

UNITED STATES PATENT AND TRADEMARK OFFICE

BEFORE THE PATENT TRIAL AND APPEAL BOARD

SHARKNINJA OPERATING LLC,
SHARKNINJA MANAGEMENT LLC, AND
SHARKNINJA SALES COMPANY,

Petitioner,

v.

IROBOT CORPORATION,
Patent Owner.

IPR2020-01639
Patent 10,296,007 B2

Before BARRY L. GROSSMAN, TERRENCE W. McMILLIN, and
JASON W. MELVIN, *Administrative Patent Judges*.

MELVIN, *Administrative Patent Judge*.

JUDGMENT
Final Written Decision
Determining All Challenged Claims Unpatentable
35 U.S.C. § 318(a)

I. INTRODUCTION

A. BACKGROUND

SharkNinja Operating LLC, SharkNinja Management LLC, and SharkNinja Sales Company (“Petitioner”) filed a Petition (Paper 1, “Pet.”) requesting *inter partes* review of claims 1–22 of U.S. Patent No. 10,296,007 B2 (Ex. 1001, “the ’007 patent”). iRobot Corporation (“Patent Owner”) filed a Preliminary Response. Paper 6. Although the Petition challenged claim 22 based on Köchel, Patent Owner disclaimed that claim prior to filing the Preliminary Response. Ex. 2001; Prelim. Resp. 21–22 n.4. Thus, claims 1–21 are the challenged claims. After preliminary briefing, we instituted review. Paper 9 (“Institution Decision” or “Inst.”). Patent Owner filed a Response (Paper 16, “PO Resp.”), Petitioner filed a Reply (Paper 22, “Pet. Reply”), and Patent Owner filed a Sur-Reply (Paper 26, “PO Sur-Reply”). An oral hearing was held on January 13, 2022, and a transcript appears in the record. Paper 32.

We have jurisdiction under 35 U.S.C. § 6(b). This is a Final Written Decision under 35 U.S.C. § 318(a) and 37 C.F.R. § 42.73. For the reasons set forth below, we find Petitioner has demonstrated by a preponderance of evidence that claims 1–21 of the ’007 patent are unpatentable.

B. RELATED MATTERS

The parties indicate that no judicial or administrative matters involve the ’007 patent. Paper 3, 2; Pet. 74.

C. REAL PARTIES IN INTEREST

The parties identify only the captioned entities as the real parties in interest. Pet. 74; Paper 3, 2.

D. THE '007 PATENT

The '007 patent relates to “a mobile robot and a method of confining the movement of the robot to a limited area, such as the surface of an area rug.” Ex. 1001, 1:33–35. It describes using a sensor that measures a signal’s reflection from the floor surface to indicate an edge of the floor surface. *Id.* at 1:49–60, 5:9–18. The robot may be redirected when the sensor indicates a change in floor surface. *Id.* at 1:63–2:6, 2:27–39. In that manner, the robot may be kept on one floor surface and prevented from crossing onto another surface. *Id.* at 5:64–67. The '007 patent describes that, when the robot encounters the perimeter of a designated area, it may use “a series of escape modes so that the robot can turn away from the boundary and/or clean the surface adjacent to the perimeter before resuming a normal cleaning behavior.” *Id.* at 5:67–6:5.

As the '007 patent describes, behavior modes “cause the robot 100 to take an action, such as maneuvering the robot 100 in a manner designed to cover an area or in a new direction when an obstacle or flooring change is detected.” *Id.* at 7:45–50. Those behavior modes may include Area Coverage Modes 352 and Escape Behavior Modes 354. *Id.* at 7:50–52. The Escape Behavior Modes are relevant here. According to the '007 patent, “[i]n some examples, the Escape Behavior Modes 354 features selecting a new heading by implementing a clockwise or counterclockwise turn to achieve the new heading.” *Id.* at 8:51–54. When a sensor on one side of the robot detects a surface change, the robot can turn to the other side, “to turn the robot away from a sensed floor surface edge.” *Id.* at 8:58–9:3. The specification states also that, “[i]n some examples, the robot is turned while traveling forward,

so as to follow a curved floor surface edge, such as the edge of a circular or oval area rug.” *Id.* at 9:4–6.

E. CHALLENGED CLAIMS

Independent claim 1 is reproduced below:

1. A cleaning robot comprising:
 - a drive system configured to drive the cleaning robot;
 - a sensor configured to produce a sensor output indicative of a characteristic of a surface on which the cleaning robot is traveling; and
 - a controller in communication with the drive system and the sensor, the controller configured to control the drive system to drive the cleaning robot within a first area having a first surface type, and alter a drive direction of the cleaning robot in response to a determination indicating an edge of the first area having the first surface type has been reached, in which the edge represents a traversable border between the first area and a second area having a second surface type that is different from the first surface type, the determination being based on a change in a surface characteristic determined from a change in the sensor output, the drive direction altered so as to keep at least a portion of the cleaning robot from crossing the edge of the first area, wherein the edge of the first area is an edge of at least one of a rug, a carpet, a hardwood surface, or a tile surface on which the cleaning robot is moving, and the sensor output is produced in response to sensing a signal reflected from another surface adjacent the edge of the at least one of the rug, the carpet, the hardwood surface, or the tile surface.

Ex. 1001, 16:42–67. Claims 2–12 depend, directly or indirectly, from claim 1. *Id.* at 17:1–52. Independent claim 13 is reproduced below:

13. A method of maneuvering an autonomous robot across a surface within a bounded area having at least one open edge, the method comprising:
- driving the autonomous robot across a surface while sensing a sensor output from a sensor of the autonomous robot, the sensor output indicative of a characteristic of the surface on which the autonomous robot is traveling;
 - while continuing to drive the autonomous robot, evaluating the sensor output against a baseline signal characteristic to determine whether the sensor output is indicative of the autonomous robot being adjacent the at least one open edge of the bounded area, in which the open edge represents a traversable border between the bounded area having a first surface type and a second area having a second surface type that is different from the first surface type; and,
 - in response to determining from the sensor output that the autonomous robot is adjacent the at least one open edge of the bounded area, altering a direction of motion of the autonomous robot such that the autonomous robot is directed away from the at least one open edge, wherein the open edge is an edge of at least one of a rug, a carpet, a hardwood surface, or a tile surface on which the cleaning robot is moving, and the sensor output is produced in response to sensing a signal reflected from another surface adjacent the edge of the at least one of the rug, the carpet, the hardwood surface, or the tile surface.

Id. at 17:53–18:17. Claims 14–21 depend, directly or indirectly, from claim 13. *Id.* at 18:18–58.

F. PRIOR ART AND ASSERTED GROUNDS

Petitioner asserts the following grounds of unpatentability:

Claim(s) Challenged	35 U.S.C. §	References/Basis
1–7, 10–18, 20	103	Köchel ¹
8, 9, 19, 21	103	Köchel, Windorfer ²

Pet. 2. Petitioner relies also on two Declarations of Noah J. Cowan, Ph.D. (Ex. 1002 and Ex. 1018).

II. ANALYSIS

A. LEVEL OF ORDINARY SKILL IN THE ART

Petitioner proposes that a person of ordinary skill “would have had at least a bachelor’s degree in physics, electrical engineering, mechanical engineering, computer science, or a related discipline, and would have had at least one year of experience in the design and implementation of robotics and embedded systems, or some other equivalent combination or education and experience.” Pet. 4–5 (citing Ex. 1002 ¶ 19). Patent Owner does not dispute this definition of a person of ordinary skill. *See generally* PO Resp. We adopt Petitioner’s proposed level of ordinary skill as it appears to be consistent with the level of skill reflected by the specification and the asserted prior art.

¹ German Patent Publication No. DE10113105 A1 (Ex. 1004 (original); Ex. 1005 (certified translation)).

² US 2014/0075689 A1, filed Sept. 18, 2013, published Mar. 20, 2014 (Ex. 1006).

B. CLAIM CONSTRUCTION

For an *inter partes* review petition filed after November 13, 2018, we construe claim terms “using the same claim construction standard that would be used to construe the claim in a civil action under 35 U.S.C. 282(b).” 37 C.F.R. § 42.100(b) (2019). Petitioner submits that no term requires express construction. Pet. 5. Patent Owner contends that that we should construe “directed away” as recited in claim 13. PO Resp. 10.

In the Institution Decision, we construed “directed away” as requiring that “a robot is turned such that its heading is not aligned with the edge between floor surfaces and points toward the interior of the bounded area. Inst. 10. Patent Owner contends that the preliminary construction is correct as to the robot’s alignment, but should further require that “the robot is caused to depart the at least one open edge to an interior of the bounded area.” PO Resp. 10 (citing Ex. 2066 ¶¶ 37–47).

Initially, we are mindful of the claim language itself. The limitation at issue recites “altering a direction of motion of the autonomous robot such that the autonomous robot is directed away from the at least one open edge.” Ex. 1001, 18:8–10. That language uses “such that” to indicate a direct relationship between “altering a direction of motion” and the robot being “directed away” from the detected edge—the direction must be altered in a manner that directs the robot away from the edge. Thus, the plain claim language is consistent with a direction change alone being sufficient to satisfy the “directed away” limitation.

According to Patent Owner, the specification supports a requirement to move away from the edge in addition to turning away from the edge. PO Resp. 13. Patent Owner relies on a description that the robot “may rotate

right *before proceeding*.” Ex. 1001, 8:66–9:1 (emphasis added). We do not read the specification the same way. The “before proceeding” passage follows a statement that, when sensors on the robot’s two sides detect a surface or elevation change, “Escape Behavior Mode 354 may include a rotation such that a heading of the robot 100 is to the left of a previous travel heading.” *Id.* at 8:64–66. And following the “before proceeding” sentence, the specification summarizes: “In other words, the controller may act to turn the robot away from a sensed floor surface edge.” *Id.* at 9:1–3. Patent Owner argues that the reference using “in other words” indicates that turning the robot away from a sensed edge includes proceeding away from the edge. PO Resp. 13. We do not agree, as the preceding examples (turning left and turning right) share only a heading change, not forward motion. Thus, the specification does not support that forward motion is a necessary part of altering the robot’s direction of motion such that it is directed away from a detected edge.

Although the intrinsic record appears to support the construction we adopted in the Institution Decision, we need not resolve the precise limit of forward motion required for a robot to be directed away from a detected edge. As discussed below, we are persuaded that Köchel’s disclosures render claim 13 obvious even under a construction that requires some degree of forward motion. Thus, we do not address the parties’ dispute over whether a robot requires more than a direction change to be “directed away” from a detected edge. *See Nidec Motor Corp. v. Zhongshan Broad Ocean Motor Co.*, 868 F.3d 1013, 1017 (Fed. Cir. 2017).

Patent Owner, however, argues that a robot that “only incidentally distances from the edge in the context of aligning to or following the edge” does not satisfy the proper construction. PO Resp. 50 (distinguishing Köchel’s robot). The only support that Patent Owner provides for the distinction, however, is the specification’s statement that, “[i]n some examples, the robot 100 resumes the Area Coverage Mode 352 upon no longer detecting a ‘non-selected’ floor surface type.” *Id.* (quoting Ex. 1001, 7:65–67). That passage arises when the specification explains that a robot detecting a flooring change may switch to Escape Behavior Mode before resuming Area Coverage Mode. Ex. 1001, 7:53–65. While the specification discloses Escape Behavior Mode as a way to turn away from a detected boundary, the cited passage indicates that Escape Behavior Mode need not control the robot’s behavior for any particular extent (temporal or spatial). Indeed, the passage states that the robot may resume Area Coverage Mode “upon no longer detecting” the different floor surface, indicating that Escape Behavior Mode may apply only when the different floor surface is actively detected. *See* Ex. 1001, 7:65–67. Thus, we do not agree with Patent Owner that a robot may be “directed away” only when it departs the edge in a substantial way. *See* PO Resp. 50.

Beyond that, Patent Owner’s proposed construction requires only that “the robot is caused to depart the at least one open edge to an interior of the bounded area.” *Id.* at 10. As discussed below, that does not distinguish Köchel’s teachings.

C. OBVIOUSNESS OVER KÖCHEL

Köchel discloses a floor care machine such as a vacuum cleaner. Ex. 1005, code (57). Köchel's machine uses ultrasonic sensors to determine the surface texture of floor coverings, and explains that the sensor "is arranged in front of the center of gravity in the travel direction," allowing the machine to recognize downward leading steps. *Id.* ¶¶ 2, 4, 7. As another configuration, Köchel discloses using two sensors "directly alongside each other" to recognize "transitional edges between different floor coverings." *Id.* ¶ 7; *accord id.* ¶¶ 65–67 (discussing Fig. 12).

Köchel discloses methods "for orienting the travel movement of an automatic floor care machine . . . along an edge of a particular floor covering" by performing a direction change upon detecting the change in floor covering. *Id.* ¶ 9. To align with an edge, Köchel discloses that the machine may be maneuvered in "a zig zag approaching of the travel direction to the marginal edge of the floor covering," where "the degree of the first direction change is more than 90°." *Id.* In a further description of that process, Köchel states that, "[a]s soon as the change in the floor covering is detected via the evaluation electronics, a change in direction with respect to the travel direction *r* of the floor care machine 1 is undertaken, where the degree of a first change in direction at first amounts to more than 90°." *Id.* ¶ 63.

1. Claim 1

Claim 1 recites the controller be configured to "alter a drive direction of the cleaning robot in response to a determination indicating an edge . . . has been reached, . . . so as to keep at least a portion of the cleaning robot

from crossing the edge.” Ex. 1001, 16:50–60. Petitioner submits that Köchel discloses that limitation because it states that “[a]s soon as [a] change in the floor covering is detected . . . a change in direction with respect to the travel direction *r* of the floor care machine 1 is undertaken.” Pet. 16 (quoting Ex. 1005 ¶ 63), 19 (same). Petitioner points also to Köchel’s Figure 12, which depicts the machine moving along a detected edge by using “two parallel arranged ultrasonic transducers” on each side of the machine to detect the position of an edge. *Id.* at 19 (citing Ex. 1005, Fig. 12); *accord* Ex. 1005 ¶¶ 65–67.

Patent Owner argues that Köchel’s disclosure of direction change “as soon as the change in the floor covering is detected” does not satisfy the claim language because it relates to timing, not distance. PO Resp. 20. Patent Owner does not explain that distinction, but instead asserts Köchel is uncertain regarding “the precise nature and extent of the robot’s movements” between initially crossing an edge and ultimately aligning travel with the edge. *Id.* at 22. That focus misses the point. While Köchel discloses a series of maneuvers that a robot may use to align its travel along a detected edge, Petitioner relies on only the initial motion once detecting the edge. *See* Pet. 14–16. Whether Köchel discloses additional actions after the initial turn does not bear on the claim language at issue.

Patent Owner argues that Köchel fails to describe a turn that would prevent the robot from completely crossing the edge. PO Resp. 23–37. First, Patent Owner submits that “detection latency” could be sufficiently large to permit Köchel’s robot to fully cross a detected edge before turning. *Id.* at 23–27. Because Köchel describes averaging the sensor output over time

and implementing hysteresis when filtering the sensor signal, Patent Owner submits that Köchel's "robot would fully cross the edge if the detection latency was sufficiently long." *Id.* at 24–27. Petitioner, on the other hand, submits that detection latency would be negligible and that Patent Owner's suggestion otherwise is unsupported speculation. Pet. Reply 3–5.

In particular, Petitioner points to testimony from Patent Owner's expert demonstrating he did not use a sound basis on which to draw his conclusions. Ex. 1017, 15:10–16:1. We agree that Patent Owner's expert did not sufficiently support his conclusion that detection latency would allow Köchel's robot to fully cross a detected edge. Moreover, Patent Owner's expert testified as to ranges of operating conditions, and Petitioner's expert conducted simulations using those conditions. *See* Pet. Reply 4–6. Those simulations show that Köchel's robot would not fully cross a detected edge. Ex. 1018 ¶¶ 6–12. Patent Owner points to an error in the simulation parameter for travel speed, but presents a corrected simulation that also shows the robot does not fully cross a detected edge. PO Sur-Reply 14–16 (citing Ex. 2072 39:19–42:18; Ex. 2069). Patent Owner argues that Petitioner's expert, Dr. Cowan, improperly "limit[ed] the simulation to a single set of tightly controlled conditions" (PO Sur-Reply 14–21), for example by averaging five samples, which Köchel discloses as the minimum for a "preferable" approach (*id.* at 16–17 (citing Ex. 1005 ¶ 8)). We do not agree that Dr. Cowan's approach was unreasonable or shows an unrealistic view of Köchel. Especially because signal averaging is merely preferred in Köchel, we see no reason that a simulation should average a higher number of samples. It is true that Patent Owner can identify parameters causing a

simulated robot to fully cross a detected edge, but the question is whether Köchel discloses a robot that turns without fully crossing the edge, not whether it discloses only that. Stated otherwise, if Köchel discloses a robot that turns without fully crossing the edge when operated in a certain way but does fully cross the edge if configured differently, that satisfies the claim. *See ParkerVision, Inc. v. Qualcomm Inc.*, 903 F.3d 1354, 1361 (Fed. Cir. 2018) (holding that a reference discloses a device as claimed when it discloses a device that may operate as claimed at least in some configurations).

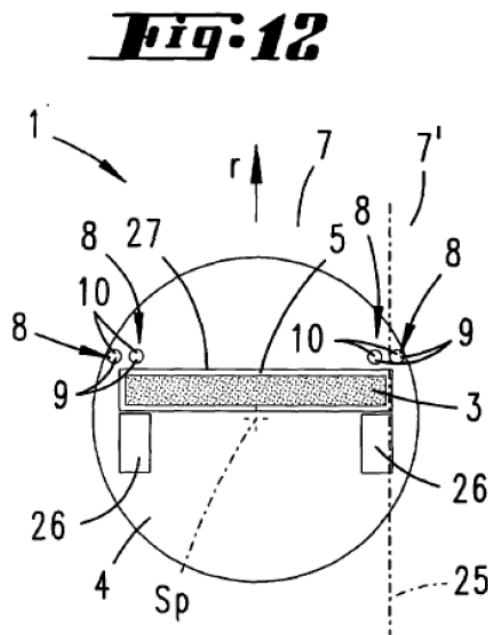
Petitioner submits further that Köchel’s description of a “zigzag” approach is consistent with a robot that stops to turn before proceeding forward on a new heading. Pet. Reply 6–13. In that regard, Petitioner criticizes Patent Owner’s depiction of a gradual turn as inconsistent with Köchel’s teachings. *Id.* at 7–12. We agree with Petitioner that a sharp turn is consistent with Köchel’s stated goal of thoroughly cleaning a surface. *See* Ex. 1005 ¶ 7. As Petitioner points out, the gradual turn Patent Owner contends is disclosed (*see* PO Resp. 28) would leave areas uncleaned. We agree with Petitioner also that the record supports that Köchel uses the term “zig zag” consistently with its ordinary meaning. Ex. 1017, 50:1–6. Although Patent Owner’s expert, Dr. Hooper, asserts that “zig zag” encompasses any back-and-forth movement (Ex. 2066 ¶¶ 72–73; *see* PO Resp. 31) and cites several references, we find Petitioner’s view of the term more persuasive. The first reference, Lewis, specifically defines its zig zag as a sinusoidal function. Ex. 2032, 4. That supports that the term may be applied to such motion, but does not indicate it is the ordinary meaning.

Moreover, Lewis instructs that its zig-zag motion is achieved by adding “a constant forward bias . . . so the robot makes constant progress,” but that approach is not consistent with Köchel’s goal of thoroughly cleaning a surface. Another reference, Sandin, depicts a robot’s sensor output measuring grass-height signals as it “execut[es] an edge following behavior,” producing a “vertical zig-zag appearance” in the sensor signal. Ex. 2033, 31:51–54; *see id.*, Fig. 16E. The sharp changes Sandin depicts are consistent with sharp direction changes, as in Petitioner’s view of a zig-zag motion. *Id.*, Fig. 16E. Finally, Thompson describes a robot mower’s pattern as including a “zig-zag pattern to shift the wheel tracks” as the robot repeats travel along a boundary, and specifically instructs that a sine pattern is an alternative to the zig zag. Ex. 2034, 9:51–63. Considering the record as a whole, we read Köchel’s “zig zag” travel as relatively sharp turns connected by straight segments. As discussed above regarding Dr. Cowan’s simulations, it is unnecessary to determine whether Köchel’s description includes some forward motion during a turn because even if it does, Köchel discloses a maneuver in which the robot does not fully cross the detected edge. *See supra* at 12–13; Pet. Reply 5; Ex. 1018 ¶¶ 11–12.

Patent Owner raises additional arguments about what Köchel’s disclosures might allow, submitting that “more than 90°” allows for a 270° turn, for example. PO Resp. 32–35. Those suppositions, however, are not consistent with Köchel’s disclosure that its robot turns “[a]s soon as the change in the floor covering is detected” and its ultimate goal of traveling along a detected marginal edge. *See* Ex. 1005 ¶ 63. For that same reason, we do not agree with Patent Owner’s argument that Köchel fails to disclose a

robot “configured” to not fully cross a detected edge. *See* PO Resp. 35. Because Köchel’s robot turns as soon as the edge is detected, it is configured to keep the robot from fully crossing the edge.

Finally, Patent Owner argues that Petitioner’s further reliance on Köchel’s Figure 12 “is unavailing.” PO Resp. 37–44. Patent Owner contends that Figure 12 depicts an alternative embodiment for “the physical arrangement of ultrasonic transducers” and would use the same “more than 90°” turn and “zig zag” movement discussed above. *Id.* at 41. Figure 12 is reproduced below:



Ex. 1005, Fig. 12. Figure 12 depicts a “parallel arrangement of ultrasonic transducers 8,” one pair on each side of the robot. *Id.* ¶¶ 65–66. Because the Figure 12 embodiment would use the same maneuvers, Patent Owner submits that it does not help Petitioner’s showing for claim 1’s requirement to “keep at least a portion of the cleaning robot from crossing the edge.”

PO Resp. 44. As discussed above, however, we agree with Petitioner that those maneuvers satisfy the disputed claim language.

Patent Owner does not otherwise dispute Petitioner’s showing regarding obviousness of claim 1 over Köchel. We determine Patent Owner has waived any such argument. *See* Paper 10, 8 (“Patent Owner is cautioned that any arguments not raised in the response may be deemed waived.”); *In re NuVasive, Inc.*, 842 F.3d 1376, 1380–81 (Fed. Cir. 2016); Consolidated Trial Practice Guide 52 (Nov. 2019), *available at* <https://www.uspto.gov/TrialPracticeGuideConsolidated> (“CTPG”). Petitioner’s contentions address each limitation of claim 1. Pet. 10–24. We have reviewed the parties’ contentions and the evidence presented and conclude that Petitioner has shown by a preponderance of the evidence that the subject matter of claim 1 would have been obvious over Köchel.

2. Claim 13

Claim 13 requires “altering a direction of motion of the autonomous robot such that the autonomous robot is directed away from the at least one open edge [of a bounded area].” Ex. 1001, 17:53–18:10. Petitioner submits that Köchel teaches this limitation with the same disclosures discussed above with claim 1. Pet. 47–49 (citing Ex. 1005 ¶¶ 9, 63). Petitioner additionally points to Köchel’s disclosure that “the degree of the first direction change is more than 90°.” *Id.* at 49 (quoting Ex. 1005 ¶ 63); *accord* Ex. 1005 ¶ 63. The greater-than-90° direction change, in Petitioner’s view, means the robot is directed away from an open edge. Pet. 49.

Patent Owner disputes only one aspect of claim 13. Patent Owner argues that Köchel’s “more than 90°” turn upon detecting an edge fails to

satisfy the claim language because it is part of Köchel's procedure to align its robot's travel with the edge. *Id.* at 44–49. Whether Köchel's robot makes additional maneuvers after turning away from the edge, however, is not implicated by the claim language. The limitation at issue relates to the robot's response to determining that the robot is adjacent an open edge of the bounded area, and requires altering the robot's direction of motion “such that the autonomous robot is directed away from” the open edge. Ex. 1001, 18:6–10. Patent Owner's argument to the contrary—focusing on the intent and ultimate goal of Köchel's turn away from the edge—attempts to impose a requirement that the claim language does not. Thus, we do not agree with Patent Owner that Köchel's ultimate goal of aligning its robot's travel with a boundary undermines its disclosure of turning away from the boundary when first detected.

As discussed above, we find that Köchel discloses a robot that, when it detects a floor covering edge, turns before the entire robot crosses the edge. *See supra* at 13–15. By disclosing that its robot turns by more than 90°, Köchel additionally teaches that the robot's heading after turning will be away from the detected edge, toward the interior of the original surface.

Patent Owner argues also that Köchel discloses *only* a heading change upon detecting an edge, therefore failing to satisfy the claim's requirement to depart the edge toward the interior. PO Resp. 49–51. As discussed above regarding claim construction, Patent Owner does not adequately support a requirement for a particular travel distance after turning away from the edge. *See supra* at 7. Patent Owner does not dispute that Köchel's robot proceeds forward to some degree after the “more than 90°” turn. *See, e.g.,*

PO Resp. 28 (citing Ex. 2066 ¶¶ 63–64 (depicting a Köchel’s robot making a gentle turn after detecting an edge, then proceeding toward the interior)), 29–32 (arguing Köchel’s robot maintains forward motion through its turn). Thus, we find that Köchel’s robot departs the edge after its turn away from the edge.

Accordingly, under Patent Owner’s proposed construction as limited above (*see supra* at 8–9), we conclude that Köchel discloses a robot that alters its direction of motion such that it is directed away from a detected edge.

Patent Owner does not otherwise dispute Petitioner’s showing regarding obviousness of claim 13 over Köchel. PO Resp. 44–51. We determine Patent Owner has waived any such argument. *See* Paper 10, 8; *NuVasive, Inc.*, 842 F.3d at 1380–81; CTPG 52. Petitioner’s contentions address each limitation of claim 13. Pet. 40–52. We have reviewed the parties’ contentions and the evidence presented and conclude that Petitioner has shown by a preponderance of the evidence that the subject matter of claim 13 would have been obvious over Köchel.

3. Claim 4

Claim 4 depends from claim 1 and further recites that

the sensor is configured to produce the sensor output in response to sensing a reflection of a signal from a surface, and the cleaning robot further comprises multiple sensors disposed at different locations about a peripheral edge of the cleaning robot, and wherein the controller is configured to alter the drive direction as a function of which sensor out of the multiple sensors senses the reflection of the signal from which the

determination is made indicating the edge of the first area has been reached.

Ex. 1001, 17:13–22. Petitioner relies on Köchel’s embodiments with sensors on each side of the robot, as in Figures 11 and 12, which depict one or two ultrasonic sensors on each side of the robot, respectively. Pet. 27–29.

Patent Owner argues that the Petition relies on a single pair of sensors (from Figure 12), on one side of Köchel’s robot, and therefore does not satisfy the requirement for “multiple sensors disposed at different locations about a peripheral edge” of the robot. PO Resp. 53. We do not agree, as the Petition additionally identifies Köchel’s paragraph 59, which describes Figure 11, depicting one sensor on each side of the robot. Pet. 27; *see also id.* at 28 (annotating Köchel’s Figure 12 to identify sensors on both sides of the robot). Thus, the Petition identified multiple sensors disposed at different locations about the robot’s peripheral edge.

Patent Owner contends that Köchel does not describe a robot configured to alter drive direction as a function of which sensor around the periphery detects the edge. PO Resp. 53–55 (arguing that Petitioner relies on only disclosures relating to two immediately adjacent sensors). Petitioner points to Köchel’s teachings of changing travel direction “in dependence on a detection of the change in the floor covering.” Pet. 28 (quoting Ex. 1005 ¶ 9). Petitioner additionally relies on Köchel’s disclosure that the multiple transducers shown in Figure 11 (one on each side of the robot) “can also serve for orienting the travel movement of an autonomous floor care machine 1 along an edge of a detected floor covering.” Ex. 1005 ¶ 63; *see* Pet. 28. Based on those disclosures, we agree with Petitioner that Köchel discloses altering the robot’s direction as a function of which sensor detects

a floor-surface change. Because Figure 11 depicts one sensor on each side of the robot, and Köchel describes orienting the robot's travel based on detecting the floor covering with those sensors, Köchel discloses altering the robot's drive direction based on which sensor detected a change in floor surface.

Accordingly, we conclude that the subject matter of claim 4 would have been obvious over Köchel.

4. Claim 17

Claim 17 depends from claim 16 (and indirectly from claim 13) and further recites “the direction of motion of the autonomous robot is altered as a function of what portion of the sensor output differs greatest from the baseline signal characteristic.” Ex. 1001, 18:36–39. Petitioner relies on Köchel's disclosure of changing direction “in dependence on a detection of the change in the floor covering.” Pet. 59 (quoting Ex. 1005 ¶ 9). Petitioner further submits that Köchel discloses multiple adjacent sensors and can locate itself relative to a floor boundary based on relative amplitudes of the sensor signals. *Id.* (citing Ex. 1005 ¶¶ 11, 67). Regarding evaluating a sensor output against the baseline signal characteristic, Petitioner points to Köchel's disclosure of comparing a sensor's output against a threshold based on the sensor's prior output to recognize a change. *Id.* at 59–60 (citing Ex. 1005 ¶ 94 (“If a carpet floor has already been recognized, the echo amplitude must exceed a higher threshold value many times in order to recognize a hard floor. On the other hand, the echo amplitude must fall below a lower threshold value many times, if a hard floor was already recognized, in order to recognize a carpet floor.”))).

Patent Owner argues that Köchel’s disclosures fail to satisfy claim 17’s requirements because Köchel’s robot compares sensors to each other, not to the baseline signal characteristic. PO Resp. 58–60. Patent Owner challenges whether Petitioner has adequately identified Köchel’s disclosure mapping to the “baseline signal characteristic.” PO Sur-Reply 30. But Petitioner points to Köchel’s description of comparing a sensor’s signal to a threshold value based on prior detection conditions for the sensor. Pet. 60; Pet. Reply 21 (citing Ex. 1005 ¶ 94). Patent Owner has not proposed a construction for “baseline signal characteristic” and, without a basis to do otherwise, we read that term as distinct from the “baseline distribution” discussed in the specification. *See* Ex. 1001, 11:45–14:59; *Invitrogen Corp. v. Clontech Laboratories, Inc.*, 429 F.3d 1052, 1078 (Fed. Cir. 2005) (reasoning that distinct terms generally have distinct scope). Based on Petitioner’s contentions, we agree that a threshold determined based on the sensor’s history satisfies the claimed “baseline signal characteristic.” Pet. 60; Pet. Reply 21; Ex. 1005 ¶ 94 (“[A] threshold value is loaded, either a lower threshold value (P82) for hard floor recognition or an upper threshold value (P82') for no recognition.”). Based on Petitioner’s identification of comparing sensor output to threshold values, we agree that the Petition is not limited to comparing two sensor’s outputs to one another.

We further agree with Petitioner that it would have been obvious to alter the robot’s direction “as a function of what portion of the sensor output differs greatest” from the baseline. Pet. 60–61. Indeed, that is fundamental to Köchel’s navigation technique—detecting the floor surface change, using

multiple sensors positioned around the robot, and then steering the robot based on that change. Ex. 1005 ¶ 63.

Accordingly, we conclude that the subject matter of claim 17 would have been obvious over Köchel.

5. Claim 18

Claim 18 depends from claim 16 (and indirectly from claim 13) and further recites “the direction of motion of the autonomous robot is altered to navigate a corner of the bounded area in response to the sensor output indicating differences between respective signals received at sensors located on opposite sides of the autonomous robot.” Ex. 1001, 18:40–44.

Petitioner contends that Köchel satisfies the additional limitation because it discloses navigating based on detecting a change in floor covering. Pet. 61 (citing Ex. 1005 ¶ 9). Petitioner cites a statement that “cleaning can be done even in critical corner regions.” *Id.* (quoting Ex. 1005 ¶ 9). Patent Owner disputes that disclosure, asserting that Petitioner’s translation is inaccurate and that, with a proper translation, Köchel instead discloses cleaning in “critical edge regions.” PO Resp. 61 (quoting Ex. 2027, 1–2).

We need not resolve the conflicting evidence regarding Köchel’s express disclosure of cleaning corner regions, because Köchel’s other disclosures disclose navigating based on detecting flooring changes, as discussed extensively above. Ex. 1005 ¶ 9. While Patent Owner argues that Petitioner relies exclusively on adjacent “parallel arranged transducers” (PO Resp. 62), Köchel discloses using individual sensors in different locations around the robot’s periphery to navigate based on detected flooring

boundaries (*e.g.*, Ex. 1005 ¶¶ 59, 65) and Petitioner relies on that aspect of Köchel (Pet. 61 (“multiple sensors . . . at opposite sides of the floor care machine 1”). Patent Owner has not explained what additional capabilities are required to “navigate a corner” and we conclude that the plain claim language supports Petitioner’s view that Köchel’s method of turning away from detected edges would allow its robot to navigate a corner.

Accordingly, we conclude that the subject matter of claim 18 would have been obvious over Köchel.

6. Additional Claims

For claims 2–7, 10–12, 14–16, and 20, Petitioner provides contentions showing how Köchel renders obvious each of the recited elements. Pet. 24–63. Other than as addressed above, Patent Owner does not challenge Petitioner’s contentions regarding Köchel with respect to those claims. *See* PO Resp. 17–63. We determine Patent Owner has waived any such argument regarding those claims. *See* Paper 10, 8; *NuVasive, Inc.*, 842 F.3d at 1380–81; CTPG 52.

We have reviewed the parties’ contentions and the evidence presented and conclude that Petitioner has shown by a preponderance of the evidence that the subject matter of each of claims 2–7, 10–12, 14–16, and 20 would have been obvious over Köchel.

D. OBVIOUSNESS OVER KÖCHEL AND WINDORFER

1. Claim 8

Claim 8 depends from claim 7 (and indirectly from claim 1) and further recites “the signal generator is configured to emit an infrared signal

and wherein the sensor output indicates a reflection of the infrared signal from the surface.” Ex. 1001, 17:33–36.

For the additional aspects of claim 8, Petitioner relies on Windorfer. *See* Pet. 65–66, 72. Petitioner asserts that Windorfer discloses “an automatically traveling floor cleaning appliance equipped with sensors that can produce a sensor output indicative of a characteristic of a surface on which the appliance is traveling.” Pet. 66. Windorfer describes both ultrasonic and infrared sensors. *Id.* (citing Ex. 1006 ¶¶ 7, 14, 29). Based on Windorfer, Petitioner asserts “it was well known in the robotic space to use infrared sensors and/or ultrasound sensors to detect surface characteristics, and thus a POSITA would have considered infrared sensors and ultrasound sensors to be suitable substitutes for purposes of producing sensor output indicative of a characteristic of a surface.” *Id.*; *accord id.* at 72 (asserting Windorfer’s infrared sensor would be a simple substitution for Köchel’s ultrasonic sensor).

Patent Owner contends that Köchel’s innovation focused on “special ultrasonic transducers” that integrate transmitters and receivers in one device. PO Resp. 55–57. In Patent Owner’s view, substituting Windorfer’s infrared sensors would “fundamentally alter Köchel’s principle of operation” by requiring a separate infrared emitter and detector. *Id.* at 57–58. We do not agree.

Köchel describes the use of an integrated ultrasonic transducer as merely “preferable” over a separate sender and receiver. Ex. 1005 ¶ 11 (“[I]t is proposed that two ultrasound senders and/or transducers are provided alongside each other. In this regard, separate ultrasound senders and

ultrasound receivers may be provided. Preferable, however, is an arrangement per claim 1, where the same ultrasound transducer works as both the ultrasound sender and the ultrasound receiver.”). Indeed, Köchel even claims a separate sender and transducer, supporting that its invention is not limited to an integrated device. *Id.*, claim 18 (“ultrasound floor recognition by means of ultrasound sender (9) and transducer (8)”). Because Köchel discloses its integrated sensor as merely preferable and discloses a separate sender–receiver pair as within the scope of its invention, we do not agree with Patent Owner that modifying Köchel’s robot to use infrared sensors would change its principle of operation.

Petitioner makes a persuasive showing, based on Windorfer’s disclosures, that skilled artisans would have considered infrared sensors as an alternative to ultrasonic sensors, and therefore would have had reason to use Windorfer’s infrared sensors in place of Köchel’s ultrasonic sensors. Pet. 65–66, 72; *see* Ex. 1006 ¶ 14 (disclosing “surface area and/or room detection capability” using “ultrasound and/or infrared sensors”).

Accordingly, we conclude that the subject matter of claim 8 would have been obvious over Köchel and Windorfer.

2. Additional Claims

Petitioner provides contentions regarding obviousness of claims 9, 19, and 21 over Köchel and Windorfer. Pet. 67–72. Other than as already addressed, Patent Owner does not dispute those contentions. We have reviewed the parties’ contentions and the evidence presented and conclude that Petitioner has shown by a preponderance of the evidence that each of claims 9, 19, and 21 would have been obvious over Köchel and Windorfer.

III. CONCLUSION³

For the reasons discussed, we conclude:

Claim(s)	35 U.S.C. §	Reference(s)/Basis	Claim(s) Shown Unpatentable	Claim(s) Not Shown Unpatentable
1–7, 10– 18, 20	103	Köchel	1–7, 10–18, 20	
8, 9, 19, 21	103	Köchel, Windorfer	8, 9, 19, 21	
Overall Outcome			1–21	

IV. ORDER

It is

ORDERED that Petitioner has proven that claims 1–21 of the '007 patent are unpatentable; and

FURTHER ORDERED that, because this is a Final Written Decision, parties to the proceeding seeking judicial review of the decision must comply with the notice and service requirements of 37 C.F.R. § 90.2.

³ Should Patent Owner wish to pursue amendment of the challenged claims in a reissue or reexamination proceeding subsequent to the issuance of this decision, we draw Patent Owner's attention to the April 2019 *Notice Regarding Options for Amendments by Patent Owner Through Reissue or Reexamination During a Pending AIA Trial Proceeding*. See 84 Fed. Reg. 16,654 (Apr. 22, 2019). If Patent Owner chooses to file a reissue application or a request for reexamination of the challenged patent, we remind Patent Owner of its continuing obligation to notify the Board of any such related matters in updated mandatory notices. See 37 C.F.R. § 42.8(a)(3), (b)(2).

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