

UNITED STATES PATENT AND TRADEMARK OFFICE

BEFORE THE PATENT TRIAL AND APPEAL BOARD

Wybotics, Co. Ltd. f/k/a Tianjin Wangyuan
Environmental Protection and Technology Co., Ltd.
Petitioner

v.

Zodiac Pool Systems LLC
Patent Owner

Case No. IPR2026-00159
Patent No. 11,262,766

PATENT OWNER'S RESPONSE

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EXHIBIT LIST

No.	Description
2001	Memorandum: “Interim Processes for PTAB Workload Management,” March 26, 2025 (the “Interim Processes Memo”)
2002	Complaint, <i>Zodiac Pool Sys. LLC v. Wybotics, Co. Ltd. f/k/a Tianjin Wangyuan Env’t Prot. & Tech. Co.</i> , No. 2:25-cv-582-JRG-RSP (E.D. Tex. filed May 23, 2025) (the “Texas Litigation”)
2003	First Amended Scheduling Order in the Texas Litigation (Dkt. 53)
2004	First Amended Complaint, <i>Wybotics Inc. v. Zodiac Pool Sys. LLC</i> , No. 2:25-cv-08526 CAS (AGRx) (C.D. Cal. filed Sept. 24, 2025) (the “Petitioner DJ”)
2005	Complaint, <i>Beatbot Tech. (USA) Co. Ltd. v. Zodiac Pool Sys. LLC f/k/a Zodiac Pool Sys., Inc.</i> , No. 3:25-cv-01946 (S.D. Cal. July 31, 2025) (“Beatbot DJ”)
2006	Case Management Order in the Beatbot DJ (Dkt. 18)
2007	IPR2026-00200, Paper 2, Petition for <i>Inter Partes</i> Review of U.S. Patent 11,262,766 (“Beatbot Petition”)
2008	Statistics for Time to Trial – Eastern District of Texas
2009	Proposed Rule by the Patent and Trademark Office on October 17, 2025, 37 CFR 42 (“Proposed Rule”)
2010	U.S. Patent No. 5,613,261 (“Kawakami”)
2011	EP 0687964 A1 (“Giordano”)
2012	Chart Comparing the Petition to the Declaration
2013	FAQs for Interim Processes for PTAB Workload Management (“FAQs”)
2014	June 4, 2024, Letter from Zodiac to Wybotics
2015	Application Proof of Wybotics Co., LTD
2016	U.S. Patent No. 7,398,138 (“Emery”)
2017	Prosecution History of U.S. Patent No. 9,388,595
2018	FAQs for Interim Director Discretionary Process
2019	U.S. Patent No. 9,388,595 (“the ’595 Patent”)
2020	<i>Wybot M2</i> , WYBOT, https://www.wybotpool.com/pages/wybot-m2 (last visited Aug. 10, 2026)

2021	<i>WYBOTICS Unveils Groundbreaking WYBOT M2 at CES 2024: World's First Cordlessly Self Docking Pool Cleaning Robot with Underwater Vision Recognition</i> , PR Newswire (Jan. 16, 2024), https://www.prnewswire.com/news-releases/wybotics-unveils-groundbreaking-wybotm2-at-ces-2024-worlds-first-cordlessly-self-docking-pool-cleaning-robot-withunderwater-vision-recognition-302035728.html
2022	Wybotics HK IPO Application Proof, Apr. 24, 2024
2023	Jonathan Horgan & Daniel Toal, Computer Vision Applications in the Navigation of Unmanned Underwater Vehicles, IntechOpen (Jan. 1, 2009) (refiled version of Ex. 1026)
2024	Rafael Garcia, Tudor Nicosevici and Xevi Cufi, On the Way to Solve Lighting Problems in Underwater Imaging, Computer Vision and Robotics Group, IEEE (2002)
2025	Raimondo Schettini and Silvia Corchs, Underwater Image Processing: State of the Art of Restoration and Image Enhancement Methods, EURASIP Journal on Advances in Signal Processing Volume 2010, Article ID 746052 (Feb. 2, 2010)
2026	Evan Ackerman and Erico Guizzo, iRobot Brings Visual Mapping and Navigation to the Roomba 980, IEEE Spectrum (Sept. 16, 2016) available at https://spectrum.ieee.org/irobot-brings-visual-mapping-and-navigation-to-the-roomba-980
2027	Davidson et al., MonoSLAM: Real-Time Single Camera SLAM, IEEE Transactions on Pattern Analysis and Machine Intelligence (Volume: 29, Issue: 6, June 2007)
2028	Rachel Metz, The new Roomba uses AI to avoid smearing dog poop all over your house, CNN (Sept. 9, 2021) available at https://www.cnn.com/2021/09/09/tech/roomba-ai-avoids-dog-poop/index.html
2029	Brian Heater, iRobot's new Roomba knows where it's going, TechCrunch (Sept. 5, 2018) available at https://techcrunch.com/2018/09/05/irobots-new-roomba-knows-where-its-going/
2030	Expert Declaration of Dr. Hagen Schempf
2031	Curriculum Vitae of Dr. Hagen Schempf

I. INTRODUCTION

Zodiac Pool Systems LLC (“Zodiac” or “Patent Owner”) submits this Response to Petitioner Wybotics, Co. Ltd.’s (“Wybotics” or “Petitioner”) petition for inter partes review of U.S. 11,262,766 (the “’766 Patent” or “the Challenged Patent”).

The Challenged Claims recite a novel and non-obvious autonomous swimming pool cleaner that uses cameras to detect dirt in the pool and take images of it, and which images are used to direct the autonomous pool cleaner toward that dirt. None of Petitioner’s cited prior art discloses this concept.

The Petition begins with a flawed challenge of purported anticipation. But the cited reference—Fu—is deficient, and the Petition tacitly acknowledges as much by presenting fallback obviousness grounds. Fu does not anticipate any claim. Petitioner does not cure Fu’s deficiencies through citations to a secondary reference that discloses neither a camera that is capable of capturing an image of the bottom of the swimming pool nor a filter that retains debris.

Petitioner’s other obviousness challenges are based on an inapposite application of unrelated art from the much different design space of “Roomba” style terrestrial robotic vacuums. Such devices are expressly for use out of water, and none of their features are applicable to underwater designs, as Patent Owner’s technical expert Dr. Hagen Schempf explains in detail. In contrast to Dr. Schempf, Petitioner’s

expert, Dr. Reinholtz, simply repeats the Petition's speculative arguments without providing further detail or explanation. The Federal Circuit has consistently rejected such unsupported and conclusory obviousness challenges.

The Petition fails to carry its burden, and the Board should affirm the patentability of the Challenged Claims.

II. EXPERT TESTIMONY

This Response is supported by expert testimony of Dr. Hagen Schempf (Ex. 2030), who has decades of experience in the relevant technology area. Dr. Schempf has a bachelor's degree in mechanical engineering from the Stevens Institute of Technology. Ex. 2030, ¶5. He received a master's from MIT, and in 1990, a Ph.D. in mechanical and oceanographic engineering from MIT and Woods Hole Oceanographic Institution (WHOI). *Id.*

Dr. Schempf began his career developing deep ocean underwater robots for open-ocean exploration. *Id.* ¶6. Dr. Schempf applied mechanical, electrical, and software skills to develop those robots. *Id.* At MIT and WHOI, Dr. Schempf developed underwater robotic platforms, remotely operated vehicles (ROVs), closed-loop underwater navigation, and underwater camera system integration as part of his tenure. *Id.* Then, Dr. Schempf developed industrial automation and robotic systems for factory automation. *Id.*, ¶8.

As a Director of the Professional Master's Degree in Robotics, Dr. Schempf taught courses in Mechanical and System Engineering, focusing on robotics and intelligent systems development. *Id.*, ¶11. He also developed a robotics teaching laboratory. *Id.* Dr. Schempf has led teams of graduate students in the development of prototype robotic systems, to conceive and develop commercially viable autonomous robotic systems. *Id.*, ¶12. Some examples of applications include law and professional sports-field maintenance and aerial agricultural assessment platforms. *Id.*

As Dr. Schempf explains, a person of ordinary skill in the art ("POSITA") of the Challenged Patent would have a bachelor's degree in mechanical or electrical engineering or a related field, and two years of experience in designing and developing robotic pool cleaners or similar products, with additional experience substituting for education and vice versa. *Id.*, ¶39.

In contrast to Dr. Schempf's testimony and as demonstrated in Patent Owner's Comparative Chart (Ex. 2011), vast portions of the declaration of Petitioner's expert Dr. Reinholtz (Ex. 1010) duplicate the Petition verbatim. Unlike Dr. Schempf, Dr. Reinholtz offers no independent technical reasoning, no calculations, and no secondary evidentiary support to substantiate his conclusory assertions.

III. STATE OF THE ART AS OF JULY 10, 2012.

The earliest claimed priority date of the Challenged Patent is July 10, 2012, which Petitioner does not dispute. At that time the availability of autonomous pool-cleaning robots was much different than today. This difference is reflected in the references on which the Petition attempts to apply to the Challenged Claims.

A. Pool Cleaning Robots.

Maintaining the cleanliness of swimming pools has historically posed significant challenges. Ex. 1003, 1:24–29. Manual cleaning of the floor and sides of a swimming pool is often tedious, time-consuming, and labor-intensive. As a result, automated robotic pool cleaners were developed to alleviate this burden and improve the efficiency of pool maintenance. *Id.* As of July 10, 2012, conventional automated pool cleaners navigated pool surfaces blindly, either through purely random “bounce” patterns or pre-programmed geometric paths. While such automated pool cleaners offered improvements over manual methods, ensuring that all portions of a pool’s submerged surfaces were satisfactorily cleaned remained a challenge. *Id.* Moreover, these systems typically lacked the ability to provide monitoring to verify cleaning coverage, making it difficult for users to determine whether additional cleaning was necessary. *Id.*

The Challenged Patent addresses these challenges and claims a novel and nonobvious pool cleaning system using “a self-propelled pool cleaner” with a “filter

configured to retain the debris collected from the submerged surface,” and “at least one camera to capture imagery of the pool surface.” *Id.*, 1:33–48. A controller, in electronic communication with the camera, processes the captured imagery and generates control signals in response to the captured image to direct the movement of the body “within the swimming pool to, or away from, the first portion of the submerged surface.” *Id.* Unlike prior art random-walk or dead-reckoning systems, the claimed cleaner utilizes closed-loop visual feedback to dynamically steer the cleaner relative to specific imaged portions of the pool floor. For example, controller may identify debris and direct movement of the pool cleaner towards the debris based on that identification.

B. Camera Technology and the Use of Cameras in Underwater Environments as of July 10, 2012.

Camera use underwater, let alone underwater navigation and feature-recognition, was not yet fully developed, much less commercially available as of July 10, 2012. Ex. 2030, ¶56. Underwater camera imaging presents significantly more challenges than camera imaging in air, as there are fundamental physical and optical incompatibilities between air-medium and underwater cameras. *Id.*, ¶¶57–58.

As Dr. Schempf explains, capturing images through air versus capturing images through a turbulent, refracting liquid medium are fundamentally distinct optical engineering domains. *Id.*, ¶¶57–67. In air, light rays travel in substantially

straight lines, subject to minimal scattering or attenuation. *Id.*, ¶63. Underwater, however, camera systems face severe physical constraints. *Id.*, ¶57. Specifically, Dr. Schempf explains that “image quality is affected by lack of distinguishable seafloor ... features, the need for artificial light, water clarity, turbidity, depth, surface conditions, scattering, attenuation, image distortion, and image-processing limitations.” *Id.* (citing Ex. 1026, 197 (refiled as Ex. 2023))¹. Backscatter can result in bright specks on the image, i.e., marine snow, and backscatter and forward scatter together affect image contrast and blur object edges. *Id.*, ¶58. “[A]bsorption and attenuation reduce the effective range of underwater vision systems and that refraction at water/glass and glass/air interfaces can produce non-linear image deformation requiring calibration.” *Id.*

Shallow water also presents high levels of difficulty. Light (i.e., sun rays) is refracted by the water with irradiance irregularly concentrated in some portions of the image and not others, including shadowing. *Id.*, ¶61. The shadowing may occur quickly, as wind or human presence may change the visibility underwater in seconds. *Id.* Absorption and scattering “generate some problems in underwater images, such as blurring of image features, limited range, clutter and lack of structure in the

¹ As explained by Dr. Schempf, this survey paper provided examples of deep-water applications, where surface lighting is not relevant, whereas in pool-level water imaging, surface lighting has a large impact on the clarity of the image captured. *Id.*, ¶59 (citing Ex. 1026, 197 (refiled as Ex. 2023)).

regions of interest.”” *Id.*, ¶60 (quoting Ex. 2024, 1018). Therefore, a POSITA would recognize the need to address “shadowing due to uncontrollable [] location and intensity of pool-external light-sources (sun, perimeter-lights, etc.) and their effects on submerged pool-surface shadows generated by pool-edges, pool-external structures, environmental conditions, and floating debris/toys.” *Id.*, ¶61. This complexity further increases the barriers associated with underwater images. *Id.*, ¶62.

Prior to July 10, 2012, underwater cameras resulted in images with poor visibility “because light is exponentially attenuated as it travels in the water and the scenes result poorly contrasted and hazy.” *Id.*, ¶63. Thus, the water would degrade the image quality compared to images taken in air. *Id.* The image processing community recognized the challenges of obtaining clear images in underwater settings. *Id.*, ¶64. “[E]xisting [] algorithms were still not robust enough” for application with guaranteed success, “requiring additional testing and evaluation, implying that a successful implementation was not necessarily guaranteed.” *Id.*, ¶66. Contrary to Petitioner’s assertion that underwater image processing was a plug-and-play function, contemporary literature confirms that this was not the case but rather an unsolved engineering challenge that required specialized optical housings, custom illumination geometry, and complex calibration. *Id.*, ¶60.

Indeed, the prior art cited in the Petition highlights these exact physical barriers. Benzler explicitly acknowledges that an optical camera cannot distinguish a submerged pool cleaner against the reflective blue water surface, forcing Benzler to rely on a surface float extending out of the water rather than capturing images of the pool-floor. Ex. 1013, [0029]. Similarly, Schnittman discloses a dry-land vacuum cleaner operating exclusively in an air medium. *See* Ex. 1008. A POSITA would recognize that placing Schnittman's air-calibrated optical sensors underwater would introduce severe multi-interface refraction, attenuation, and backscatter, rendering its camera unable to distinguish surface features without extensive, unguided re-engineering, assuming such air-calibrated optical sensors would function at all if immersed in water. Ex. 2030, ¶¶58, 149.

Lastly, the use of underwater cameras required specialized hardware and software, each tailored to a particular narrow task. *Id.*, ¶56. And that specialized hardware and software could still fail unless conditions were ideal. *Id.* As of July 10, 2012, a POSITA would recognize that camera functionality underwater faced major challenges, requiring extensive experimentation and testing, and very likely would not be functional at that time given the state of the art. *Id.*

C. Land-Based Cleaning Robots Were Not Designed or Available for Use in Underwater Environments and Constitute Non-Analogous Art.

Hardware and software requirements differ fundamentally for terrestrial and underwater contexts; therefore, terrestrial cleaning robots are specifically designed for their environment and are not available for or adaptable to underwater use. Terrestrial cleaning robots are not designed to address the specific design challenges faced by robotic pool cleaners, including “the buoyancy, traction, hydrodynamic forces, water-flow resistance, debris transport (and dispersion/disturbance) in a liquid medium, debris retention, and reliable surface contact on pool floors and walls.” Ex. 2030, ¶54. As Dr. Schempf describes, the “robotic pool-cleaner hardware had to integrate mobility, surface-adhesion and -traction, fluid handling, and cleaning functions in a submerged environment on a singular platform,” all of which would need to be addressed to convert a terrestrial cleaning robot to exhibit the disclosures in the Challenged Patent. *Id.* As one of many examples, the terrestrial cleaning robot would have to include vehicle propulsion along a submerged surface, vacuum propulsion, or liquid jets, something that terrestrial robots neither incorporate nor require. *Id.*

The history of terrestrial cleaning robots illustrates the challenges associated with modifying terrestrial robots for land use. For example, in 2015 iRobot Roomba,

the assignee of Schnittman, only had a camera that could point forwards and upwards, not towards the ground as a pool-cleaning robot requires. *Id.* ¶69.

Six years later, in 2021, iRobot released a “real-time floor-located obstacle and ‘object’ detection capability in a leading floor-cleaning system.” *Id.* ¶71. This extensive development timeline indicates that the amount of testing, experimentation, and financial burden is very high to modify a terrestrial cleaning robot for improved terrestrial use. *Id.* ¶72. A POSITA would be aware of the complexity in autonomous robot design and they would not consider modifying a terrestrial robot—e.g., a robotic vacuum such as a “Roomba”—for underwater use, which would introduce even more complexity. *Id.*

D. Summary of Ex. 1007, CN 101139007 B (“Fu”).

Fu describes “an underwater cleaning robot.” Ex. 1007, Abstract. Fu describes that in operation its robot includes two working modes, “remote control and autonomous control.” *Id.* at Abstract. Fu does not describe a robot that controls its location or directional movement using input from a camera. Rather, Fu’s “underwater cleaning robot ensures autonomous navigation and operation through dead reckoning, using its installed inertial navigation components and the encoders of the four cleaning driving wheels 3.” Ex. 1007, [0026]. Further “[w]hen the robot performs cleaning tasks underwater ... it uses the inertial navigation components

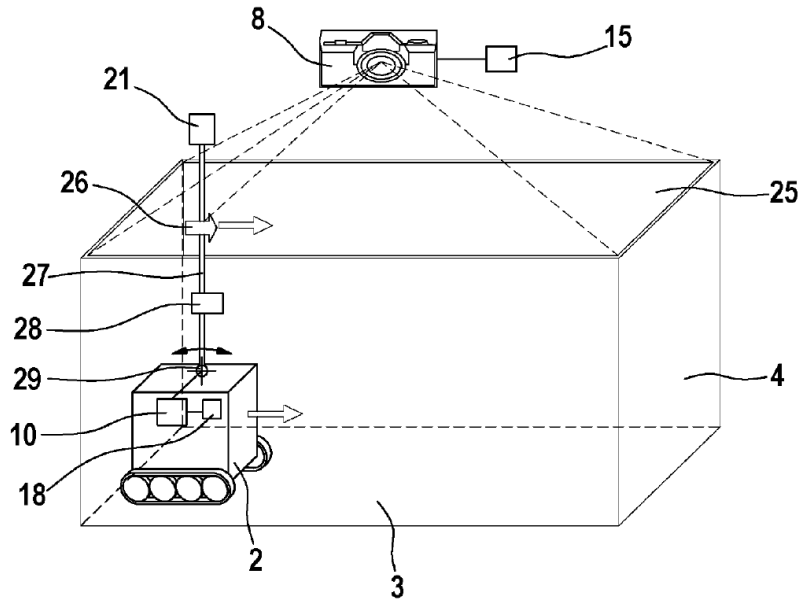
and the cleaning driving wheels 3 to perform dead reckoning to obtain its position information.” Ex. 1007, [0026].

Fu never explains that it somehow controls its robot’s position or location based on guidance from a camera. Rather, Fu uses image comparison against a “cleanliness image threshold” solely to adjust cleaning intensity via wheel-speed differentials, while the robot continues along a preset dead-reckoning path. Ex. 1007, [0026]. Similarly, Fu does not include any description of the filter used by its robot, beyond stating that it includes “a water flow filter screen (23)” (*id.* at 2) that “is fixed within the water flow channel and, together with the inner wall of the robot housing and the driving and control sealed housing, divides the water flow channel into two parts.” *Id.*, [0005]. Fu never describes that its filter is “configured *to retain debris* collected from the submerged surface,” as is required by the Challenged Claims.² Instead, Fu relies on an anti-backflow flap (25) at the water inlet (26) to prevent water and debris from flushing back out of the water flow channel (24) when pump suction ceases. Ex. 1007, [0005], [0026]. Fu discloses no filter structure that itself retains debris.

² All emphasis added unless otherwise noted.

**E. Summary of Ex. 1013, U.S. Patent Pub. No. 2010/0299016
("Benzler").**

Benzler describes a pool-based cleaning robot. Benzler's pool robot, as shown in Figure 3, relies exclusively on an external camera 8 positioned outside of the pool, and not mounted to the cleaning robot. Ex. 1013; fig. 3, [0010].



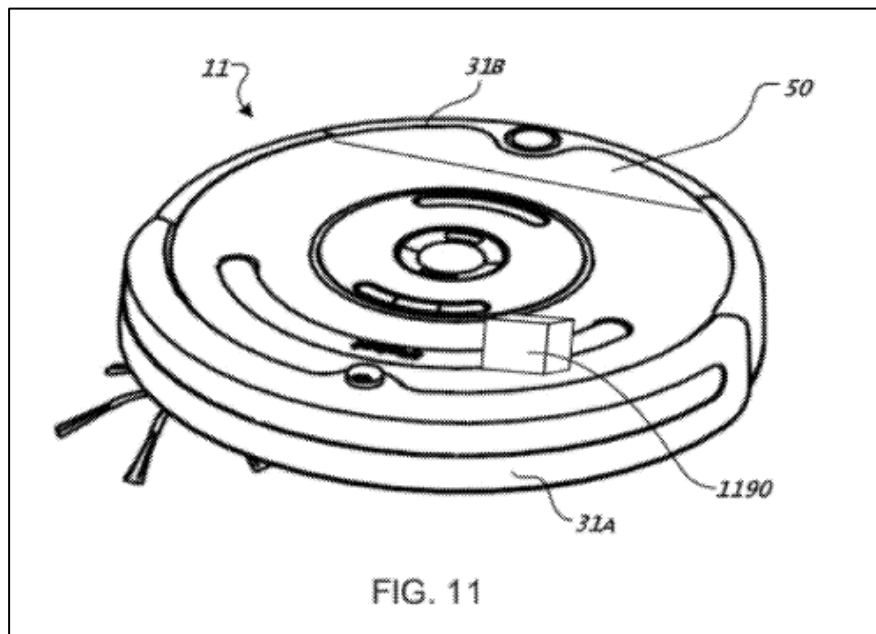
Benzler is explicit that its external color camera cannot “distinguish the robotic vehicle from the environment, in particular from the blue and reflecting water surface,” i.e., the color camera cannot distinguish the pool cleaner from any other object—including dirt and other debris—on the bottom of the pool. Ex. 1013, [0029]. Instead, the pool-robot is connected to a “swimmer [carried] along on a rod, in particular a telescope rod that is pivoted. The swimmer is preferably movable relative to and along the longitudinal direction of the rod.” *Id.*, [0029]. Rather than capturing the robot’s location, or any image of the submerged floor surface, Benzler

explains instead that the “camera 8 ... continuously detects the position of the swimmer.” *Id.*, [0050].

Benzler discloses no onboard camera, nor does its pool embodiment ever capture or classify images of the submerged pool floor to guide movement. Benzler similarly does not include any description of any filter used by the pool-based cleaning robot, much less a filter that is “configured *to retain debris* collected from the submerged surface,” as is required by the Challenged Claims.

F. Summary of Ex. 1008, U.S. Patent Pub. No. 2012/0169497 (“Schnittman”).

The only embodiments described in Schnittman are terrestrial (“dry” or “out-of-the-water”) designs of an iRobot-Roomba style robot-vacuum. *See, e.g.*, fig. 11:



Indeed, Schnittman is a published version of what ultimately issued as US 8,742,926, which states on its face that is assigned to the maker of Roomba, iRobot Corp.

(12) United States Patent Schnittman et al.		(10) Patent No.: US 8,742,926 B2	
		(45) Date of Patent: Jun. 3, 2014	
(54) DEBRIS MONITORING		(56) References Cited	
(75) Inventors: Mark Steven Schnittman , Somerville, MA (US); Michael Todd Rosenstein , Westford, MA (US)		U.S. PATENT DOCUMENTS	
(73) Assignee: iRobot Corporation , Bedford, MA (US)		4,401,909 A 8/1983 Gorsek	
(*) Notice: Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 85 days.		4,674,048 A 6/1987 Okumura	
		4,918,441 A 4/1990 Bohman	
		4,920,605 A 5/1990 Takashima	
		4,961,304 A 10/1990 Ovsborn et al.	
		5,023,788 A 6/1991 Kitazume et al.	
		5,109,566 A 5/1992 Kobayashi et al.	
		5,163,202 A 11/1992 Kawakami et al.	
		5,216,777 A 6/1993 Moro et al.	
		5,233,682 A 8/1993 Abe et al.	
		5,251,358 A 10/1993 Moro et al.	
		5,284,522 A 2/1994 Kobayashi et al.	
(21) Appl. No.: 13/340,784		(Continued)	
(22) Filed: Dec. 30, 2011		FOREIGN PATENT DOCUMENTS	
(65) Prior Publication Data			
US 2012/0169497 A1 Jul. 5, 2012		EP 1331537 A1 7/2003	
		EP 1836941 9/2007	

Schnittman never describes any embodiment that is submersible or even for use in a wet or aquatic environment. Rather, Schnittman is limited to a terrestrial robot vacuum for use in dry environments. Accordingly, Schnittman discloses no pool cleaner structure, no underwater filtration mechanism, and no camera capable of capturing an image of a submerged surface in a liquid medium. Ex. 1008, fig. 11, [0204]–[0205], [0248]. Nor could a POSITA modify Schnittman to include any of these.

IV. **GROUND 1a: FU DOES NOT ANTICIPATE CLAIMS 1–4.**

Anticipation under 35 U.S.C. § 102 requires that a single prior art reference disclose each and every limitation of the claimed invention, expressly or inherently, arranged as in the claim. *Verdegaal Bros. v. Union Oil Co. of Cal.*, 814 F.2d 628, 631 (Fed. Cir. 1987); *Connell v. Sears, Roebuck & Co.*, 722 F.2d 1542, 1548 (Fed.

Cir. 1983); *Richardson v. Suzuki Motor Co.*, 868 F.2d 1226, 1236 (Fed. Cir. 1989).

Petitioner fails to meet this high burden.

A. Fu Does Not Anticipate the Controller Limitation.

The Challenged Claims recite that the claimed “pool cleaner” comprises “a controller ... configured to generate, in response to the captured image [of at least a first portion of the submerged surface], at least one control signal to cause movement of the body within the swimming pool to, or away from, the first portion of the submerged surface.”³ The Petition fails to demonstrate that Fu discloses this limitation.

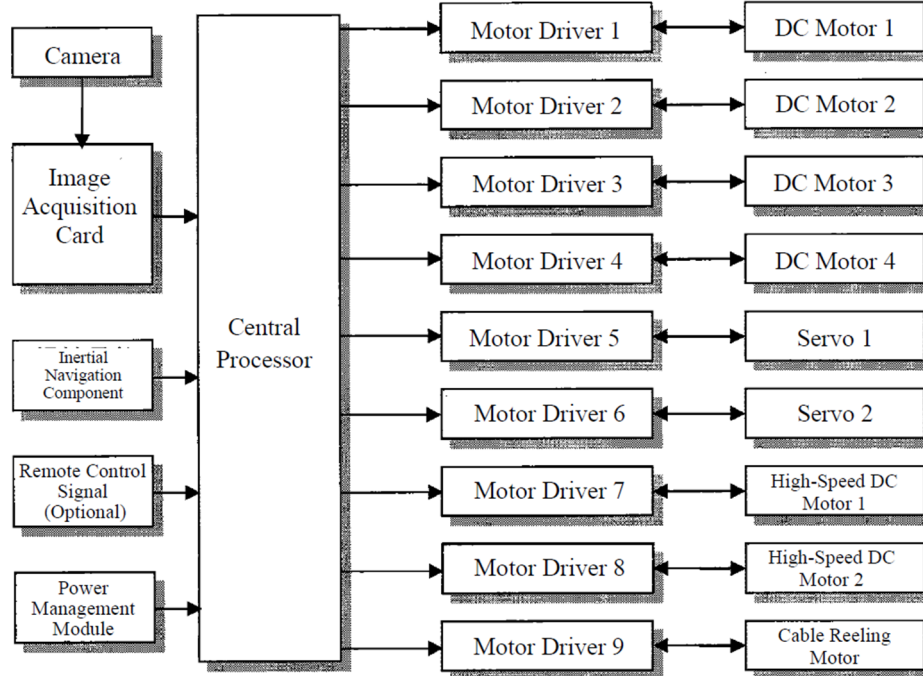
Fu describes an “underwater cleaning robot that performs a pre-set cleaning path.” Ex. 2030, ¶90. Fu’s spatial movement is controlled entirely by dead reckoning via wheel encoders and inertial sensors, while camera imagery is used solely to adjust cleaning intensity (wheel speed differentials) along that pre-set path. *Id.*, ¶¶100–01; Ex. 1007, [0026].

³ Claim 3 recites “a controller ... configured to generate, in response to *at least one of the captured image or information from the portable electronic device*, at least one control signal to cause movement of the body within the swimming pool to, or away from, the first portion of the submerged surface.”

**i. Fu Determines and Controls Its Location Based On
“Inertial Navigation” and “Dead Reckoning,” Not Camera
Guidance.**

The Petition points to Fu’s central processor and argues that “[b]ased on the captured image, ‘control signals are generated by the central processor, which autonomously plans paths and actions ... to drive the robot’s execution layer [*i.e.*, motor drivers that drive wheels 3] and complete the underwater cleaning task.’” *See e.g.*, Pet. at 19. This fundamentally misreads the express disclosure of Fu, which explains that Fu determines its positioning based on “dead reckoning.”

Fu explains that “[t]he underwater cleaning robot ensures autonomous navigation and operation through *dead reckoning, using its installed inertial navigation components* and the encoders of the four cleaning driving wheels 3.” Ex. 1007, [0026]. Further “[w]hen the robot performs cleaning tasks underwater ... it uses the *inertial navigation components* and the cleaning driving wheels 3 to perform *dead reckoning to obtain its position information.*” Ex. 1007, [0026]; [0011] (“When the robot performs cleaning tasks underwater with the cable, it uses the inertial navigation components and the cleaning driving wheels to perform dead reckoning to obtain its position information.”).



Ex. 1007, fig. 6 (showing the camera and image acquisition card (the “environmental perception layer”) as separate from the inertial navigation component).

Fu never explains that it guides its position or location based on guidance from a camera. Critically, as Dr. Schempf explains, dead reckoning, which is the process of calculating an object’s current position by using a previously known position and advancing it based on speed estimates, direction, and elapsed time, “fully depends on internal evidence, so the navigational movements are not determined by any external evidence, such as images captured by the camera.” *Id.*, ¶101. Fu’s dead reckoning uses the “installed inertial navigation components and the encoders of the four cleaning driving wheels.” Ex. 1007, [0026]. Fu’s navigational movements are determined by internal programming and encoders found on the wheels to determine the robot’s location. These movements are neither generated in response to the

captured image, nor are they directed “to, or away from” any imaged portion of the pool floor. Ex. 2030, ¶¶99–101.

Fu’s disclosure is in direct contrast to Petitioner’s assertion. Fu’s “four independent cleaning driving wheels 3 are controlled by their *respective motor drivers*.” Ex. 1007, [0025]. Those motor drivers depend on the inertial navigation components and dead reckoning to obtain position information—that movement of the robot is not determined by the images captured by the camera. *See* Ex. 1007, [0026].

ii. Fu Uses Its Cameras to Determine a “Cleanliness Image Threshold,” Which Is Used to Determine the Intensity of Cleaning, Not the Robot’s Positioning or Guidance.

Fu describes that “in conjunction with a preset cleaning task,” its central processor “autonomously plans paths and actions based on perceived environmental information and its own position and attitude information” “to drive the robot’s execution layer and complete the underwater cleaning task.” Ex. 1007 [0008]. A preset cleaning task does not depend on identifying dirt and directing the robot to the dirty area. Instead, a preset cleaning task follows a previously set travel path and may modify its cleaning intensity as it encounters dirt along said path. Fu does not disclose that the robot drives “to, or away from” a first portion (or any area based on debris); rather, Fu describes that based on the environmental information, its robot

modifies cleaning intensity as it completes the preset underwater cleaning task. Ex. 1007 [0008]; Ex. 2030, ¶¶95–98.

Fu makes clear that completion of this cleaning task does not involve camera-based guidance of the location of the robot. Instead, the robot is controlled by “autonomous navigation and operation through dead reckoning, using its installed inertial navigation components and the encoders of the four cleaning driving wheels 3.” Ex. 1007, [0026]. Rather than generating control signals to guide spatial movement relative to an imaged floor region, information from Fu’s camera is solely used to control the scrubbing intensity of the cleaning along that preset dead reckoning route based on a “pool cleanliness image threshold.” Ex. 2030, ¶¶95–98.

As Fu explains, “[d]uring the autonomous cleaning process, a pool cleanliness image threshold is set. The robot uses its monitoring cameras 2 to capture images of the pool floor and compares them with the threshold to determine the level of cleanliness.” Ex. 1007, [0026]. The very next sentence then explains that the robot “plans its *cleaning movements* and adjusts the *working state of the four cleaning driving wheels* 3 and the water discharger to complete the cleaning task.” *Id.* The wheel speeds determine the cleaning “intensity.” *Id.*

By using different combinations of wheel speeds, cleaning actions of varying intensity can be achieved. For example, if the front wheels rotate quickly clockwise and the rear wheels rotate slowly counter-clockwise, the underwater cleaning robot will advance in the direction determined by the clockwise rotation of the front wheels, but the cleaning intensity in this case will be much greater than if the rear

wheels were rotating clockwise. At the same time, adjusting the discharge position and direction of the water outlet 10 and the speed of the drainage propeller 11 can also change the cleaning intensity, making the robot's work more efficient.

Ex. 1007, [0026]. Thus, Fu's environmental perception layer—the camera and image acquisition card (*id.*, [0007])—controls and determines the cleaning intensity of the robot; it does not steer the robot “to, or away from” a specific floor region. Ex. 2030, ¶¶95–98, 102.

Petitioner cherry-picks language from Fu, and in so doing ignores Fu's full context. For example, Fu states:

[i]n said autonomous mode, control signals are generated by the central processor, which autonomously plans paths and actions based on information from the environmental perception layer and its own attitude and positioning layer, in conjunction with a preset cleaning task, to drive the robot's execution layer and complete the underwater cleaning task.

Ex. 1007, [0025]. Petitioner rewrites this sentence as “[I]nformation from the environmental perception layer,’ *i.e.*, image captured by the monitoring cameras 2, is expressly identified as the basis upon which ‘control signals are generated by the central processor ... to drive the robot[.]’ in the autonomous mode. *Id.*, [0025].” Pet. at 19. Petitioner misconstrues Fu to claim that the environmental perception layer generates control signals to steer the robot. This is not what Fu discloses. Instead, Fu describes that in autonomous mode, the central processor generates control signals, *i.e.*, cleaning intensity, based on the environmental perception layer, in

conjunction with the preset cleaning task and completes that cleaning task. Ex. 1007, [0025].

Petitioner’s contention that Fu’s environmental perception layer influences where the robot goes is incorrect, as the environmental perception layer has no impact on the spatial navigational movements of the robot. Ex. 2030, ¶¶102–03. The environmental perception layer merely helps determine, based on the level of cleanliness identified by the cameras, the robot’s cleaning intensity—achieved by different combination of wheel speeds—before and while the robot embarks on its preset cleaning path, as controlled by dead reckoning. *Id.*, ¶101; Ex. 1007, [0026].

iii. Dr. Reinholtz Merely Parrots the Petition and Thus His Testimony Should Be Given No Weight.

Dr. Reinholtz adds nothing independent to the Petition’s analysis. Instead, he parrots the Petition almost word-for-word. *See* Ex. 2011. Such conclusory testimony should be afforded no weight, to the extent it is even accepted, as it provides no helpful analysis, factual support, or explanation on which the Board can rely. Ex. 1010, ¶248; *see MarkForged Inc. v. Continuous Composites, Inc.*, IPR2022-01431, Paper 7, at 14 (P.T.A.B. Jan. 18, 2023) (“[Expert’s] declaration testimony ... is entitled to little to no weight as it merely parrots the Petition.”); *Xerox Corp. v. Bytemark, Inc.*, IPR2022-00624, Paper 9, at 15 (P.T.A.B. Aug. 24, 2022) (precedential).

Nothing in Fu discloses that Fu’s robot moves “to, or away from” a specific location or imaged portion in the pool. Rather, Fu’s spatial navigational movements are controlled entirely by dead reckoning—via inertial navigation components and wheel encoders—along a preset cleaning path, independent of camera imagery. At most, Fu’s environmental perception layer determines cleaning intensity along that preset path. Because Fu fails to disclose camera-based spatial guidance, Petitioner’s anticipation ground fails.

B. Fu Does Not Anticipate the Claimed Filter.

The Petition asserts that this limitation is somehow met by Fu’s filter screen 23 coupled with an anti-backflow device 25 installed above water inlet 26. *See* Pet. at 14–15. The Petition fails to show Fu anticipates “*a filter configured to retain debris* collected from the submerged surface,” as is required by the Challenged Claims. Instead, Petitioner impermissibly conflates distinct structural components of Fu’s fluid path—a mesh divider and a check-valve flap—to fabricate a “filter” that Fu does not disclose.

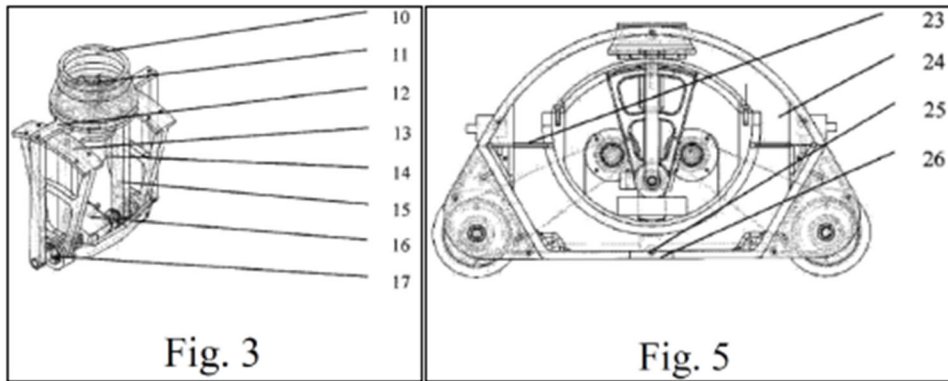
i. The Petition Points to a “Drainage Mechanism” As Retaining Debris Rather than the Claimed Filter.

Attempting to satisfy element 1[c], Petitioner describes how the “‘drainage mechanism’ is designed to draw in pool water, filter out debris from the water, and discharge the filter water while retaining the debris.” Pet. at 14. The Petition further urges that “the debris is retained within water flow channel 24,” not the filter. Pet. at

1. Thus, at the outset, the Petition acknowledges “debris ... is retained within the water flow channel 24.” *Id.* But this is not sufficient. The claim does not require debris be “retained in the water flow channel 24.” Instead, the claim requires “*a filter configured to retain debris.*”

In pool cleaner technology, a “filter” is a discrete structural component (such as a filter basket, bag, or canister) designed to capture and hold debris. Ex. 2030, ¶84. In Fu, the “filter screen 23” is merely a planar mesh divider that splits water flow channel 24 into two halves. The structure that actually prevents debris from returning to the pool upon pump shutdown is the mechanical anti-backflow flap 25 at the bottom water inlet 26. An anti-backflow flap (a check-valve) and an elongated fluid conduit (water flow channel 24) are structurally and functionally distinct from a “filter.” Petitioner cannot satisfy its burden of proving anticipation by lumping distinct structural elements of Fu’s flow path together and labeling the entire assembly a “filter.”

The Petition’s cites to Figures 3 and 5 confirm the fault in its analysis. Pet. at 14.



Ex. 1007, figs. 3 & 5.

Figure 3 does not show a “filter” or even the “filter screen 23.” Instead, Figure 3 is a schematic diagram of the “water discharger, wherein 10 – water outlet, 11 – drainage propeller, 12 – water outlet bracket, 13 – water outlet mounting frame, 14 – drainage propeller high-speed DC motor, 15 – drainage propeller bracket, 16 – water outlet driving servo, 17 – water outlet driving shaft.” Ex. 1007, [0016]. Nothing in Figure 3, or in the remainder of Fu’s specification, indicates that the “water discharger” includes a filter or much less a filter that is configured to retain debris, as the claims require.

Figure 5 identifies “23 – water flow filter screen, 24 – water follow channel, 25 – anti-backflow device, 26 – water inlet” with nothing indicating the filter screen is configured to retain debris. In fact, all references to a “filter” in Fu indicate that the filter screen is configured to “filter out debris,” not retain it. Ex. 1007, [0026] (“water passes through the water flow filter screen 23, which filters out debris”).

ii. Fu's Anti-Backflow Device 25 Is Not Part of Any Filter and Is Instead a Mechanical Valve that Prevents Water from Flowing When the Pump Is Off.

The anti-backflow device 25 is not a component of any filter nor does it perform any filtering function. Rather, it is simply a binary check-valve that prevents backflow, i.e., water from flowing out of water flow channel 24 when the pump is off. Ex. 1007, [0024] (“When water stops entering, the anti-backflow device 25 returns to a closed state, ensuring that water within the water flow channel 24 does not flow backward.”); [0026] (“When the water flow stops, the [anti-backflow device 25] closes due to the absence of water force, which prevents debris from flowing out of the water flow channel 24.”).

An anti-backflow device does not filter water or retain debris, both of which are required by the claims. While the pump is running and drawing water in, anti-backflow flap 25 is forced open and provides zero debris retention or filtering. Ex. 1007, [0026]. When the pump is turned off, flap 25 simply closes like a door to seal channel 24. *Id.* A valve flap that opens to allow unfiltered intake and closes to seal a duct is not a “filter.”

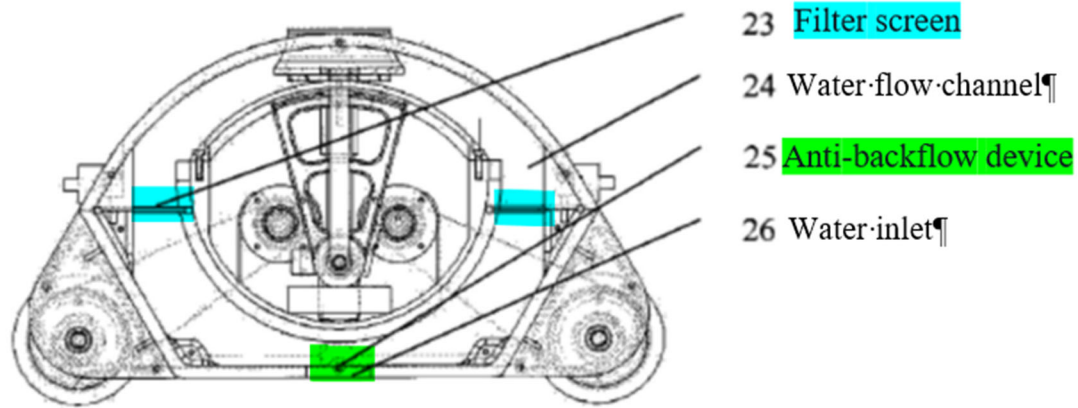


Fig. 5

Ex. 2030, ¶83; Ex. 1007, fig. 5 (annotated).

At most Fu describes preventing debris from flowing out of the “water flow channel 24.” But the Petition never suggests, much less explains, how Fu could disclose “*a filter* configured to retain debris.” To the contrary, the Petition simply identifies the components of the drainage mechanism but acknowledges the filter itself does not retain debris. *See* Pet. at 15 (“The drainage mechanism also retains the debris that is filtered out from the water.... Thus, the debris is retained within water flow channel 24.”). Petitioner’s attempt to equate the overall “drainage mechanism” with the claimed “filter” is fatally flawed and irrelevant to the claim language, which expressly requires “*a filter* configured to retain debris.”

iii. Dr. Reinholtz Merely Parrots the Petition and Thus Adds Nothing to the Petition’s Barebones Analysis.

Dr. Reinholtz adds nothing to independent the Petition’s analysis. The conclusory testimony of Petitioner’s expert, Dr. Reinholtz, which merely repeats Petitioner’s argument—and thus is entitled little to no weight—does not demonstrate otherwise. *Compare* Pet. at 14–15 (addressing element 1[c]), *with* Ex. 1010, ¶¶236–39; *see also* Ex. 2011; *see MarkForged*, IPR2022-01431, Paper 7, at 14; *Xerox*, IPR2022-00624, Paper 9, at 15 (precedential).

Claims 2–4 likewise recite the same element, and the Petition merely refers to its flawed analysis of claim 1[c]. Pet. at 21–28. Petitioner’s anticipation ground fails for this additional reason.

V. GROUND 1b: FU DOES NOT RENDER OBVIOUS CLAIMS 1–4.

Petitioner bears the burden of demonstrating that subject matter was obvious. *See KSR Int’l Co. v. Teleflex Inc.*, 550 U.S. 398, 418 (2007) (quoting *Graham v. John Deere Co. of Kan. City*, 383 U.S. 1, 17–18 (1966)). The obviousness analysis articulated in *Graham* and *KSR* is not optional—a finding of obviousness cannot be sustained without providing the requisite analysis. *Apple Inc. v. Samsung Elecs.*, 839 F.3d 1034, 1048 (Fed. Cir. 2016); *In re Magnum Oil Tools Int’l, Ltd.*, 829 F.3d 1364, 1380 (Fed. Cir. 2016). Petitioner fails to identify or analyze the structural and functional differences between the Challenged Patent and Fu that a POSITA would supposedly determine as obvious. Petitioner offers no hardware or software roadmap

explaining why a POSITA would have been motivated to abandon Fu's dead-reckoning navigation framework in favor of camera-based spatial control. Nor does the Petition establish any reasonable expectation of success in making such a fundamental modification. Petitioner's obviousness analysis fails.

A. Fu Does Not Render Obvious the Controller Limitation.

As explained, Fu's image comparison guides the robot's cleaning intensity movement of the cleaning wheels (through wheel speed ratios), not the directional navigational movement of the robot. Ex. 1007, [0026].

Petitioner argues—in conclusory fashion—it would be “obvious to implement motion control in Fu to direct the cleaning robot (i) toward image-identified dirty regions (*i.e.*, regions below Fu's cleanliness threshold), and (ii) away from clean regions (*i.e.*, regions above the threshold).” Pet. at 29. As explained in detail *supra*, this is not disclosed anywhere within Fu. To the contrary, Fu describes controlling the intensity of cleaning based on a “cleanliness image threshold.” Ex. 1007, [0026]. But this cleanliness image threshold is never used for guidance, instead “[t]he underwater cleaning robot ensures *autonomous navigation* and operation through *dead reckoning, using its installed inertial navigation components* and the encoders of the four cleaning driving wheels 3.” Ex. 1007, [0026].

Petitioner's Ground 1b analysis never explains any reference that discloses guidance based on an image. Rather than citing to such a reference, Petitioner instead

tries to fill the gap with expert testimony, devoid of any support in the available prior art. Pet. at 30 (“implementing this control behavior in Fu would have required no more than routine software configuration within a POSITA’s skill.”). But neither Petitioner nor its expert explain the deficiency that must be filled, and the changes a POSITA would be motivated to make to fill that deficiency. *See* Pet. at 28–30.

Petitioner explains its motivation as “mov[ing] toward dirtier (sub-threshold) regions and away from cleaner (above-threshold) regions” (Pet. at 33) and explains that the motivation is simply “because this would improve cleaning efficiency and task completion time.” *Id.* But none of this is taught or suggested by Fu or any other reference. Rather, it is simply pulled whole-cloth from Petitioner’s belief that such a process would inherently be more efficient. This is pure hindsight, in particular because Fu already explains that its dead reckoning positioning system, which can increase cleaning intensity at specific dirtier locations, works well, as it is. Ex. 1007, Abstract (describing Fu’s invention as “exhibit[ing] good practicality, stability, energy efficiency, economy, and versatility”), [0003] (the invention “provide[s] an underwater robot that is agile, economical, energy-efficient, and capable of multiple operating modes, thereby better accomplishing underwater cleaning tasks”), [0026] (“adjusting the discharge position and direction of the water outlet 10 and the speed of the drainage propeller 11 can also change the cleaning intensity, making the robot's work more efficient.”). Petitioner does not grapple with this evidence, nor

does it explain how moving toward specific areas that include dirt is more efficient than following a pre-set path to clean the entire pool and throttling cleaning intensity at specific areas that include more dirt.

The lack of motivation aside, neither Petitioner nor its expert explain any of the hardware or software changes that would be required or address any technical limitations that plainly are not provided by Fu's limited disclosure of its processor or camera. Indeed, there is no description in Fu *at all* of the type of camera and processor provided, instead there is a mere block diagram. *See* Ex. 1007, Fig. 6. This includes no explanation or suggestion that these elements would even have the capacity for camera-based guidance.

Even if they did, the Petition never explains any modification that would be made to enable such guidance. Instead, the Petition wishfully states—without supporting evidence—“[s]uch implementation would reflect only routine, predictable applications of well-known control techniques, requiring no new hardware and instead leveraging Fu's disclosed central processor.” Pet. at 29. Dr. Schempf explains Petitioner's “assumption skips the identification and detailing of the technical steps needed to arrive at the claimed configuration, including at minimum (i) identifying the imaged portion as a spatially defined portion of the submerged surface, (ii) correlating (scaling, ranging, etc.) that portion in the image to the robot's position and heading, (iii) choosing whether to approach or avoid that

portion (detection identification and classification related to debris and/or obstacle, etc.), and (iv) generating wheel-control signals that move (steering and driving) the body relative to that portion in the image.” Ex. 2030, ¶110. Nor would there be any motivation, other than hindsight, to modify Fu to include camera-based guidance as Fu itself indicates that dead reckoning works well, as it is. *Id.*, ¶¶112–13; Ex. 1007, Abstract, [0003], [0026].

Converting Fu to camera-based navigation would require removing its entire inertial framework and developing closed-loop image-plane tracking—a major technical redesign that cannot be hand-waved as “routine software configuration.” Under Federal Circuit law, where a missing limitation goes to the heart of the invention, an obviousness challenge supported only by conclusory expert testimony and uncorroborated “common sense” and “general skill in the art” fails as a matter of law. *Arendi S.A.R.L. v. Apple Inc.*, 832 F.3d 1355, 1363 (Fed. Cir. 2016) (“In cases in which ‘common sense’ is used to supply a missing limitation ... our search for a reasoned basis for resort to common sense must be searching. And, this is particularly true where the missing limitation goes to the heart of an invention.”).

Here, the missing elements are “more than a peripheral issue” and “therefore require[] a core factual finding.” *K/S Himpp v. Hear-Wear Techs., LLC*, 751 F.3d 1362, 1365 (Fed. Cir. 2014). Indeed, it is error to accept an “assertion from a third party about general knowledge in the art *without evidence on the record*,

particularly where it is an important structural limitation that is not evidently and indisputably within the common knowledge.” *Id.* at 1365–66. The element is **not** in the instituted prior art (Fu), and there is substantial dispute as to Petitioner’s claims regarding common knowledge. Ex. 2030, ¶111.

Dr. Reinholtz adds nothing to the analysis, again simply repeating the Petition’s conclusionary arguments almost word-for-word. *Compare* Petition at 28–30 (addressing Ground 1b) *with* Ex. 1010, ¶¶274–77; *Xerox*, 2022 WL 3648989, at *6.

Petitioner fails to demonstrate how a POSITA may remedy Fu’s failure to disclose the claim limitation 1[e], and the similar limitations in claims 2–4, and thus this Ground fails.

B. Petitioner Does Not Argue that Fu Renders Obvious the Filter Limitation.

Fu fails to teach or suggest this limitation, and Petitioner presents no argument this limitation would have been obvious. *See* Pet. at 28–30. Indeed, Petitioner does not even mention element 1[c] in its Ground 1b analysis. *See* Pet. at 28–30. Petitioner fails to offer any explanation or *KSR* rationale for how the knowledge of a POSITA would remedy Fu’s failure to teach or suggest “a filter configured to **retain debris**.” This failure is fatal as a matter of law. An obviousness showing must address every claim limitation and provide an explicit reasoning or motivation to modify the prior art. *Graham*, 383 U.S. at 1; *KSR* 550 U.S. at 1395–96.

Even if Petitioner had offered an explanation, it would be unfounded. As discussed above, Fu’s anti-backflow device prevents water from flowing backward; it does not filter water or constitute a filter structure configured to retain debris, both of which are required by the Challenged Claims. All references to a “filter” in the Fu reference indicate the filter screen 23 is configured to “filter out debris,” not retain it. *See, e.g.*, Ex. 1007 [0026]. Dr. Reinholtz adds nothing to the analysis, again simply parroting the Petition almost word-for-word. *Compare* Pet. at 28–30 (addressing Ground 1b), *with* Ex. 1010, ¶¶274–77; *Xerox*, No. IPR2022-00624, Paper 9, at 15; *see also* Ex. 2011.

Petitioner fails to establish a *prima facie* case of obviousness of claims 1–4.

VI. GROUND 1c: FU, IN VIEW OF BENZLER, DOES NOT RENDER OBVIOUS CLAIMS 1–4.

A. The Combination of Fu in View of Benzler Does Not Render Obvious the Controller Limitation.

Petitioner’s proposed combination fails because neither reference discloses an onboard or external camera capable of capturing an image of a submerged surface portion to guide movement relative to that portion. Benzler’s camera is external to the pool and detects only an above-water floating red swimmer, with Benzler explicitly admitting its camera cannot distinguish objects beneath the reflective water surface. Ex. 1013, [0029], [0031], [0050]; fig. 3. This external camera is not

configured for use underwater, but even if it were, combining Fu with Benzler cannot remedy Fu's complete absence of camera-based spatial guidance.

i. The Petition Fails to Establish that Fu Teaches or Renders Obvious this Claim Element.

Ground 1c relies on Fu as primary reference. *See* Pet. at 31–34. The Petition does not add any additional analysis beyond its earlier description of Fu in ground 1a, and as explained above, the Petition fails to carry its burden with respect to Fu. *See supra* Section IV & V.

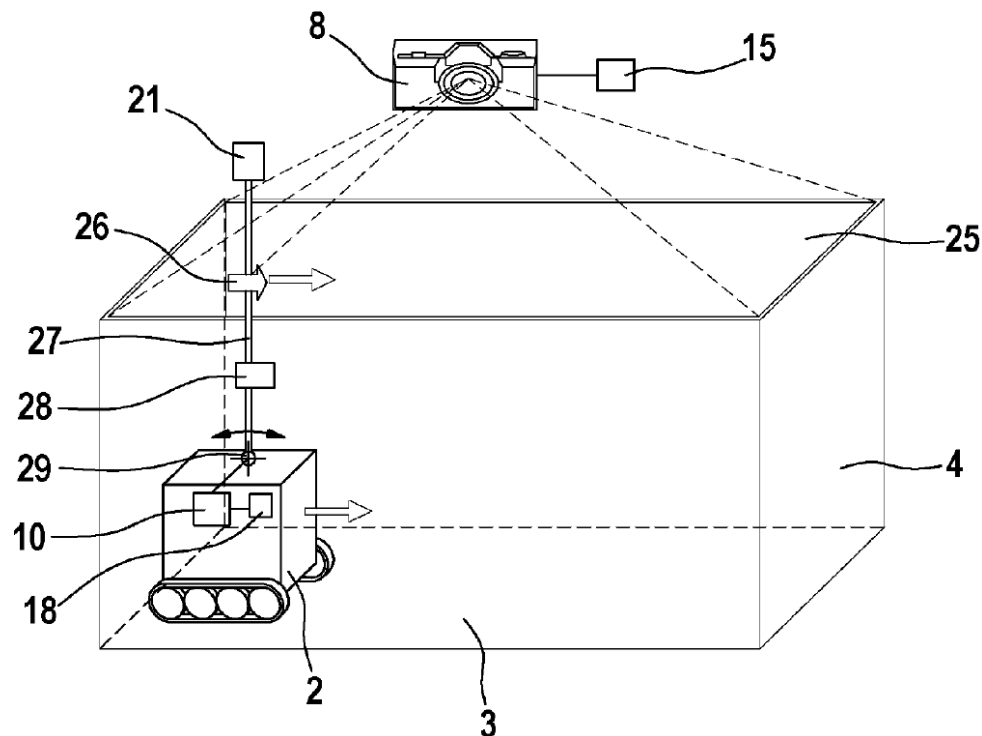
ii. Benzler Does Not Teach Guiding Its Pool Robot Based on an Image of the Submerged Surface.

The Petition urges that “[a]pplying Benzler’s classification-driven motion to Fu’s thresholded cleanliness determinations would have yielded the control signal for causing movement “to, or away from” a portion of the submerged surface captured by the camera, with the robot moving toward sub-threshold (dirtier) regions and away from above-threshold (cleaner) regions.” Pet. at 33. This is incorrect.

Benzler is explicit that its external color camera cannot “distinguish the robotic vehicle from the environment, in particular from the blue and reflecting water surface,” i.e., the color camera cannot distinguish the pool cleaner from any other object—including dirt and other debris—on the bottom of the pool. Ex. 1013, [0029]; Ex. 2030, ¶128. Thus, Benzler explains that its camera does not capture images of the bottom of the pool—as would be required for using an image to cause

“the robot [to] mov[e] toward sub-threshold (dirtier) regions and away from above-threshold (cleaner) regions.” Pet. at 33.

Benzler confirms it cannot capture images of the bottom of the pool by itself. Instead, Benzler relies on an external camera that captures images of “a swimmer” moving on the water surface.” Ex. 1013, [0029]. This is captured throughout Benzler’s description of the pool-robot embodiment (Ex. 1013, [0029]–[0032], [0050]–[0055]). As explained, the pool-robot is connected to a “swimmer along on a rod, in particular a telescope rod that is pivoted. The swimmer is preferably movable relative to and along the longitudinal direction of the rod.”



Ex. 1013, fig. 3.

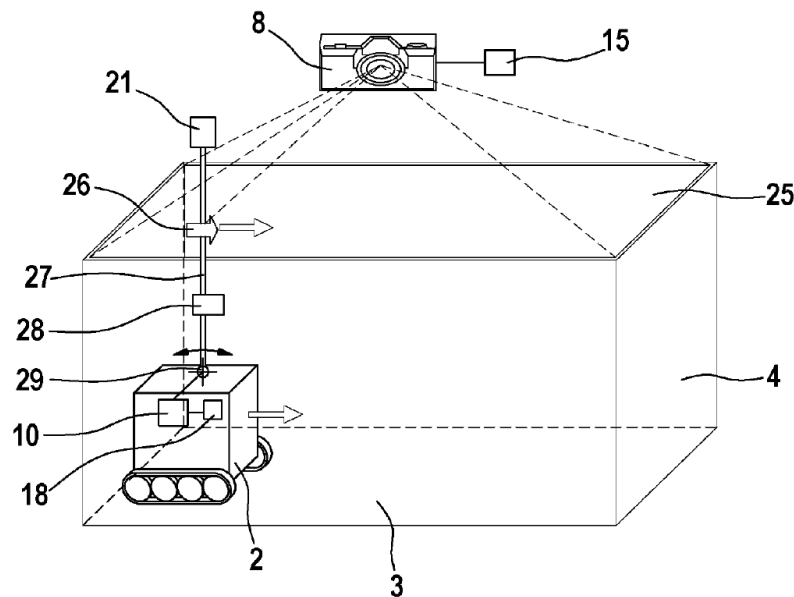
Rather than capturing the robot's location or any portion of the submerged pool floor, Benzler explains instead that the "camera 8 ... continuously detects *the position of the swimmer*" floating on the surface of the pool. Ex. 1013, [0050]. Confirming that camera 8 could not be used for the purposes for which the Petition suggests, Benzler explains that "when the color of the swimmer (preferably red) differs from the color of the water surface (usually blue) the logic unit can determine the exact position of the swimmer and therefore of the robotic vehicle with the aid of the image data that is delivered by the camera." Ex. 1013, [0031]. Thus, Benzler does not disclose that its camera set up can be used to detect debris or to generate control signals to cause movement "to, or away from" any such debris.

As Dr. Schempf explains, a POSITA would recognize that the camera of Benzler's system, which cannot capture the position of the pool-robot without the swimmer, could similarly not determine the location of debris on the bottom of the pool. Ex. 2030, ¶131. A POSITA would recognize that such a camera system would be prone to many errors and uncertainties as it would not capture the submerged surface, including because of the contrast and other issues. *Id.*, ¶123. These issues are exactly why Benzler's system requires a swimmer have a specific color, "(preferably red) [that] differs from the color of the water surface (usually blue) [so] the logic unit can determine the exact position of the swimmer." Ex. 1013, [0031].

Benzler discloses no system for detecting debris or classifying submerged pool floor images.

iii. Benzler Discloses Only an External Camera to Capture a Surface of the Pool, which is Irrelevant to the Claimed Guidance.

As shown in Figure 3 of Benzler every embodiment of Benzler’s swimming pool robot discloses a camera that is *external* to the robot and positioned outside the pool. Benzler discloses no onboard camera of the pool cleaner for capturing an image of a submerged surface, as required by claims 1–3.



Such an external camera is irrelevant to the claim’s requirements that the “at least one camera mounted directly or indirectly to the body”⁴ And, as explained, the camera is expressly described as incapable of capturing images of portions of the

⁴ Claims 2–3 and 5 recite similar limitations.

submerged surface. As Dr. Schempf explains, a POSITA would recognize that a camera for use out-of-water is not applicable for taking images below the water, much less suitable for operations in an underwater environment. Ex. 2030, ¶¶120, 131–32.

iv. Benzler’s Lawnmower Embodiment is Not Applicable to a Pool-Robot, Much Less Identifying Debris on a Submerged Pool Surface.

The Petition impermissibly misconstrues and imports Benzler’s terrestrial “classification-driven motion control” into the pool embodiment.

Benzler discusses “classification-driven motion control” for the lawnmower embodiment. But that embodiment is not applicable to determining debris on the bottom of a swimming pool. Indeed, Benzler explains that its camera cannot detect the location of the pool-robot without a swimmer and instructs that the swimmer have a specific color (red) to provide sufficient contrast to identify it on *the surface* of the pool. Ex. 1013, [0031]. As Dr. Schempf explains, “Benzler’s above ground camera may be capable of detecting mowed and non-mowed sections, but that detection algorithm is different from detecting dirt on a submerged pool surface.” Ex. 2030, ¶130.

Benzler’s pool embodiment only detects the location of the robot via a swimmer found on the surface of the water from above. Ex. 1013, [0051]–[0054]. Benzler’s “classification-driven motion” is the detection of mowed and unmowed

areas that update an “alongside” trajectory for the robot to follow on land. Ex. 2030, ¶130. This does not disclose, and is irrelevant to, targeting debris on the bottom of a swimming pool. *Id.* Nor is an embodiment regarding the application of classification-driven motion to a lawnmower relevant to the control of an autonomous underwater robot. *Id.* Petitioner’s attempt to graft Benzler’s dry-land lawnmower algorithm onto a submerged cleaner—while ignoring Benzler’s express warning that underwater optical classification fails—is driven by impermissible hindsight.

v. A POSITA Would Not Have Been Motivated to Modify Fu’s Intensity Cleaning System in View of Benzler’s Positional System.

As described *supra*, Petitioner has failed to identify any reason to modify Fu at all, as Fu itself indicates that its dead reckoning navigation system works well. But even if such motivation existed, a POSITA would not have been motivated to modify Fu in view of Benzler. Any modification of Fu with Benzler’s exterior imaging system that tracks the location of a swimmer would destroy Fu’s intended principle of operation and render it inoperable. At a minimum the entire configuration of image detection and analysis would have to be changed.

To the extent Petitioner suggests taking Benzler’s camera technology and mounting it *inside* Fu, that modification fails. Benzler’s system monitors the surface of a pool from an external overhead position to detect a floating swimmer

(specifically colored to distinguish it from pool water) and explicitly relies on an out-of-water camera setup. Re-engineering Benzler's external optical system for an onboard, underwater robot like Fu would require significant modification in both hardware and source code for use in an underwater robot mounted design, as is described by Fu. Ex. 1007, [0026]; Ex. 2030, ¶123.

Indeed, as explained by Benzler, its camera has difficulty detecting objects on the surface of the swimming pool; therefore, such a design would necessarily struggle and fail to detect objects on the bottom of the swimming pool. Ex. 2030, ¶123. Applying Benzler's camera to Fu would require an entirely different camera configuration that can be mounted in a sealed, underwater, compartment. *Id.* As Dr. Schempf explains this would require significant redesign of the camera and related firmware, which would be unlikely to have been successful at the relevant timeframe. *Id.* Indeed, neither Fu, nor Benzler, describes any software or other processing to account for “[s]hadowing, glare, spectral absorption induced color loss, surface light-reflection and -refraction, water-surface rippling from wind/pumping action, and floating debris or other floating items (toys, etc.), are just some of the imaging-related factors that must be accounted for” in using such a camera design. *Id.* Rather than accounting for these, Benzler instead relies upon an external swimmer, as explained.

Even if it were obvious to a POSITA to combine and reconfigure Fu to implement Benzler's "classification-driven motion detection," that robot would still not be analyzing the submerged surface. The Fu-Benzler combination that Petitioner proposes would have (1) an underwater camera with a logic unit that is configured to only analyze cleanliness threshold to change the intensity of the cleaning during a preset pathway and (2) an above external camera used to determine the location of the swimmer (and by extension the robot) within the pool based on an image of the water surface. Ex. 2030, ¶122. At best, the combination would result in an in-pool camera robot processing cleaning intensity, not dynamic cleaning coverage or camera-guided trajectory adjustment as claimed by the Challenged Patent.

vi. The Proposed Combination Undoes Benzler's Core Teaching and Destroys Its Intended Principle of Operation.

In addition to the lack of motivation, combining Benzler's optical tracking with Fu's submerged cleaner would destroy Benzler's intended principle of operation. A proposed obviousness combination that requires discarding the very feature that a reference teaches as necessary to accomplish its intended purpose is fatally defective. *See In re Gordon*, 733 F.2d 900 (Fed. Cir. 1984).

Benzler explicitly teaches that an optical camera positioned above or inside a pool cannot reliably distinguish a submerged cleaner (or submerged floor debris) directly through the refracting, reflecting blue water surface. Ex. 1013, [0031]. Benzler's explicit technical solution to this failure mode is to attach a rigid guide rod

27 extending above the water surface equipped with a high-contrast (preferably red) floating swimmer 26, allowing an external overhead camera 8 to track the above-water float rather than looking into the water. *Id.*

Petitioner’s proposed combination—taking Benzler’s optical tracking algorithms and applying them to Fu’s submerged onboard camera 2—requires a POSITA to completely discard Benzler’s surface-float mechanism and force an overhead image-processing strategy onto a submerged, close-up camera. A POSITA would not be motivated to adopt a reference’s teaching by abandoning the very feature (the surface float) that the reference discloses as necessary to overcome optical distortion underwater. Because Petitioner’s proposed combination requires plucking algorithmic concepts from Benzler while discarding the physical and optical structure mandated by Benzler, Ground 1c fails as a matter of law.

vii. Dr. Reinholz Parrots the Petition and thus His Testimony Should Be Given Little Weight.

The conclusory testimony of Petitioner’s expert, Dr. Reinholz, which merely repeats Petitioner’s arguments regarding Benzler’s “classification-driven motion control”—and thus is entitled little to no weight—does not demonstrate otherwise. Ex. 1010, ¶281; *see MarkForged*, IPR2022-01431, Paper 7, at 14; *Xerox*, IPR2022-00624, Paper 9, at 15.

Thus, the Petition fails to carry its burden with respect to Ground 1c.

B. Fu, in view of Benzler, Does Not Render Obvious the Filter Limitation.

For the same reasons as discussed above, Petitioner fails to carry its burden of demonstrating that Fu discloses or renders obvious “a filter configured to retain debris collected from the submerged surface.” *See supra* Section IV.

i. The Petition Does Not Attempt to Cure Fu’s Failure with Benzler or Any Other Reference.

The Petition does not attempt to suggest that Benzler may be relied upon to cure Fu’s failure. Indeed, the Petition fails to provide any discussion of this limitation at all in its analysis of this ground, much less point to any disclosure in Benzler or provide a motivation for modifying Fu to include element 1[c]. *See* Pet. at Ground 1c (including only a summary of Benzler and analysis purporting to address “Obviousness Of The ‘To, Or Away From’ Limitation Over Fu In View Of Benzler”). Further, Benzler discloses no filter structure whatsoever, and Petitioner’s silence as to this element in Ground 1c fails to establish a *prima facie* case of obviousness.

The Petition fails to demonstrate that Fu, whether alone or in view of Benzler, discloses or renders obvious claims 1–4 of the Challenged Patent.

VII. GROUND 1d: FU, IN VIEW OF HUI, DOES NOT RENDER OBVIOUS CLAIM 5.

A. Fu in view of Hui Does Not Render Obvious the Filter Limitation or the Controller Limitation.

As discussed above, the Petition fails to establish that the filter limitation (5(c)) and the controller limitation (5(f)) are disclosed or rendered obvious by Fu. *See supra* Sections IV & V. The Petition introduces Hui only to address a chemical dispenser (5(d)) but does not otherwise discuss, address, or supplement its analysis regarding the other claim elements.

B. A POSITA Would Not Have Been Motivated to Combine Fu's System with Hui.

A POSITA would not have been motivated to modify Fu in view of Hui. Any modification of Fu with Hui's chemical dispenser would not function. At a minimum the entire configuration of the robotic pool cleaner and chemical dispenser as Wybotics has proposed would have to be changed, thwarting the respective advantages that Fu and Hui each express about their respective devices. Ex. 2030, ¶¶138–45. Further, Hui teaches away from implementing its chemical dispenser on robotic pool cleaners that operate in a similar manner as Fu. *Id.*, ¶140.

Wybotics first proposes “integrating Hui's chemical dispenser 30 within Fu's water flow channel 24 such that the filtered water passes through the chemical dispenser before being discharged into the pool.” Pet. at 39; Ex. 1010, ¶290. This would fail to function because relying on the water flow through Fu's water flow

channel to disperse chemicals into the pool would be imprecise and unpredictable. Ex. 2030, ¶139. According to Hui, “a balance needs to be struck between no chemicals or too little chemicals and too much chemicals.” Ex. 1019, [0007]. This is because “adding too little chemicals would leave to the pool dirty and not sanitized, while ‘adding too much of a particular chemical, such as chlorine, could equally make the pool water dangerous and unsafe for human usage.’” Ex. 2030, ¶139; Ex. 1019, [0006].

In contrast, Fu’s robotic pool cleaner relies on a variable discharge rate of its water outlets to perform functions including movement and cleaning. Ex. 2030, ¶139. For instance, Fu states that “[t]he coordinated movement or positioning of multiple water outlets along the water outlet sliding grooves chang[ing] direction discharge, generating different forces that affect the robot’s movement.” Ex. 1007, [0012]. Additionally, “[t]here are also times when Fu’s robotic pool cleaner does not circulate water and there is no water flow.” Ex. 2030, ¶136.

“Because Fu’s robotic pool cleaner utilizes a variable water flow rate to perform its moving and cleaning operations, a predictable and precise flow of water through the chemical dispenser and most importantly the rate and distribution of the chemical at a particular location within the pool, cannot be guaranteed nor properly controlled.” *Id.*, ¶139. Therefore, Fu’s variable flow rate would not work with Hui’s chemical dispenser, which requires a predictable and precise flow rate. *Id.*

Further, Hui's chemical dispenser requires dispensing to be limited to "operat[ing] at the floor of the pool" because "mixing of the chemicals released by the chemical dispenser member 30 occurs at the bottom of the pool," and "[b]y mixing the chemicals at the lower depths of the pool water, complete mixing is encouraged. Unlike releasing chemicals at the surface water level where the chemicals to be dissolved in the water are much more likely to evaporate or become ineffective before complete mixing." Ex. 1019, [0041].

In contrast to Hui's clear directive, however, Fu describes its robotic pool cleaner as having the advantage of climbing walls, navigating steps, and floating along the surface. Ex. 2030, ¶138; Ex. 1007, [0011]. Fu also describes its robotic pool cleaner's ability to navigate pool steps by "adjusting[ing] [water outlets] to provide a propulsive force to the robot," and float in the water by "adjusting the discharge direction and force of the two water outlets." Ex. 1007, [0011]. Therefore, modifying Fu's robotic pool cleaner to include Hui's chemical dispenser would result in chemicals being dispersed at various points in the pool, including along the surface, not just the bottom "because Fu's robotic pool cleaner does not stay on the floor of the pool, it climbs walls and steps, and floats at the surface of the pool." Ex. 2030, ¶138; *see also* Ex. 1007, [0012]–[0013], [0026].

Even "[i]f one were to modify Fu's robotic pool cleaner such that Hui's chemical dispenser was operational, thus limiting the cleaner to floor operation only,

that would forfeit several of the advantages that Fu explains as integral to its pool cleaner.” Ex. 2030, ¶138. These advantages, as explained above, include the ability to climb walls, traverse steps, and float along the surface, thus such modification would leave a significant portion of the pool untouched.

Wybotics alternatively proposes “mount[ing] Hui’s chemical dispenser 30 externally to Fu’s robot.” Pet. at 40. This proposal would similarly fail because, unlike Hui’s clear directive that chemicals must be dispensed at the floor of the pool, Fu’s robotic pool cleaner also climbs walls, navigates steps, and floats along the water surface. Ex. 2030, ¶138. As stated above, “[i]f one were to modify Fu’s robotic pool cleaner such that Hui’s chemical dispenser was operational, thus limiting the cleaner to floor operation only, that would forfeit several of the advantages that Fu explains as integral to its pool cleaner,” including the ability to climb walls, traverse steps, and float along the surface. *Id.*

Finally, Hui teaches away from implementing its chemical dispenser on robotic pool cleaners that operate in a similar manner as Fu. As stated above, Hui clearly states that its “vehicle 20 operates at the floor of the pool” and releasing chemicals at the surface level a less likely “to be dissolved in the water [and] much more likely to evaporate or become ineffective before complete mixing.” Ex. 1019, [0041]. This clear directive teaches away from implementing Hui’s chemical dispenser in a robot pool cleaner like Fu that touts its ability to not only operate on

floors, but critically, climb walls, float, and maneuver steps. Ex. 2030, ¶140; *see also* Ex. 1007, [0011]–[0013], [0026].

VIII. GROUND 1e: FU, IN VIEW OF BENZLER, IN FURTHER VIEW OF HUI, DOES NOT RENDER OBVIOUS CLAIM 5.

A. Fu and Benzler in view of Hui Does Not Render Obvious the Filter Limitation or the Controller Limitation.

As discussed above, the Petition fails to establish that the filter limitation (5(c)) and the controller limitation (5(f)) are disclosed or rendered obvious by the Fu-Benzler combination. *See supra* Section VI. The Petition introduces Hui only to address a chemical dispenser (5(d)) but does not otherwise discuss, address, or supplement its analysis regarding the other claim elements. Thus, the Petition’s analysis of Claim 5 over Fu-Benzler-Hui fails for the same reasons discussed above.

B. A POSITA Would Not Have Been Motivated to Combine Fu, Benzler, and Hui.

As discussed above in Section VII, a POSITA would not be motivated to combine Fu’s system with Hui. The Petition introduces Benzler as well but does not cure any of the deficiencies discussed above, all of which are at least as applicable to the Fu-Benzler-Hui combination. Thus, the Petition does not establish a motivation to combine Fu, Benzler, and Hui for the same reasons as discussed *supra*.

IX. GROUND 2a: SCHNITTMAN, IN VIEW OF BENZLER, DOES NOT RENDER OBVIOUS CLAIMS 1–2 and 4.

A. A POSITA Would Not Be Motivated to Combine Schnittman’s Land-Based Cleaning Robot with Benzler’s Underwater Pool Robot Design.

The Petition fails to show that a POSITA would have been motivated to combine Schnittman and Benzler. As explained above, the only relevant embodiment of Benzler is a pool-based cleaning robot. In contrast, the only embodiments described in Schnittman are out-of-the-water designs of an iRobot style robot-vacuum. *See, e.g.*, fig. 11. Both references disclose only terrestrial cameras of use outside of water. Petitioner does not provide any motivation to modify such terrestrial cameras for use underwater, nor is there such a motivation.

i. Schnittman Is Not Analogous Art to the Challenged Patent.

Petitioner is incorrect that Schnittman is analogous art to the Challenged Patent. *See* Pet. at 43. Schnittman is not from the same field of endeavor as the Challenged Patent and it is not reasonably pertinent to the problem faced by the inventors of the Challenged Patent for the same reason.

Prior art qualifies as analogous art only if it satisfies at least one prong of the two-part test set forth in *In re Bigio*, (1) whether the art is from the same field of endeavor, regardless of the problem addressed; and (2) if the reference is not within the field of the inventor’s endeavor, whether the reference still is reasonably

pertinent to the particular problem with which the inventor is involved. 381 F.3d 1320, 1325 (Fed. Cir. 2004). Schnittman fails both prongs.

Regarding the first prong, the field of endeavor of the Challenged Patent is self-propelled, submerged aquatic pool cleaning vehicles operating in a liquid medium. Schnittman does not include any description at all of an underwater device or of anything capable of performing tasks in a liquid medium, much less underwater, as is required by the claimed “self-propelled pool cleaner for cleaning debris from *a submerged surface of a swimming pool.*” Instead, Schnittman is directed to terrestrial autonomous robots, which is different from the underwater autonomous cleaning robots. Ex. 2030, ¶148. The physical dynamics of dry terrestrial sweeping share no overlap with submerged hydrodynamic vehicle operation and thus are not in the same field of endeavor. *Id.*

Regarding the second prong, a POSITA would not consider Schnittman to address any problems addressed by the Challenged Patent as it is directed to a terrestrial cleaning robot, with different capabilities. The problem faced by the inventors of the Challenged Patent was determining and directing surface coverage on submerged pool floors under conditions of water turbidity, refraction, and glare. *Id.* Schnittman is directed to a completely different type of autonomous robot than the Challenged Patent, requiring “different types of cameras, mechanics, and software for their respective purposes and environments.” *Id.*, ¶152. A POSITA

attempting to solve underwater optical vision degradation would not reasonably consult dry-land vacuum cleaner patents like Schnittman that operate exclusively in an air medium. *Id.*, ¶153.

As Dr. Schempf testifies, a “POSITA would know of the difficulties and undue experimentation required to convert aspects of Schnittman to an underwater cleaning robot.”⁵ Ex. 2030, ¶148. Those difficulties were not “straightforward” and within “a POSITA’s skill,” as Petitioner claims. *Id.*

Because Schnittman is non-analogous art, it cannot be combined with Benzler or any other reference under 35 U.S.C. § 103.

ii. A POSITA Would Understand that a Terrestrial Camera as Discussed in Schnittman Is Not Readily Applicable to an Underwater Design.

A POSITA would have understood the “camera-calibration issues related to light-transmission [] associated with the camera setup and lensing for underwater navigation.” Ex. 2030, ¶149. These lenses require multiple air-to-lens-to-air-to-glass-to-water transition, where the ray-bending would have to be accounted for by the controller. *Id.* Further, a POSITA would recognize the additional issue of reflection and refraction as light bounces off water molecules, further distorting the

⁵ As an additional example of the complexity, a leading developer and manufacturer of terrestrial autonomous cleaning robots, iRobot (the assignee of Schnittman), has not developed an underwater cleaning robot to date. See https://www.irobot.com/en_US/shop/vacuum.html

captured image. *Id.* This would require modifications not contemplated by the Petition or its expert, and indeed, Benzler specifically identifies pool-related issues impacting the functionality of its camera and for that reason includes its surface-swimmer to identify the location of its pool-robot. Ex. 1013, [0031]; Ex. 2030, ¶152.

As evidenced by Benzler, a POSITA would understand that the lack and sparsity of features underwater, i.e., lack of contrast, underwater is a major issue for navigation and positioning underwater.⁶ Ex. 2030, ¶149. And similarly, a POSITA would recognize the lighting issues with underwater imaging. *Id.* In an outdoor setting, the effects of clouds or other objects would create shadowing in the pool, which would result in challenges discerning between an obstacle, a shadow, or cleanliness level. *Id.*

Simply put, “due to the vast differences between underwater and terrestrial camera use, a POSITA simply would not have even thought to look to terrestrial robotics [] to address the problems addressed by the Challenged Patent, and if they had, they would have been readily dissuaded from using any terrestrial robotics systems underwater due to the complexity and undue experimentation required” to make it work. *Id.*, ¶151.

⁶ Petitioner and Dr. Reinholtz do not address this issue. Instead, they cite to Exhibit 1017, where the testing environment was fully controlled: an indoor pool with controlled lighting and highly reflective and contrasting targets, with no possibility of wind or shadows. This is not the environment of the invention is used in. Ex. 2030, ¶179.

Petitioner makes the conclusory statement that “[a] POSA making a debris detecting pool cleaner would have thus consulted Schnittman” without providing any reasoning why a POSITA creating a *pool* cleaner would have consulted a terrestrial cleaning robot when a POSITA would be aware of the challenges in translating terrestrial autonomous cleaning robots for an underwater purpose. Pet. at 44. As Dr. Schempf explains, this is incorrect. Ex. 2030, ¶151.

iii. Benzler Does Not Fill Schnittman’s Gaps and Confirms Schnittman’s Inapplicability to an Underwater Design.

Benzler does not fill in Schnittman’s gaps as it does not provide nor disclose how a POSITA would take the terrestrial cleaning robot disclosed in Schnittman and modify it for an underwater environment. While Benzler covers a system for robotic vehicles, that may include vehicles in the pool environment, a POSITA would not be motivated to combine Schnittman with Benzler for all the reasons stated above, including that Benzler’s camera is explicitly not capable of capturing images of the bottom of the pool. Ex. 2030, ¶¶158, 176. A POSITA would be aware of the various complications and challenges of modifying the robot disclosed in Schnittman for an underwater purpose. *Id.*, ¶177.

Moreover, Benzler does not describe or disclose how the pool robotic vehicle would function underwater or perform the cleaning function on a submerged surface of a swimming pool, much less perform image capture of that submerged surface. *Id.*, ¶¶155, 177. Indeed, as explained in detail in Section VI *supra*, Benzler describes

a camera positioned *outside of the pool* and explains that its camera is not capable of capturing submerged images and instead is reliant on a swimmer traveling along the surface of the pool to even detect the location of the pool-robot. *Id.*, ¶155.

Thus, to the extent there is a motivation to make the combination, it still would not result in the claimed invention because neither reference discloses or suggests a camera capable of acquiring images of the pool surface to cause movement “to, or away from” a portion of the submerged surface.

iv. Dr. Reinholtz’s Parroting of the Petition Provides No Additional Analysis and Should Be Afforded Little Weight.

Again, Dr. Reinholtz’s speculative testimony is not supported by any evidence or analysis. *See* Ex. 1010, ¶¶297–304. Rather, it is purely conclusory.

B. Schnittman, in view of Benzler, Does Not Render Obvious the Filter Limitation.

Benzler is silent as to any specific filter, instead simply describing “filter vehicle and/or cleaning or purifying vehicle,” (Ex. 1013, [0028]) without including any description at all of the specific filter, and never disclosing that such a filter “*retains* debris collected from the submerged surface.”

The Petition points to Schnittman’s internal filter 54. *See* Pet. at 55–56. As explained, Schnittman describes a terrestrial filter without ever suggesting such a filter is for operating “submerged” in a pool as required by the claims. As described in Schnittman, this filter is for filtering debris from air. *See, e.g.*, Ex. 1008, [0248]

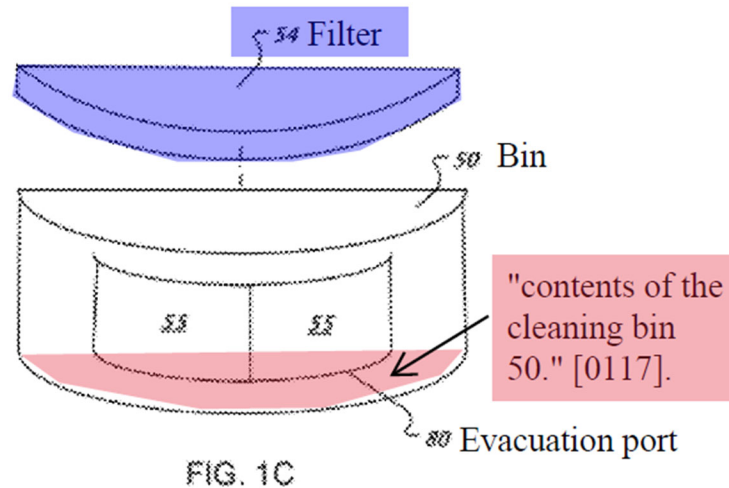
(“The bin 50’ further includes a filter 811, a motor 815, and an impeller 817. During use, a fluid stream 819 (e.g., *debris carried in air*) is drawn into the bin 50’ by negative pressure created by rotation of the impeller 817 driven by the motor 815.”).

Schnittman never describes that this filter is configured to filter water, much less that the “motor 815, and an impeller 817” could move water, or that any debris would be captured by the filter. Nor would such debris simply fall into the bin were it positioned in water, versus operating terrestrially as Schnittman describes. Ex. 2030, ¶¶162–63. Water is approximately 800 times denser than air; a POSITA would recognize that Schnittman’s pneumatic air impeller 817 and air filter 811 would cavitate, instantly clog, or structurally fail if submerged in water. *Id.*, ¶148.

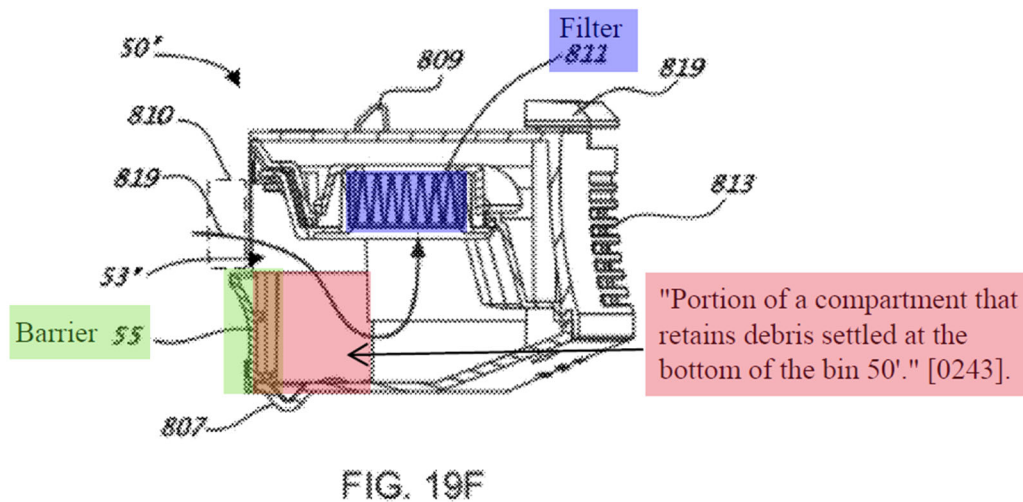
As mentioned above, a POSITA would not take Schnittman and simply transpose the robotic vehicle underwater, particularly not in combination with Benzler. *Id.*, ¶169–71. But even if that were possible, which it is not, Schnittman does not disclose a filter configured to retain debris. *Id.* Instead Schnittman describes the “fluid stream 819 moves through a filter 811 such that the debris is separated from the air, with *the debris remaining in the bin 50’.*” Ex. 1008 [0247], *see* figs. 1C, 19F.

Schempf’s annotations of Figures 1C and 19F, reproduced below, illustrate that the *filter* in Schnittman is not configured to retain debris, but rather the bin. In Figure 1C, “the filter 54, highlighted in blue, is not configured to retain debris

because it sits atop the bin 50, which retains the debris, highlighted in red, that may be evacuated through evacuation port 80.” Ex. 2030, ¶162.



In Figure 19F, “the filter 811, highlighted in blue, is not configured to retain debris; rather, the bin 50 defined by barrier 55, highlighted in green, is the “portion of a compartment that retains debris.” *Id.*, ¶163.



The Petition also incorrectly states that because the internal filter must be cleaned, it means that it collected and retained debris. Pet. at 55. Schnittman does

not state this. Schnittman discloses a removable bin to “access and clean a filter disposed within the cleaning bin.” Ex. 1008 [0124]. Nowhere does Schnittman disclose that debris must be cleaned, or that the filter is configured to retain debris. Ex. 2030, ¶165.

i. The Petition Never Provides a Motivation or Explanation of the Modification of Schnittman to Include the Claimed Filter.

The Petition fails to offer a legally cognizable basis for how the knowledge of a POSITA would remedy Schnittman’s failure to teach or suggest the absent claim features. Petitioner also *fails to provide any motivation for combining* Schnittman and Benzler to fill in the missing 1[c] limitation in Schnittman.

With respect to this limitation, the Petition urges

[a]s explained by Dr. Reinholtz, a pool-cleaner implementation of Schnittman would include a filter like that described in Schnittman, with the filter retaining debris collected by the robot while passing filtered, clean water back into the swimming pool.... Such on-board filters for pool-cleaning robots were well-known at the time of the alleged invention, and a POSITA would have understood how to modify or replace Schnittman’s filter for use in Benzler’s pool-cleaning context.

Pet. at 55–56. But Schnittman does not teach a filter that retains debris, and Dr. Reinholtz never explains any modification, instead simply stating that such filters, which are never disclosed in the cited art, are somehow “well-known.” Ex. 2030, ¶¶167–68. Nor does Dr. Reinholtz include any further explanation or point to any particular such filter that is “well-known,” instead he simply parrots the Petition. *See*

Ex. 1010, ¶317. Petitioner’s resort to unsubstantiated “common knowledge” to supply a missing claim element is impermissible as a matter of law. *See Apple*, 839 F.3d at 1062; *Arendi*, 832 F.3d at 1363.

Thus, Schnittman, in view of Benzler, does not disclose or render obvious this limitation.

C. Schnittman, in View of Benzler, Does Not Render Obvious the Camera Limitation.

Claim 1 requires “at least one camera mounted directly or indirectly to the body for capturing an image of at least a first portion of the submerged surface,” and claims 2 and 4-5 recite similar limitations.

Both Schnittman and Benzler rely on terrestrial or above-water cameras. The Petition does not attempt to fill this gap. Instead, the Petition concedes that “Schnittman does not disclose capturing an image of a ‘submerged [underwater] surface.’” Pet. at 58. And then provides a conclusory statement that “a pool-cleaner implementation of Schnittman in view of Benzler would capture such an image,” without providing any explanation or structural mapping. Pet. at 58.

As explained above, Benzler does not disclose an underwater camera. Further, Benzler acknowledges that its camera is limited to capturing images of a surface-float above the pool. Ex. 1013, [0031]. Simply put, there is no camera disclosed or suggested in either Benzler or Schnittman that is capable of capturing images of the

bottom of a pool, much less detecting debris on the bottom of the pool. Ex. 2030, ¶¶173–83.

Dr. Reinholtz attempts to fill this gap but fails. He cites three references as purported evidence that “the use of cameras in underwater environments was commonplace.” Ex. 1010, ¶209. But two of the references are not in the record (Ex. 1026 and Ex. 1028), and the SubjuGator paper (Ex. 1017) does not support his conclusion. Far from establishing that underwater imaging was routine, the SubjuGator paper readily concedes “[b]ecause *underwater environments can pose many types of challenges for object identification* such as varying luminosities, sunlight dissipation, particle noise, and occlusions, combinations of novel normalization, filtering techniques and color space models are developed to robustly extract relevant target information from the environment in real-time.” Ex. 1017, 7. Thus, the very reference that Dr. Reinholtz points to as support for his opinion that “the use of cameras in underwater environments was commonplace” *refutes* his conclusion. *See* Ex. 1017; Ex. 2030, ¶¶178–81.

In any event, as discussed in Section III *supra*, underwater camera capabilities were not commonplace as of July 10, 2012. There were many technical challenges associated with underwater camera development, some of which include shadowing, lack of contrast, and varying illumination. Ex. 2030, ¶181. Thus, a POSITA would not have been motivated to combine Schnittman and Benzler to disclose this claim

limitation. *Id.*, ¶177. And even if a POSITA would have somehow been motivated to make such a combination, the combination would not have resulted in the claimed invention because neither reference teaches a camera capable of capturing an image of a submerged surface “to cause movement of the body within the swimming pool to, or away from” a portion of the submerged surface. *Id.*

D. Schnittman, in View of Benzler, Does Not Render Obvious the Controller Limitation.

The Petition fails to offer a legally cognizable basis for how the knowledge of a POSITA would remedy Schnittman’s failure to teach or suggest the absent claim features.

i. Schnittman Does Not Disclose or Suggest Operations on a Submerged Surface, as the Claim Requires.

Schnittman is directed to an iRobot terrestrial vacuum with a debris monitoring method, where the robot moves towards the debris based on sensing the debris through its debris sensor. The Schnittman robot uses its camera to determine the size of the debris to move away from that area; however, Schnittman is missing a key limitation of the claim, it does not move to, or away from, the first portion of the *submerged surface*. Ex. 1008, [0045].

While Schnittman discloses movement away from a portion captured in an image on a dry floor, nothing in Schnittman indicates that this can be implemented

for underwater use. As explained above, a POSITA would not be motivated to modify Schnittman for underwater use. Ex. 2030, ¶148.

As Dr. Schempf explains, converting cameras for underwater use requires far more than routine experimentation, as contrast, shadowing, glare, reflection, and refraction would need to be considered for the pool environment. *Id.*, ¶149. All of these considerations teach away from making such a modification and confirm that a POSITA would not seek to modify Schnittman for an underwater environment. *Id.*, ¶151.

ii. Benzler Does Not Cure Schnittman’s Deficiency.

Benzler describes only an external camera positioned outside the pool, and that camera is only capable of tracking the location of a floating red swimmer on the surface of the pool. Indeed, Benzler explicitly acknowledges that its optical camera cannot distinguish objects or the robot against the reflective, blue submerged pool surface. Ex. 1013, [0029], [0031]; *supra* Section VI. As Dr. Schempf explains, such a camera cannot capture images of the bottom of the pool, nor would a POSITA use such an external surface-tracking camera for submerged floor inspection or debris-targeted navigation. Ex. 2030, ¶¶189–90.

For all these reasons, the Petition fails to demonstrate that Schnittman, whether alone or in view of Benzler, discloses or renders obvious “a controller ... configured to generate, in response to the captured image, at least one control signal

to cause movement of the body within the swimming pool to, or away from, the first portion of the submerged surface.” *Id.*, ¶193. Therefore, the Petition fails to demonstrate that Schnittman, whether alone or in view of Benzler, renders obvious claims 1, 2, and 4 of the Challenged Patent.

X. GROUND 2b: SCHNITTMAN, IN VIEW OF BENZLER, IN FURTHER VIEW OF BAILEY, DOES NOT RENDER OBVIOUS CLAIM 3.

As discussed above, neither the filter limitation (3(c)) nor the controller limitation (3(e)) are disclosed or rendered obvious by the Schnittman-Benzler combination. *See supra* Section IX. The Petition introduces Bailey only to address communications with an electronic device (3(e)(ii)) but does not otherwise discuss, address, or supplement its analysis regarding the other claim elements. Thus, the Petition’s analysis of Claim 3 over Schnittman-Benzler-Bailey fails for the same reasons discussed above.

XI. GROUND 2c: SCHNITTMAN, IN VIEW OF BENZLER, IN FURTHER VIEW OF HUI, DOES NOT RENDER OBVIOUS CLAIM 5.

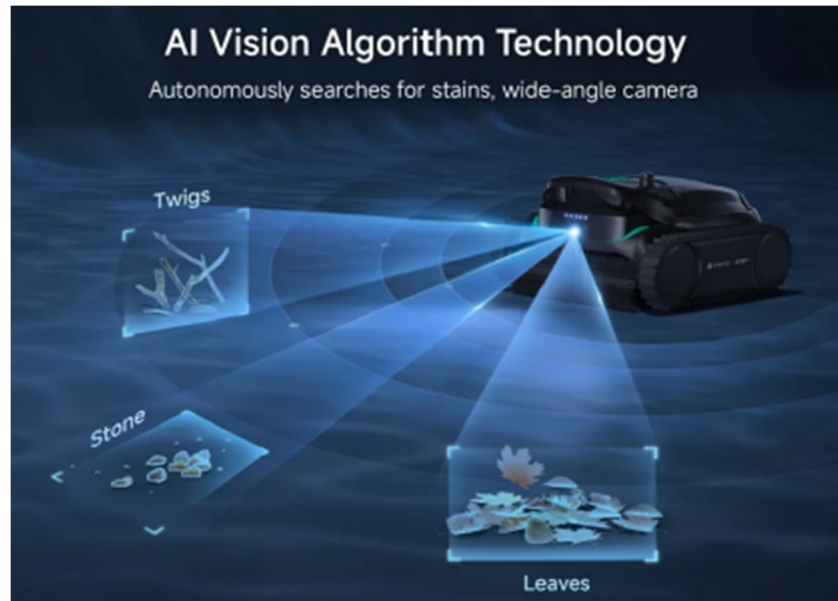
As discussed above, neither the filter limitation (5(c)) nor the controller limitation (5(f)) are disclosed or rendered obvious by the Schnittman-Benzler combination. *See supra* Section IX. The Petition introduces Hui only to address a chemical dispenser (5(d)) but does not otherwise discuss, address, or supplement its analysis regarding the other claim elements. Thus, the Petition’s analysis of Claim 5 over Schnittman-Benzler-Hui fails for the same reasons discussed above.

**XII. COMMERCIAL SUCCESS AND PRAISE FROM PETITIONER
CONFIRM NON-OBVIOUSNESS.**

Market praise, including from Petitioner and Petitioner's commercial success in selling its practicing products demonstrate that the claims of the Challenged Patent are not obvious.

There is a strong nexus between the objective evidence of secondary considerations and the Challenged Claims. The claimed underwater vision navigation approach allows the controller in the robotic pool cleaner to use an image of the submerged surface of the pool captured by a camera on the robotic pool cleaner to generate a control signal to cause the robotic pool cleaner to move within the pool to, or away from, a portion of the imaged submerged surface.

Petitioner's WYBOT M2 and other robotic pool cleaner products embody the Challenged Claims. As shown in Petitioner's marketing materials detailed below, Petitioner's products, including the WYBOT M2, incorporate a camera to capture images of the submerged surface of the pool and generate control signals to direct the robotic pool cleaner toward or away from the imaged submerged surfaces—precisely the claimed underwater vision navigation approach. Because Petitioner's products embody the claimed features, a presumption of nexus applies. *Fox Factory, Inc. v. SRAM, LLC*, 944 F.3d 1366, 1373 (Fed. Cir. 2019).



Ex. 2020, 4 (Wybotics advertisement for WYBOT M2).

Petitioner cannot overcome this presumption because, as Petitioner’s own statements demonstrate, the commercial success and industry praise are directly attributable to the novel underwater vision navigation approach—not to extraneous unclaimed features. However, even if the presumption does not apply, the “evidence [below] of secondary considerations is the ‘direct result of the unique characteristics of the claimed invention.’” *Fox Factory*, 944 F.3d at 1374 (quoting *In re Huang*, 100 F.3d 135, 140 (Fed. Cir. 1996)).

“Evidence that the industry praised a claimed invention or a product that embodies the patent claims weighs against an assertion that the same claimed invention would have been obvious.” *Apple*, 839 F.3d at 1053. This is especially true when competitors praise the claimed invention or a product that embodies the patent

claims because “competitors[] are not likely to praise an obvious advance over the known art.” *Id.*

Petitioner’s marketing materials confirm the value of this “groundbreaking” claimed camera-responsive approach. Ex. 2021, 2. As a first example, in a January 2024 press release, Petitioner described “the unveiling of the WYBOT M2.” *Id.* Petitioner touts that its WYBOT M2 “feature[s] the world’s first underwater vision system,” which “[r]epresent[s] a quantum leap in pool cleaning technology.” *Id.*

The underwater vision recognition system on the WYBOT M2 works by a “high-resolution camera, strategically positioned on the robot’s front, incorporat[ing] the innovative ‘Dirt Hunting Mode.’” *Id.* Petitioner explains that “[t]his technology allows the camera to navigate complex underwater environments, and focus on accurate detection, efficient elimination of debris and dirt, ensuring a thorough cleaning experience.” *Id.* Petitioner goes on, describing “[t]he unique algorithm processes scanned pool images and garbage locations, allowing the robot to automatically plan the optimal route for targeted pool cleaning.” *Id.* This “automated route planning based on processed data signals a significant step forward in cleaning precision.” *Id.*

According to Petitioner, the advantages provided by the underwater vision recognition system are so monumental that “[a]fter undergoing rigorous testing, the WYBOT M2, leveraging its advanced underwater vision recognition system, has

demonstrated an astonishing 10-20 times improvement in cleaning efficiency compared to traditional pool cleaning robots.” *Id.*

Petitioner’s statements strongly “weigh[] against an assertion that the same claimed invention would have been obvious” because Petitioner, a competitor of Patent Owner, is “not likely to praise an obvious advance over the known art.” *Apple*, 839 F.3d at 1053.

Petitioner’s Application Proof for its Initial Public Offering on the Hong Kong Stock Exchange also praises the claimed underwater vision navigation approach and attributes its alleged commercial success of certain robotic pool cleaners to this approach. Petitioner identifies its “underwater AI vision” as a “key business development milestone of [its] Group.” Ex. 2022, 100. And the products that Petitioner offers Direct-to-Consumer “are primarily our latest and most advanced models equipped with proprietary technologies such as AI-powered underwater vision.” *Id.* at 157. According to Petitioner, these Direct-to-Consumer products resulted in revenue of 458,825,000 RMB (Chinese Yuan)—approximately \$67,998,232.

Petitioner attributes its commercial success to its “strong R&D team,” which “ha[s] achieved various breakthroughs in core technologies, including ... underwater AI vision ... [and] *autonomous navigation*.” *Id.* at 120. Petitioner further states that its product portfolio includes “high computing power AI processors and cameras,

[so] our robotic pool cleaners can utilize visual signals and deep learning algorithms to identify different types of stains and automatically adjust the cleaning modes for targeted cleaning,” which includes “intelligently planning the optimal cleaning path.” *Id.*

XIII. CONCLUSION

For at least the reasons set forth above, the Petition fails to shoulder its burden of establishing that the Challenged Claims of the Challenged Patent are unpatentable.

Dated: August 11, 2026

Respectfully submitted,

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CERTIFICATE OF WORD COUNT

Pursuant to 37 C.F.R. § 42.24(d), the undersigned certifies that this **Patent Owner Response** contains 13,990 words according to the word-processing program used to prepare this paper. The foregoing word count complies with the 14,000 word type-volume limit specified by 37 C.F.R. § 42.24(b)(1).

Dated: August 11, 2026

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CERTIFICATE OF SERVICE

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