercepting targets such as other UAVs, the types, shapes, and sizes of which may vary significantly.

For such tracking / interception, the distance to the target from the UAV may be used. But, of the over forty (40) prior art references cited during prosecution of the '711 Patent and in this Petition only Kumar mentions using the physical size corresponding to the type of the target in determining the distance to the target. Kumar is silent however, on how the target type and the corresponding size can be determined. *See generally*, EX1007; EX1008. Moreover, no cited prior art is concerned with a UAV tracking / intercepting other UAVs of varying types, shapes, and sizes. As such, it was highly unpredictable whether some other prior art would have cured what Kumar fails to disclose. Therefore, significant experimentation would have been necessary to arrive at the claimed invention of Claim 7 of the '711 Patent.

Per Factor 6, “the relative skill of those in the art,” *In re Wands*, 858 F.2d at 737, is high, but nevertheless suggests that a high amount of experimentation would be required. The reason is, a POSITA who may configure a UAV for autonomous operation may be significantly skilled in the field of mechanical and/or aeronautical engineering, but may not be skilled, at least not to a sufficient level, in the field of image processing that is needed to configure the UAV for image-analysis based flight operations.

Finally, Factor 8, “the breadth of the claims,” *In re Wands*, 858 F.2d at 737, and the scope of Claim 7 in particular, is rather narrow, as Claim 7 recites a peculiar solution for determining a distance to the target using the target type and the corresponding size. But because Kumar provides no guidance whatsoever on how these parameters can be determined, *see generally*, EX1007; EX1008, significant experimentation could not have been avoided to arrive at the solution recited in Claim 7.

In summary, all of the *In re Wands* factors demonstrate that in light of Kumar’s disclosure, rather the lack thereof, the invention recited in Claim 7 could not have been achieved without substantial, complex experimentation. Therefore, Kumar does not enable the invention recited in Claim 7.

In *Raytheon*, the Federal Circuit held that “a reference that does not provide an enabling disclosure for a particular claim limitation may nonetheless furnish the motivation to combine, and be combined with, another reference in which that limitation is enabled.” *Raytheon Technologies*, 993 F. 3d at 1380. “But even though a non-enabling reference can play a role in an obviousness analysis, the evidence of record must still establish that a skilled artisan could have made the claimed invention.” *Id.* at 1381. Petitioners and Dr. Singhose do not contend that Beard and/or Laufer enable Kumar’s disclosure, and do not present any other

evidence of such enablement. *Id.* at 1381-82; *see* Pet. at 38-43; EX1003, ¶¶157-164.

Thus, Kumar individually and in combination with Beard and Laufer does not enable the invention recited in Claims 7 and 8 (which depends from Claim 7), and as such, Claims 7 and 8 are patentable for this additional reason over the Beard-Laufer-Kumar combination.

D. Ground 5

1. A POSITA Would Not Combine Beard, Laufer, and Sahasrabudhe

Petitioners propose the combination of Beard, Laufer, and Sahasrabudhe in discussing Claim 13, which depends from Claim 1. The discussion for Ground 1 explains that a POSITA would not combine Beard and Laufer. *See supra* § IV.A.1. That reasoning applies to this Ground and is not cured by adding Sahasrabudhe to Beard-Laufer. A POSITA would not further combine Beard, Laufer, and Sahasrabudhe because, *inter alia*, that combination (the “Beard-Laufer-Sahasrabudhe combination”) does not provide a reasonable expectation of achieving the claimed invention. *See Intelligent Bio-Systems*, 821 F. 3d at 1367; *Personal Web Technologies*, 848 F. 3d at 993-94; *Belden Inc.*, 805 F.3d at 1073. The reason is, Claim 13 recites “*the speed adjustment factor is greater for a smaller magnitude of deviation as compared to [that] for a greater magnitude of deviation.*” EX1001, 32:8-10. As discussed below, Sahasrabudhe teaches the

opposite, a greater speed adjustment for a greater magnitude of error, where the speed adjustment does not exceed a specified limit for safety. *See infra* at 46-47.

Therefore, a POSITA would have understood that per Sahasrabudhe, the speed of a UAV is never adjusted to be “*greater for a smaller magnitude of deviation as compared to [that] for a greater magnitude of deviation*,” as Claim 13 recites. Therefore, a POSITA would have no expectation at all, of achieving the above-identified limitation recited in Claim 13. Therefore, a POSITA would not have been motivated to combine Beard, Laufer, and Sahasrabudhe.

2. Claim 13

In Ground 5, Petitioners argue that Claim 13, which depends from Claim 1, is unpatentable over the combination of Beard, Laufer, and Sahasrabudhe (hereinafter “Beard-Laufer-Sahasrabudhe”). *See Pet.* at 45-48. Claim 13 recites that “*the speed adjustment factor is greater for a smaller magnitude of deviation as compared to for a greater magnitude of deviation.*” Petition’s argument is incorrect, as discussed below.

Beard and Laufer do not teach or suggest the above-quoted limitation and Petitioners do not allege so. *See Pet.* at 45-48. Rather, Petitioners argue that Sahasrabudhe discloses the claim limitation at issue. *See id.* In discussing Claim 13, Petitioners do not cite however, any particular disclosure from Sahasrabudhe to support its allegation, and instead, refers to the motivation to combine Beard,

Laufer, and Sahasrabudhe, and cites the Declaration of Dr. Singhose. *See id.* at 47-48 (citing EX1003 ¶175). Thus, Petitioners fail to meet the requirements of 35 U.S.C. § 312(a)(3) for the Beard-Laufer-Sahasrabudhe combination. *See Harmonic Inc.*, 815 F. 3d at 1363; *Acceleration Bay*, 908 F. 3d at 775. Notwithstanding this flaw, Dr. Singhose’s analysis and Petitioners’ arguments are incorrect.

First, the “*magnitude of deviation*” that Claim 13 recites is “*a magnitude of deviation of a direction of the three-dimensional relative location*” “**of the target,**” per the base Claim, i.e., claim 1. EX1001, 31:17-29; *see* Pet. at 20 (stating that ‘the three-dimensional relative location’ refers to the ‘three-dimensional relative location of the target’). Sahasrabudhe does not teach or suggest such a magnitude of deviation because Sahasrabudhe’s “magnitude of error,” that Petitioners allege as the claimed “magnitude of deviation,” *see* Pet. at 45-47, is in fact, an error between two distinct positions of an aircraft itself and not between the aircraft and its target. *See* EX1025, ¶¶[0016]-[0018], FIG. 1.

In particular, Sahasrabudhe states that “[g]lobal positioning coordinates of the lead aircraft 14 are obtained and transmitted to the follower aircraft 12, where the **relative position of the follower aircraft 12** is determined.” *Id.*, ¶[0016]. Sahasrabudhe further states that “[t]he relative position 42 is compared to a **selected relative position 44** at the flight control computer 40,” that “directs the

follower aircraft 12 into a **desired position envelope 52**,” i.e., “to the selected relative position.” *Id.*, ¶¶[0017], [0019].

Petitioners concede that to determine the magnitude of error, Sahasrabudhe compares two positions of the follower aircraft itself. *See* Pet. at 45-46 (stating that the “follower determines a relative range (distance), azimuth, and elevation” where “[t]his relative position is compared to a **selected position of a desired position envelope**”). Thus, Sahasrabudhe does not even teach or suggest the claimed “*magnitude of deviation*” in the first place, because its magnitude of error is based on the actual and desired positions of the follower aircraft itself, and is not based on the target’s, i.e., the lead aircraft’s position. Accordingly, Sahasrabudhe’s speed adjustment is unrelated to the claimed “*magnitude of deviation*.”

Importantly, Sahasrabudhe’s speed adjustment is **never greater** for a smaller magnitude of error as compared to that for a greater magnitude of error, and instead, it is generally smaller for a smaller magnitude error. Sahasrabudhe computes a magnitude of errors and determines based thereon whether high gain or low gain corrective measures are necessary. EX1025, ¶¶[0017]-[0018].

Sahasrabudhe also discloses “**safety features** to avoid overaggressive” corrections. *See id.*, ¶[0019]. Specifically, “the intended corrections are compared to limits at a correction limiter 54, which then **limits the amount of correction** available.” *Id.* Thus, Sahasrabudhe does not teach or suggest greater velocities for

smaller magnitude of error. To the contrary, it discloses that for any magnitude of error, the corresponding velocities are at least as great as those for any lower magnitude of error. Accordingly, Sahasrabudhe does not teach or suggest a greater velocity (or speed adjustment) for a smaller magnitude of error. Thus, Sahasrabudhe does not teach the limitations recited in Claim 13.

Second, Petitioners also argue that “speed is a result-effective variable for maintaining the orientation between a moving vehicle and another object.” Pet. at 47-48. Claim 13 does not recite an optimized value or a range of speed. Rather, it recites a relationship that is novel and unobvious. *In re Applied Materials, Inc.*, 692 F. 3d 1289, 1297 (Fed. Cir. 2012) (quoting *In re Yates*, 663 F.2d 1054 (CCPA 1981)); *Application of Antonie*, 559 F. 2d 618, 620 (CCPA 1977). When the magnitude of deviation increases, a POSITA would expect to accelerate the interceptor UAV and not slow it down. The relationship that Claim 13 recites is thus a counter-intuitive, reverse relationship. As such, the claimed “speed adjustment factor” per Claims 1 and 13 is not a “result-effective variable.”

E. Grounds 7 and 8

Grounds 7 and 8 use the combination of Pierce and Kumar (hereinafter “Pierce-Kumar”) in alleging invalidity of independent claims 1, 19, and 20, and certain dependent claims. *See* Pet. at 50-68. Contrary to Petitioner’s allegations,

Pierce-Kumar fails to show several limitations recited in Claims 1, 19, and 20, and additionally fails to show the limitations recited in various dependent claims.

1. Claims 1, 19, and 20

a “detecting a target in the image by applying a machine learning model” and “detect a target in the image”

These claim terms are properly interpreted as “applying aboard the reference UAV a machine learning model to the captured image for: (i) identifying a target in the captured image, (ii) identifying a bounding box for the identified target, and (iii) classifying the identified target, including identifying a type of the target.” *See supra* § III. Neither Pierce nor Kumar teaches these limitations.

Kumar never mentions performing any processing on a UAV, let alone a machine learning model aboard the reference UAV. *See generally*, EX1007. For implementing a neural network, Kumar only describes a generic ground-based computer system. *Id.*, ¶[0040] (“FIG. 4 illustrates one example of a neural network system 400 [that] includes a processor 401, a memory 403, [and] an interface 411”) and then goes on to specify a long list of several “examples of interfaces” for that system, **of which many would not be implemented on a UAV.** *Id.*, ¶[0041] (listing “Ethernet interfaces, frame relay interfaces, cable interfaces, DSL interfaces, token ring interfaces,” “fast Ethernet interfaces, Gigabit Ethernet interfaces, ATM interfaces, HSSI interfaces, POS interfaces, [and] FDDI interfaces”). Several of these interfaces, e.g., DFL, HSSI, FDDI, are used for

LANs and WANs spanning several feet and couple to long communications cables. Therefore, a POSITA would understand that system 400 supporting these interfaces would not be aboard a UAV and would instead be a ground-based system.

Pierce hardly fares any better in disclosing a machine learning model aboard the reference UAV, as it simply mimics Kumar in describing its neural network system 500. *See* EX1005, ¶[0038]. The system 500 includes the same components as Kumar’s system 400 and lists the same LAN/WAN interfaces that Kumar lists, *see id.*, ¶¶[0038]-[0039], and is therefore also a ground-based system. Though Pierce states in passing, that its “drone system 600 may be drone 102,” the system 600 includes the same LAN/WAN interfaces as the ground-based system 500. *See id.*, ¶¶[0042]-[0043]. Also, while the drone system 600 may include several optional components, Pierce does not state that it may include the neural network system 500. *See id.*, ¶¶[0042]-[0046], FIG. 6. Thus, Pierce-Kumar does appear to contemplate and does not teach or suggest “applying aboard the reference UAV a machine learning model to the captured image.”

Furthermore, Pierce is entirely silent on classifying the identified target, including identifying a type of the target, let alone disclosing such a type identification *using a machine learning model*. *See generally*, EX1007. Kumar describes “produc[ing] a noisy estimate of the relative physical position” of an object, based on “the size of the [bounding] box within the image, and the **known**

physical box size of that type of object.” EX1007, ¶¶[0021]; *see id.*, ¶[0037] (“calculating the noisy estimate 309 may include using ... the size of the bounding box within the image, a **known** physical box size of the object of interests type of object”), FIG. 3A. But this disclosure calls for merely using a “known physical size” based on object-type, and fails to teach or suggest **determining** the target type. Specifically, Kumar does not teach or suggest “applying aboard the reference UAV a machine learning model to the captured image for: ... classifying the identified target, including identifying a type of the target.” Petitioners and Dr. Singhose do not argue otherwise. *See Pet.* at 50-68; EX1003, ¶¶ [0157]-[0216].

Moreover, “*a target*” is properly construed as “an object capable of flight, that is targeted.” *See supra* § III. In Pierce and Kumar both, all the targets and potential targets that are disclosed are ground based and incapable of flight. *See* EX1005, ¶¶[0027]-[0028], [0031]-[0032] (disclosing persons, faces, and cars as objects of interest or targets), FIGS. 1-3; EX1007, ¶¶[0019], [0035] (same), FIG. 2.

For the foregoing reasons, Pierce-Kumar does not teach or suggest “*detecting a target in the image by applying a machine learning model*” and “*detect a target in the image*” as Claims 1, 19, and 20 recite.

b “[performing the / perform a] flight control operation”

Petitioners allege that Pierce’s tracking of a target using determined angular and linear velocities teaches the above-identified claim limitation. *Pet.* at 56-60.

This is erroneous because the claim terms “[*performing / perform a*] *flight control operation*” are properly interpreted as “[performing / perform a] flight control operation by the reference aerial vehicle,” *see supra* § III, and neither Pierce nor Kumar teaches a flight control operation performed by a UAV.

Pierce and Kumar may both describe the computation of angular and linear velocities, *see* Pet. at 56-60, but the only processors that Pierce discloses are processor 501 of the neural network system 500 and the processor 601 of the drone system 600. *See* EX1005, ¶¶[0038]-[0045], FIGS. 5, 6. The only processor that Kumar discloses is the processor 401 of its neural network system 400. *See* EX1005, ¶¶[0040]-[0042], FIG. 4. As discussed above, all of these systems are ground-based systems and not on-board a UAV. *See supra* § IV.E.1.a. Therefore, Pierce-Kumar does not teach or suggest “[*performing the / perform a*] *flight control operation*.”

For the foregoing reasons, Claims 1, 19, and 20 are patentable over Pierce-Kumar.

2. Claims 3, 5-9, and 15

Each of these Claims directly or indirectly depends from Claim 1, and as such, is patentable at least because Claim 1 is patentable, as discussed above for Grounds 7 and 8.

Furthermore, Claim 7 and Claim 8 (which depends from Claim 7) are patentable because, as discussed for Ground 3, Kumar does not teach or suggest “*determining the distance to the target based on ... a physical size corresponding to an identified type for the target*” according to a proper interpretation of this claim term. *See supra* §§ III; IV.C.2. To the extent the above-identified claim term / limitation is not construed as Patent Owner proposes, Kumar nevertheless does not provide an enabling disclosure of this claim term. *See supra* § IV.C.2. Pierce does not cure these defects, and Petitioners do not contend that it does. *See Pet.* at 60-66; *see generally*, EX1005; EX1008. Therefore, Claims 7 and 8 are patentable for this additional reason, as well.

F. Grounds 9-14

In challenging Claims 2, 4, 12, 17, and 18 under these grounds, Petitioners rely on Laufer (EX1010), Khan (EX1021), and Hogasten (EX1022), in addition to relying on Pierce-Kumar. *See Pet.* at 68-78. Claims 2, 4, 12, 17, and 18 depend directly or indirectly from Claim 1. EX1001, 31:30-32:30. These dependent Claims are patentable at least because Claim 1 is patentable, as discussed above for Ground 1, and because Laufer, Khan, and Hogasten do not cure the above-discussed defects in Pierce-Kumar. *See generally*, EX1010; EX1021; EX1022; *see also, supra* § IV.A.2 (discussing Laufer in connection with certain limitations of

Claim 1). Petitioners and Dr. Singhose do not contend that Laufer, Khan, and Hogasten cure these defects. *See* Pet. at 68-78; EX1003, ¶¶217-235.

Regarding Claim 12, Petitioners do not allege that Pierce-Kumar teaches or suggests the limitations recited in Claim 12. *See* Pet. at 71. Rather, Petitioners allege that in combination of Pierce-Kumar with Laufer, Laufer teaches the limitations of Claim 12. As such, the discussion of Claim 12 under Ground 1 applies here as well, and for the additional reasons presented in that discussion, Pierce-Kumar in combination with Laufer does not teach or suggest the limitations recited in Claim 12. *See supra* § IV.A.5.

G. Grounds 15-16

In Grounds 15 and 16, Petitioners challenge independent Claims 1, 19, and 20, and dependent Claims 3, 5-9, and 14-16, relying on Sahasrabudhe (EX1025), in addition to relying on Pierce-Kumar. *See* Pet. at 75-80.

1. A POSITA Would Not Combine Pierce-Kumar and Sahasrabudhe

A POSITA would not combine Pierce-Kumar and Sahasrabudhe because, *inter alia*, that combination (“Pierce-Kumar-Sahasrabudhe”) does not provide a reasonable expectation of achieving the claimed invention. *See Intelligent Bio-Systems*, 821 F. 3d at 1367; *Personal Web Technologies*, 848 F. 3d at 993-94; *Belden Inc.*, 805 F.3d at 1073. As discussed below, the reason is Sahasrabudhe

does not cure the defects in Pierce-Kumar that are discussed for Grounds 7 and 8.

See supra § IV.E.1.

Specifically, regarding Claims 1, 19, and 20, Pierce-Kumar does not teach or suggest “detecting a target in the image by applying a machine learning model,” “detect a target in the image,” “*a target*,” and “[*performing / perform a*] *flight control operation*.” *See supra* § III; IV.E.1. Petitioners do not allege that Sahasrabudhe teaches or suggests any of these limitation, *see* Pet. at 75-80, and Sahasrabudhe does not. *See generally*, EX1025. Therefore, a POSITA would have no expectation of success at all by combining Pierce-Kumar and Sahasrabudhe, and would therefore not be motivated to combine these references. *See Intelligent Bio-Systems*, 821 F. 3d at 1367; *Personal Web Technologies*, 848 F. 3d at 993-94; *Belden Inc.*, 805 F.3d at 1073.

2. Claims 1, 19, and 20

As discussed above for Grounds 7 and 8, Pierce-Kumar does not teach or suggest “detecting a target in the image by applying a machine learning model,” “detect a target in the image,” “*a target*,” and “[*performing / perform a*] *flight control operation*.” *See supra* § III; IV.E.1. Petitioners do not allege that Sahasrabudhe teaches or suggests any of these limitation, *see* Pet. at 75-80, and Sahasrabudhe does not. *See generally*, EX1025. As such, Claims 1, 19, and 20 are patentable over Pierce-Kumar-Sahasrabudhe.

3. Claims 3, 5-9, and 14-16

Claims 3, 5-9, and 14-16 depend directly or indirectly from Claims 1, and as such, are patentable at least because Claim 1 is patentable.

Regarding Claims 7 and 8, Sahasrabudhe is silent on “*a physical size corresponding to an identified type for the target*” recited in Claim 7. *See generally*, EX1025. Therefore, Sahasrabudhe does not cure the above-discussed defects in Pierce-Kumar with respect to this claim limitation, i.e., Pierce-Kumar does not teach or suggest this limitation according to its proper interpretation, *see supra* at 35-37, § II.A, and in the alternative, does not provide an enabling disclosure of this limitation. *See supra* at 36-43. Therefore, Claims 7 and 8 are patentable over the Pierce-Kumar-Sahasrabudhe combination for this additional reason, as well.

4. Claim 13

Petitioners do not allege that Claim 13 is rendered obvious by Pierce-Kumar-Sahasrabudhe. *See Pet.* at 75-80. Regardless, Claim 13 is patentable as discussed for Grounds 5 and 7-8, and because Pierce-Kumar is silent on a “*speed adjustment factor [that] is greater for a smaller magnitude of deviation as compared to [that] for a greater magnitude of deviation,*” as Claim 13 recites. *See generally* EX1005; EX1008; *supra* §§ IV.C.2; IV.E.1.

H. Grounds 17-22

In Grounds 17 and 18, Petitioners combine Sahasrabudhe with the Pierce-Kumar-Laufer combination discussed in Grounds 9 and 10. Pet. at 80. In Grounds 19 and 20, Petitioners combine Sahasrabudhe with the Pierce-Kumar-Khan combination discussed in Grounds 11 and 12. *Id.* In Grounds 21 and 22, Petitioners combine Sahasrabudhe with the Pierce-Kumar- Hogasten combination discussed in Grounds 13 and 14. *Id.*

For none of the Grounds 17-22, Petitioners provide any motivation to combine the references in the manner proposed. *See id.* Moreover, Petitioners and Dr. Singhose do not refer specifically to any disclosure in Sahasrabudhe, and instead, refer only to the discussion of the Grounds 9-14. *See id.*; EX1003, ¶¶245-247. Therefore, for the reasons provided in the discussion of Grounds 7-16, the Claims challenged under Grounds 17-22, i.e., Claims 2, 4, 12, 17, and 18 are patentable over the proposed combinations. *See supra* §§ IV.E-IV.G.

In summary, challenged Claims 1-20 are patentable because none of Grounds 1-22 teaches or suggests each and every limitation of these Claims.

V. SECONDARY INDICA OF OBVIOUSNESS

Airspace’s Interceptor UAV (hereinafter “Airspace Interceptor”) was the first fully autonomous artificial intelligence powered interceptor UAV funded by the United States Army and the result of millions of dollars of investment in Airspace

made by the United States Department of Defense (“DoD”). Airspace Interceptor’s advances over existing technology and its ability to, for the first time, autonomously detect and capture unauthorized UAVs thus protecting people and property against the threat of UAVs operated by bad actors, led the Airspace Interceptor to be inducted into the collection of the Smithsonian National Air and Space Museum (“Air and Space Museum”) in Washington, D.C.

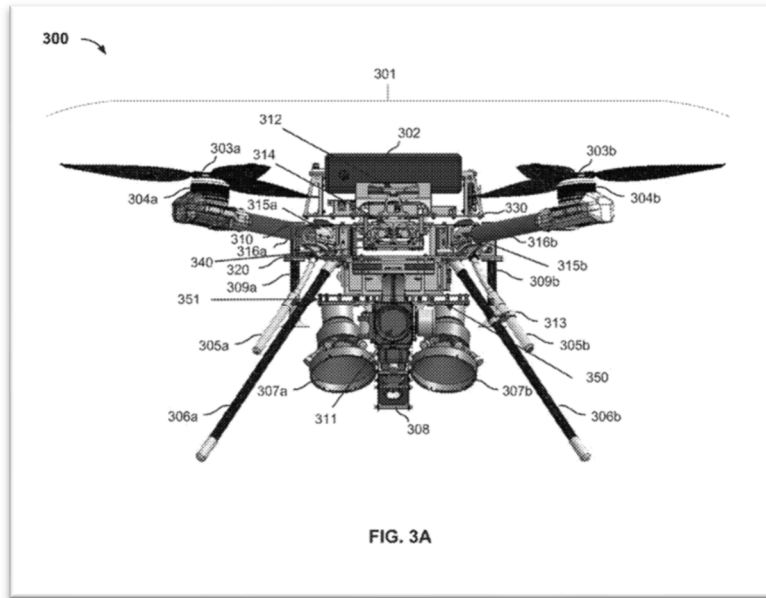
This is no small feat, as the Air and Space Museum has exacting standards that physical items must meet before they are accepted into the Smithsonian’s permanent collection. This unassailable industry praise is highly probative evidence of the fact that the invention of the ’711 Patent, which is embodied in the Airspace Interceptor, is nonobvious. *See Medtronic, Inc. v. Teleflex Life Sciences Limited, IPR2020-01344*, Paper 69, at 15 (P.T.A.B. 2022).

A. The Airspace Interceptor Practices the Challenged Claims of the ’711 Patent

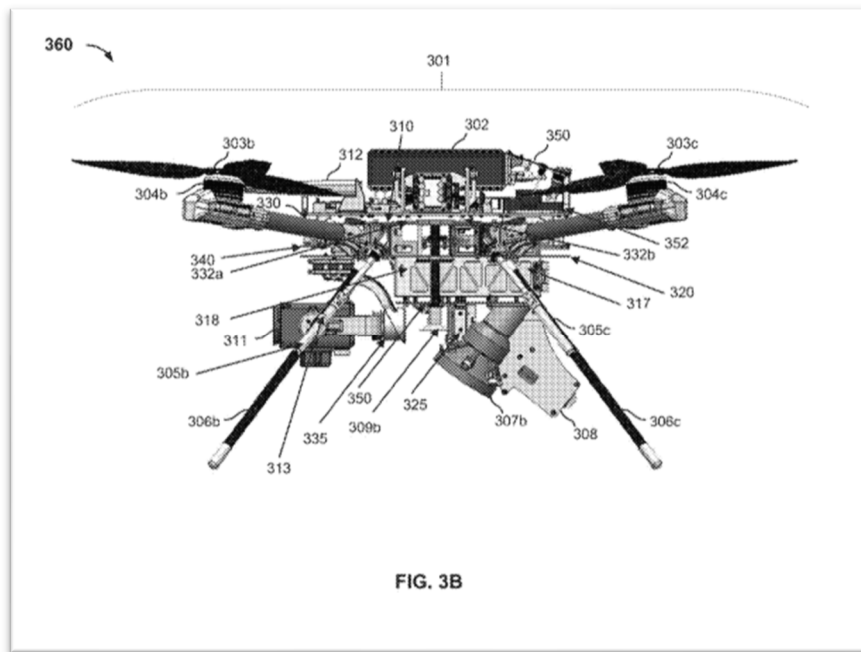
The Airspace Interceptor practices the challenged Claims of the ’711 Patent, and is the invention disclosed and claimed in the ’711 Patent. *See, e.g., EX1001*, 12:47-67, 32:47-33:2 (Claim 20). The Airspace Interceptor is a UAV product designed and developed by Airspace and is capable of autonomous flight to track and fly toward a target UAV not authorized to be operating in a given airspace using machine vision applied to images captured by a camera on the Airspace

Interceptor. EX2013 at 1-2. When an authorized UAV is detected, the Airspace Interceptor can be deployed and fly to the target UAV and capture it using a net fired from the Airspace Interceptor and then transport the unauthorized UAV to a safe location. *Id.*; *see also* EX2014. The Airspace Interceptor was the first UAV product capable of this functionality and thus represented a giant technological leap ahead in the area of autonomous UAV operation. EX2013 at 3.

The Airspace Interceptor is “the invention disclosed and claimed in the ’711 [P]atent.” *See WBIP, LLC v. Kohler Co.*, 829 F.3d 1317, 1331 (Fed. Cir. 2016). Specifically, the Airspace Interceptor is depicted in FIGS. 3A and 3B of the ’711 Patent as an example embodiment of the claimed invention of the ’711 Patent. *See* EX1001, FIGS. 3A, 3B; EX2013 at 3. “FIG. 3A is a diagram illustrating a front view of a UAV in accordance with some embodiments. Unmanned aerial vehicle 301 is an example of UAV 200 of FIG. 2 and/or aerial vehicle 102 of FIG. 1.” EX1001, 9:7-10. FIG. 1 shows “a block diagram illustrating an embodiment of a system for managing an airspace,” where the UAV in FIGS. 3A and 3B is an example of “interceptor aerial vehicle 102.” *Id.*, 3:46-54.



Id., FIG. 3A; *see id.*, 9:7-13:44.



Id., FIG. 3B; *see id.*, 13:45-48 (“FIG. 3B is a diagram illustrating a side view of a UAV in accordance with some embodiments” of the claimed invention of the ’711 Patent); *see id.*, 13:48-15:26.

The Airspace Interceptor depicted in FIGS. 3A and 3B of the '711 Patent is identical to the product of the same name, designed, developed, and currently offered for sale by Airspace. EX2013 at 3. The Airspace Interceptor is also depicted on Airspace's website:



EX2014. The Airspace Interceptor currently depicted on Airspace's website is the same as the interceptor aerial vehicle depicted in FIGS. 3A and 3B of the '711 Patent. EX2013 at 3. Additionally, the Airspace Interceptor practices at least Claims 1, 19, and 20.

As such, because the Airspace Interceptor **is the invention disclosed and claimed** in the '711 Patent and because it practices at least Claims 1, 19 and 20 of the '711 Patent, there exists a nexus between the objective indicia described herein and the claimed invention of the '711 Patent.

B. The Airspace Interceptor Satisfied Previously Unresolved Needs for an Interceptor Aerial Vehicle to Monitor and/or Capture Unauthorized UAVs

The Airspace Interceptor solved a previously unresolved need for an unmanned aerial platform that is able to autonomously interdict UAVs operated by bad actors. As explained in the '711 Patent, “some [UAV] applications may pose a risk to people or property.” EX1001, 3:5-6. For example, “UAVs have been used to carry contraband, including drugs, weapons, and counterfeit goods across international borders.” *Id.* at 3:6-8. The '711 Patent also reflects that “UAVs may be used for voyeuristic or industrial surveillance [purposes, or] to commit terrorist acts such as spreading toxins or transporting an explosive device.” *Id.* at 3:9-11.

The Airspace Interceptor filled the critical need for “[a]n interceptor aerial vehicle [] to monitor and/or capture offending aerial vehicles,” where such a solution did not exist at the time of the claimed invention of the '711 Patent. *See* EX1001, 3:15-16. That is precisely why the DoD funded the development of the Airspace Interceptor. Airspace was awarded millions of dollars in contracts from the Department of Defense to create the Airspace Interceptor, which was the first fully autonomous artificial intelligence powered interceptor UAV funded by the United States Army. The DoD recognized Airspace Interceptor as a “cutting edge counter unmanned aerial system (cUAS) robotic ‘interceptor drone’ . . . capable of finding and defeating adversarial [] Unmanned Aerial Systems (UAS).” EX2013

at 4; EX2001, Article 1, § A. More specifically, DoD specified in its Statement of Work with Airspace that:

Airspace develops cutting edge counter unmanned aerial system (cUAS) solutions. Airspace's robotic 'interceptor drone' physically interdicts, captures, and tows target adversarial drones away for recovery and forensics. The interceptor drone is autonomous and navigates space visually with optical cameras in addition to other drone based sensors. Among its unique capabilities are a "faster than software" smart trigger and Kevlar® capture system.

Airspace's core IP, however, is based on advanced machine vision, high-performance world modeling, advanced sense and avoid capabilities, and agile proximity flight. The Airspace Interceptor is able to detect, track, fly towards, and perform precise proximity maneuvers around target drones in a high speed, complex, and cluttered environment, with fast refresh rates, a high degree of autonomy, and no map. The onboard artificial intelligence (AI) uses advanced data-driven deep learning techniques [] to detect anomalies, classify targets and obstacles, plan and re-plan interception flight paths, position itself in relation to the target, and execute a capture.

EX2001, Article 1, § A.

DoD's significant investment in the development of the Airspace Interceptor was a reflection of the significant advance over previously available technology that the Airspace Interceptor represented. Specifically, the groundbreaking inventions of the '711 Patent that are embodied within the Airspace Interceptor

solved previously unresolved needs for an unmanned aerial platform able to autonomously interdict UAVs operated by bad actors to address continuing domestic and foreign national security interests. *See* EX2013 at 3-4.

C. The Airspace Interceptor Received Industry Praise by Way of Its Acceptance into the Collection of the Smithsonian National Air and Space Museum

The Airspace Interceptor was such a pioneering achievement in aeronautics and the use of artificial intelligence and machine learning in the autonomous operation of UAVs that it was inducted into the collection of the Smithsonian National Air and Space Museum in Washington, D.C. EX2002.

The Smithsonian National Air and Space Museum is exceedingly discerning when evaluating whether an item is of sufficient historical and technological significance to be included in the National Air and Space Museum's collection. The Smithsonian only accepts "donations of objects, archives, and books that hold particular significance to the history of aviation and spaceflight." EX2015. The Smithsonian "rigorously review[s] and carefully consider[s]" all offered donations "to ensure they align with [the Smithsonian's] specific collection goals and rationale." *Id.*

Airspace first offered the Airspace Interceptor to the Smithsonian for addition into its permanent collection in or around February 2023. EX2013 at 4. Following that initial offer, the Smithsonian staff undertook an extensive

evaluation of the historical and technical significance of the inventions embodied within the Airspace Interceptor, including interviews by Dr. Roger Connor, the National Air and Space Museum's curator for the Smithsonian's vertical flight collection (helicopters, gyroplanes, and vertical takeoff and landing aircraft), Army ground force aircraft, remotely piloted and autonomous aircraft systems, and ground effect vehicles. *Id.* at 4-5; *see* EX2016.

Only after months-long evaluation of the technical merits of the Airspace Interceptor, including a detailed discussions of the structure, function, and operation of its pertinent components, and an evaluation and validation of all the material provided to the Smithsonian by Airspace, Dr. Connor and his team determined whether Airspace Interceptor satisfied the Smithsonian's strict criteria,. EX2013 at 4-6. In June 2023, the Smithsonian confirmed that it would accept the Airspace Interceptor into its permanent collection as a result of the technical and historical significance of the device. *Id.* at 6.

The Smithsonian Air and Space Museum aims to curate a "collection of rare and historically significant aircraft and spacecraft." *See* EX2017. The Airspace Interceptor fit perfectly with that description because it was the first fully autonomous artificial intelligence powered interceptor UAV funded by the United States Army that was for the first time able to autonomously track and capture unauthorized UAVs thus protecting people and property against the threat of UAVs

being operated by bad actors. Given its exceedingly strict criteria for donations, acceptance into the exclusive collection of the Smithsonian Air and Space Museum is clear and strong evidence of recognition in the aeronautics industry of the significant technical advances found within the Airspace Interceptor.

These strong secondary indicia demonstrate that the invention of the '711 Patent was non-obvious.

VI. CONCLUSION

For the foregoing reasons, Patent Owner submits that Petitioners do not demonstrate a reasonable likelihood of showing that any of Claims 1-20 are unpatentable. Therefore, Patent Owner respectfully request that the Board deny institution of this IPR.

Dated: July 14, 2025

Respectfully submitted,

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Certificate of Compliance with Word Count

Pursuant to 37 C.F.R. § 42.24(d), I certify that this Patent Owner Preliminary Response complies with the type-volume limits of 37 C.F.R. § 42.24(b)(1) because it contains 13,626 words (excluding the parts of this Patent Owner's Preliminary Response that are exempted by 37 C.F.R. § 42.24(a)), according to the word processing system used to prepare this Patent Owner's Preliminary Response.

Dated: July 14, 2025

Respectfully submitted,

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Certificate of Service

The undersigned certifies that pursuant to 37 C.F.R. § 42.6(e), a copy of the foregoing PATENT OWNER’S PRELIMINARY RESPONSE was served via email on July 11, 2025 (per counsel’s consent) to lead and backup counsel of record for Petitioners as follows:

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