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Paper 8
Date: April 1, 2024

UNITED STATES PATENT AND TRADEMARK OFFICE

BEFORE THE PATENT TRIAL AND APPEAL BOARD

ABB INC.,
Petitioner,

v.

ROBOTICVISIONTECH, INC.,
Patent Owner.

IPR2023-01426
Patent 8,095,237 B2

Before PATRICK R. SCANLON, RICHARD H. MARSCHALL and SEAN P. O'HANLON, *Administrative Patent Judges.*

SCANLON, *Administrative Patent Judge*.

DECISION
Denying Institution of *Inter Partes* Review
35 U.S.C. § 314

I. INTRODUCTION

ABB Inc. ("Petitioner") filed a Petition (Paper 1, "Pet.") requesting an *inter partes* review ("IPR") of claims 1–10 and 12–28 of U.S. Patent No. 8,095,237 B2 (Ex. 1001, "the '237 patent"). RoboticVISIONTech, Inc. ("Patent Owner") filed a Preliminary Response (Paper 6, "Prelim. Resp.").

We have authority to determine whether to institute an *inter partes* review. *See* 35 U.S.C. § 314 (2018); 37 C.F.R. § 42.4(a) (2022). To institute an *inter partes* review, we must determine that the information presented in the Petition shows "a reasonable likelihood that the petitioner would prevail with respect to at least 1 of the claims challenged in the petition." 35 U.S.C. § 314(a). For the reasons set forth below, we determine that Petitioner has not demonstrated a reasonable likelihood that it would prevail with respect to at least one challenged claim. Accordingly, we do not institute an *inter partes* review of any challenged claim on any asserted ground.

II. BACKGROUND

A. Real Parties in Interest

Petitioner identifies itself as the real party in interest. Pet. 1. Patent Owner identifies itself as the real party in interest. Paper 5, 1.

B. Related Matter

The parties identify the following proceeding as a related matter involving the '237 patent: *RoboticVISIONTech, Inc. v. ABB Inc.*, No. 1:22-cv-01257-GBW (D. Del. filed September 22, 2022). Pet. 1; Paper 5, 1.

C. The '237 Patent

The '237 patent, titled "Method and Apparatus for Single Image 3D Vision Guided Robotics," issued January 10, 2012, with claims 1–28. Ex. 1001, codes (54), (45), 11:54–14:65. A Certificate of Correction for

the ’237 patent was issued July 17, 2012. *Id.* at 19. The ’237 patent describes “three-dimensional object location and guidance to allow robotic manipulation of an object with variable position and orientation using a sensor array which is a collection of one or more sensors capable of forming a single image.” *Id.* at code (57). Figure 1 is reproduced below.

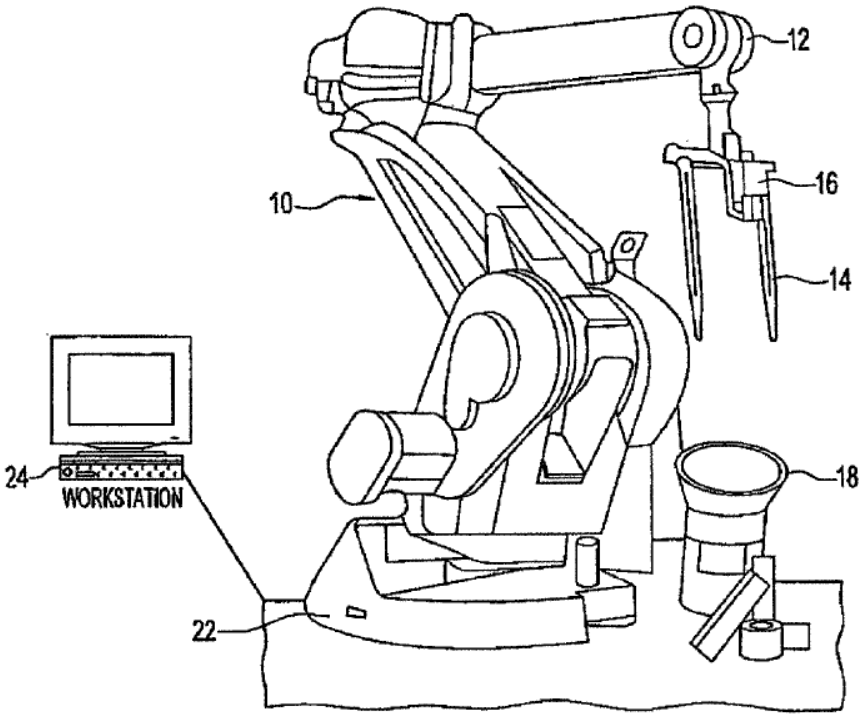

FIG. 1

Figure 1 is a perspective view of a vision-guided robot. *Id.* at 2:29. Robot 10 includes base 22 and manipulating arm 12 having tool 14 and camera 16 mounted thereon. *Id.* at 2:53–55. Tool 14 is designed to manipulate target object 18. *Id.* at 2:55–56. Robot 10 and camera 16 are electrically connected to computer control station 24 for communication of data back and forth. *Id.* at 2:57–59.

The method of operating robot 10 includes calibrating the camera. Ex. 1001, 2:60–62. The calibration process involves finding the camera

intrinsic parameters (i.e., focal length, image center, real pixel size, and radial and tangential distortion for the lens) and the position of the camera relative to the tool. *Id.* at 3:29–31, 3:36–38. "The internal parameters describe how the camera forms an image while the external parameters describe the camera's pose (i.e. position and orientation) in the world coordinate frame." *Id.* at 4:6–9. The method of operation also includes training or teaching the system at least five features on the target object. *Id.* at 2:63, 5:12–6:5.

To carry out object location and robot guidance, tool 14 is positioned in any predefined position and an image of object 18 is captured. Ex. 1001, 7:6–10. The system then searches for trained features in the image. *Id.* at 7:11–18. The positions of at least five features found in the search are used to calculate the transformation between the Object Space (i.e., a reference frame defined with respect to, and therefore rigid to, object 18) and the Camera Space (i.e., a reference frame defined with respect to a point on, and therefore rigid to, camera 16) using an extrinsic calibration algorithm. *Id.* at 2:8–9, 2:25–26, 7:19–22. The object space-to-camera space transformation is then used in conjunction with a camera space-to-tool space transformation to find the position of the Object Frame (i.e., a reference frame defined with respect to a point on, and therefore rigid to, object 18) in Tool Space (i.e., a reference frame defined with respect to a point on, and oriented along the direction of the end-effector and therefore rigid to, tool 14). *Id.* at 2:10–12, 2:27–28, 7:30–33. Robot 10 uses the Object Frame as the reference frame for the robot's operation path. *Id.* at 7:34–35.

D. Challenged Claims

As noted above, Petitioner challenges claims 1–10 and 12–28 of the '237 patent. Claims 1, 20, and 25 are independent. Claim 1 is illustrative of the claimed subject matter and is reproduced below:

> 1. A method useful in three-dimensional pose estimation for use with a single camera mounted to a movable portion of a robot, the method comprising:
>
> capturing a two-dimensional image of a volume containing a target object;
>
> locating a number of features in the captured image of the target object; and
>
> determining by a processor an object space-to-camera space transformation for the target object based at least in part on a position of at least some of the located features using only the single captured image and an algorithm that employs a known or determinable physical relationship between at least some of the located features.

Ex. 1001, 11:54–67; Certificate of Correction dated July 17, 2012.

E. Asserted Grounds of Unpatentability

Petitioner contends that the challenged claims are unpatentable based on the following grounds:

Claims Challenged	35 U.S.C. §[1]	Reference(s)/Basis
1–4, 6–10, 17–20, 24–28	103(a)	Corke[2]

[1] The Leahy-Smith America Invents Act ("AIA"), Pub. L. No. 112-29, 125 Stat. 284, 287–88 (2011), amended 35 U.S.C. § 103, effective March 16, 2013. Because the challenged claims of the '237 patent have an effective filing date before March 16, 2013, the pre-AIA version of 35 U.S.C. § 103 applies.

[2] Peter I. Corke, *Visual Control of Robots: High-Performance Visual Servoing* (1996) (Ex. 1004).

Claims Challenged	35 U.S.C. §[1]	Reference(s)/Basis
5, 12–16, 21–24	103(a)	Corke, Wei-I[3]

Pet. 5. Petitioner relies on the Declaration of Seth Hutchinson, Ph.D. (Ex. 1003) to support its challenges. Patent Owner relies on the Declaration of Thomas R. Kurfess, Ph.D. (Ex. 2001) to support its Preliminary Response.

III. ANALYSIS

A. Level of Ordinary Skill in the Art

In determining whether an invention would have been obvious at the time it was made, 35 U.S.C. § 103(a) requires us to resolve the level of ordinary skill in the pertinent art at the time of the invention. *Graham v. John Deere Co.*, 383 U.S. 1, 17 (1966). The person of ordinary skill in the art is a hypothetical person who is presumed to have known the relevant art at the time of the invention. *In re GPAC, Inc.*, 57 F.3d 1573, 1579 (Fed. Cir. 1995). Factors that may be considered in determining the level of ordinary skill in the art include, but are not limited to, the types of problems encountered in the art, the sophistication of the technology, and educational level of active workers in the field. *Id.* In a given case, one or more factors may predominate. *Id.*

Petitioner contends that a person having ordinary skill in the art "would have had a Bachelor's degree in robotics, mechanical engineering, computer science, electrical engineering, or an equivalent, and at least three years of professional experience working in the field of computer vision or three years of graduate education, including a focus on computer vision

[3] Guo-Qing Wei, et al., *Active Self-Calibration of Robotic Eyes and Hand-Eye Relationships with Model Identification*, TRANSACTIONS ON ROBOTICS AND ANIMATION, Vol. 14, No. 1 (Feb. 1998) (Ex. 1005).

applications" and "would have knowledge about machine vision and camera calibration techniques." Pet. 7–8 (citing Ex. 1003 ¶¶ 77–78). Patent Owner does not address the level of ordinary skill in the art in its Preliminary Response.

Based on our review of the record before us, we determine that Petitioner's stated level of ordinary skill in the art is reasonable because it appears consistent with the evidence of record, including the asserted prior art. Accordingly, for the purposes of this Decision, we adopt Petitioner's definition.

B. Claim Construction

In *inter partes* reviews, the Board interprets claim language using the district-court-type standard, as described in *Phillips v. AWH Corp.*, 415 F.3d 1303 (Fed. Cir. 2005) (en banc). *See* 37 C.F.R. § 42.100(b). Under that standard, we generally give claim terms their ordinary and customary meaning, as would have been understood by a person of ordinary skill in the art at the time of the invention, in light of the language of the claims, the specification, and the prosecution history. *See Phillips*, 415 F.3d at 1313–14. Although extrinsic evidence, when available, may also be useful when construing claim terms under this standard, extrinsic evidence should be considered in the context of the intrinsic evidence. *See id.* at 1317–19.

Petitioner indicates that, for purposes of the Petition, it relies on the definitions provided in the specification of the '237 patent, including the definitions for "object space" and "training space." Pet. 8 (citing Ex. 1001, 3:3–34). Regarding the claim terms "means for calibrating the camera" and "means for estimating a pose of a target object" recited in claims 20–28, Petitioner argues that the functional language provided by each of these

terms is the corresponding algorithm.[4] *Id.* at 8–9 (citing Ex. 1001, Figs. 5, 7; Ex. 1003 ¶¶ 88–89. Thus, according to Petitioner, these terms are not means-plus-function limitations under 35 U.S.C. § 112(6) and no construction is necessary. *Id.* at 9 (citing Ex. 1003 ¶ 90).

Patent Owner indicates that, although it takes no position on the proper construction of the terms, it applies Petitioner's proposed definitions of "object space" and "training space" for purposes of its Preliminary Response. Prelim. Resp. 6. In addition, Patent Owner indicates that it "takes no position as to the proper construction of the 'means for' elements recited in claims 20–28 for purposes of this Preliminary Response," and asserts that because "[n]one of Patent Owner's arguments rely on any particular construction of these claim elements, . . . the Board does not need to determine the proper construction at this preliminary stage." *Id.* at 7 (citing *Vivid Techs., Inc. v. Am. Sci. & Eng'g, Inc.*, 200 F.3d 795, 803 (Fed. Cir. 1999); *Nidec Motor Corp. v. Zhongshan Broad Ocean Motor Co., Ltd.*, 868 F.3d 1013, 1017 (Fed. Cir. 2017)).

In view of the parties' positions, we apply the definitions provided in the specification of the '237 patent for the corresponding claim terms for purposes of this Decision. Furthermore, on the present record, we do not discern a need to construe explicitly any other claim language because doing so would have no effect on our analyses below of Petitioner's asserted grounds and will not assist in resolving the present controversy between the parties. *See Realtime Data, LLC v. Iancu*, 912 F.3d 1368, 1375 (Fed. Cir. 2019) ("The Board is required to construe 'only those terms . . . that are in

[4] The Petition does not address how the claim term "means for training" recited in claims 21–23 should be interpreted.

controversy, and only to the extent necessary to resolve the controversy.'") (quoting *Vivid Techs.*, 200 F.3d at 803 (Fed. Cir. 1999)).

C. Ground 1: Asserted Obviousness Based on Corke

Petitioner asserts that claims 1–4, 6–10, 17–20, and 24–28 are unpatentable over Corke. Pet. 11–56. Patent Owner provides arguments addressing this asserted ground of unpatentability. Prelim. Resp. 10–28.

1. Corke

Corke is a textbook on the visual control of robots. Ex. 1004. More particularly, the "book is about the application of high-speed machine vision for closed-loop position control, or visual servoing, of a robot manipulator" and "aims to provide a comprehensive coverage of all aspects of the visual servoing problem: robotics, vision, control, technology and implementation issues." *Id.* at ix.[5] Corke explains that "visual servoing involves the use of one or more cameras and a computer vision system to control the position of the robot's end-effector relative to the workpiece as required by the task." *Id.* at 1. Corke includes Chapter 4 on "Machine vision," which includes a section addressing photogrammetry and camera calibration (*id.* at 137–47), and Chapter 5 on "Visual servoing." *Id.* at 151–70.

2. Independent Claim 1

Petitioner provides analysis purporting to show where each limitation recited in independent claim 1 is taught or suggested by Corke. Pet. 11–22. Claim 1 includes the following limitation, which Petitioner identifies as limitation [1.3]:

[5] For consistency, we follow Petitioner's convention of citing to the original pagination located at the top or bottom of the pages in Corke rather than the exhibit page numbers added by Petitioner.

> determining by a processor an object space-to-camera space transformation for the target object based at least in part on a position of at least some of the located features using only the single captured image and an algorithm that employs a known or determinable physical relationship between at least some of the located features.

Ex. 1001, 11:61–67; Pet. 17. Regarding limitation [1.3], Petitioner points to various disclosures in Corke and relies on a series of assertions as to what one of ordinary skill in the art allegedly would have understood from those disclosures. Pet. 17–22.

First, Petitioner argues that in view of Corke's disclosure "that in '*position* based control, features are extracted from ***the image***' of the target object 'and used in conjunction with a geometric model of the target to determine the pose of the target with respect to the camera,'" one of ordinary skill in the art "would have understood that determining the target's pose with respect to the camera is equivalent to the claimed step of determining the object space-to-camera space transformation." Pet. 18 (quoting Ex. 1004, 153; citing Ex. 1003 ¶ 110). Petitioner then argues that one of ordinary skill in the art "would have understood that Corke's references to '***the*** image' teaches that only features from a single captured image are used to determine the object space-to-camera space transformation." *Id.* at 19 (quoting Ex. 1004, 154).

Next, Petitioner argues that "Corke teaches an algorithm that uses the position of features from a single image to determine the object space-to-camera space transformation for the target object based at least in part on a position of at least some of the located features." Pet. 19 (citing Ex. 1004, 138; Ex. 1003 ¶ 112). Specifically, Petitioner asserts that in equation 4.60 of Corke, camera calibration matrix, C, "represents the relationship between

3-D world coordinates and their corresponding 2-D image coordinates as seen by the computer," with ^{i}x, ^{i}y and ^{i}z encoding the position of a feature in the image plane, and x, y, and z encoding the position of the same feature in 3D 'world coordinates.'" *Id.* at 19–20 (citing Ex. 1004, 138). Petitioner also asserts that Corke teaches that the calibration matrix, C, encodes the six extrinsic parameters (i.e., the 3D position vector and three angles of camera pose) and an algorithm that recovers these parameters by decomposing the camera calibration matrix. *Id.* at 20 (citing Ex. 1004, 143–44; Ex. 1003 ¶ 112). Thus, according to Petitioner, one of ordinary skill in the art "would have understood that if the 3D coordinates are specified with respect to the object space, then the camera pose obtained by Corke's algorithm is defined with respect to the object space, and therefore determines the object space-to-camera space transformation." *Id.* (citing Ex. 1003 ¶ 112). Petitioner further asserts that one of ordinary skill in the art

> would have understood that by multiplying the camera calibration **C** by the 3D position of any feature in 3D space, the corresponding position for that feature in the 2D image frame (^{i}x, ^{i}y, ^{i}z) is obtained, and those coordinates can be converted to two-dimensional camera frame pixel coordinates—^{i}X, ^{i}Y—by Corke's equations 4.56 and 4.57.

Id. at 20–21 (citing Ex. 1004, xi, 138; Ex. 1003 ¶ 113).

In addition, Petitioner argues that Corke's algorithm uses a known physical relationship between some of the located features using stored knowledge of model feature points in 3D space. Pet. 21 (citing Ex. 1004, 159; Ex. 1003 ¶ 114). In particular, Petitioner argues that Corke describes needing "additional information" to "determine the 3D relative pose of an object . . . from 2D image coordinates," and such additional information "includes '***knowledge of the relationship between the observed feature***

points (perhaps from a CAD model) and also the camera's intrinsic parameters." *Id.* (quoting Ex. 1004, 159; citing *id.* at 153). In view of this disclosure, Petitioner asserts that one of ordinary skill in the art

> would have understood that Corke teaches an algorithm using the position of "features extracted from the image" (only the single captured image) and "a geometric model of the target" (known physical relationship) processed by a "computer" (processor) to determine the "3D relative pose of an object" (object space-to-camera space transformation for the target object).

Id. at 22 (citing Ex. 1004, 153, 159–60; Ex. 1003 ¶ 114).

Patent Owner argues that the Petition fails to show that Corke teaches determining an object space-to-camera space transformation as required by claim 1. Prelim. Resp. 10–23. Regarding Petitioner's reliance on the camera calibration matrix, C, of Corke's equation 4.60, for instance, Patent Owner argues that this calibration matrix relates 3D world coordinates to corresponding 2D image coordinates and, thus, uses a *world coordinate system* independent of any object rather than an *object space* as defined by the '237 patent. *Id.* at 13–14 (citing Pet. 19; Ex. 1004, 137–39; Ex. 2001 ¶¶ 40–42, 44–50). Patent Owner adds that Petitioner fails to show where Corke teaches an "object space" under Petitioner's own construction of the term, and Corke does not disclose a reference frame that is rigid to, and moves with, the object. *Id.* at 19–21.

Furthermore, Patent Owner argues that Petitioner asserts that one of ordinary skill in the art "would have understood that *if* the 3D coordinates are specified with respect to the object space, then the camera pose obtained by Corke's algorithm is defined with respect to the object space, and therefore determines the object space-to-camera space transformation," but fails to explain why an ordinarily skilled artisan "would have sought to

modify Corke to specify Corke's 3-D world coordinates 'with respect to the object space.'" Prelim. Resp. 13–14 (citing Pet. 20). According to Patent Owner, Petitioner's "conclusory assertion that relies on *if* [one of ordinary skill in the art] did something, even if true, cannot establish obviousness of the challenged claims." *Id.* at 15 (citing *Belden Inc. v. Berk–Tek LLC*, 805 F.3d 1064, 1073 (Fed. Cir. 2015); *Personal Web Techs., LLC v. Apple, Inc.*, 848 F.3d 987, 993–94 (Fed. Cir. 2017)). Patent Owner asserts that even if one of ordinary skill in the art "*could* have modified . . . Corke [to specify the 3D coordinates with respect to the object space], Petitioner never explains or establishes *why* a [person of ordinary skill in the art] would have done so." *Id.* Patent Owner also argues that Petitioner's expert, Dr. Hutchinson, merely repeats the same assertion made in the Petition, without providing any further explanation, analysis, or evidence. *Id.* at 16 (citing Pet. 20; Ex. 1003 ¶ 112). Relying on the testimony of Dr. Kurfess, Patent Owner contends that one of ordinary skill in the art would not have been led to use an object space in connection with Corke's techniques. *Id.* at 16–18 (citing Ex. 2001 ¶¶ 47–61).

We find Patent Owner's arguments persuasive. As discussed above, we agree with Petitioner that the claim term "object space" should be construed in accordance with the definition provided in the specification of the '237 patent. *See supra* § III.B; Pet. 8. The '237 patent defines "object space" as "a reference frame defined with respect to, and therefore rigid to, the object 18." Ex. 1001, 3:25–26. Petitioner, however, does not adequately explain how or why Corke's camera calibration matrix, C, which "represents the relationship between 3-D *world coordinates* and their corresponding 2-D image coordinates" (Ex. 1004, 138 (emphasis added)), would relate in any way to an "object space" (i.e., a reference frame defined with respect to, and

therefore rigid to, an object). Petitioner does not identify sufficiently any object in Corke with respect to which the world coordinate system of Corke is defined.

Furthermore, we are not persuaded by Petitioner's conclusory assertion that "the camera pose obtained by Corke's algorithm is defined with respect to the object space" "*if* the 3D coordinates are specified with respect to the object space." *See* Pet. 20 (emphasis added). Petitioner does not provide adequate reasoning to support why one of ordinary skill in the art would have considered, or even envisioned, Corke's 3D coordinates to be specified with respect to an object or an object space. Instead, we agree with Patent Owner that Petitioner's unsupported conditional statement ("if the 3D coordinates are specified with respect to the object space") is insufficient to establish obviousness in this instance. *See* Prelim. Resp. 15.

Dr. Hutchinson's testimony offers little support. *See* Ex. 1003 ¶ 112. Dr. Hutchinson's declaration largely mirrors the Petition and lacks sufficient additional explanation. *See Xerox Corp. v. Bytemark, Inc.*, IPR2022-00624, Paper 9, 15 (PTAB Aug. 24, 2022) (precedential) (determining that declaration testimony is entitled to little weight when the testimony merely repeats conclusory statements from the petition); 37 C.F.R. § 42.65(a) ("Expert testimony that does not disclose the underlying facts or data on which the opinion is based is entitled to little or no weight.").

In addition, Patent Owner argues that "Petitioner inconsistently and illogically points to two different aspects of Corke" in making its arguments. Prelim. Resp. 23. Specifically, Patent Owner argues that Petitioner asserts that Corke's disclosure of determining the target's pose with respect to the camera is equivalent to the claimed step of determining the object space-to-camera space transformation, but Petitioner also points to Corke's disclosure

of determining the camera calibration matrix to meet the "based at least in part on a position of at least some of the located features" portion of limitation [1.3]. *Id.* at 23–24 (citing Pet. 18, 20). According to Patent Owner, determining the target's pose with respect to the camera, which is discussed in Chapter 5 of Corke, occurs after camera calibration, but determining the camera calibration matrix, which is discussed in Chapter 4 of Corke, occurs during camera calibration. *Id.* Patent Owner contends that

> Petitioner does not even attempt to explain how a skilled artisan could plausibly integrate the calibration algorithm from Chapter 4 with the servoing algorithm from Chapter 5 to arrive at a system in which "an object space-to-camera space transformation for the target object" is "based at least in part on a position of at least some of the located features" of the target object.

Id. at 27.

We agree with Patent Owner that Petitioner fails to explain adequately why one of ordinary skill in the art would look to Corke's camera calibration matrix and equation 4.60 in connection with Corke's disclosure of determining the target's pose with respect to the camera. Moreover, we agree with Patent Owner that, as the name suggests, the camera calibration matrix pertains to calibrating the camera and is therefore distinct from visual servoing discussed in Chapter 5 of Corke. Indeed, in Section 4.2.2, titled "Camera calibration techniques," Corke describes determining the camera calibration matrix in connection with the process of camera calibration, which is defined as "the process of determining the internal camera geometric and optical characteristics (intrinsic parameters) and the 3-D position and orientation of the camera frame relative to a certain world coordinate system (extrinsic parameters)." Ex. 1004, 139. On the other hand, Corke describes determining the pose of an object or target with

respect to the camera in connection with visual servoing but does not suggest relying on the camera calibration matrix or equation 4.60 to determine the pose. *Id.* at 153, 159. On the contrary, Corke points to "[a]nalytic solutions" from various cited references, such as "Fischler and Bolles," "Ganapathy," "Yuan," and "Wang and Wilson." *Id.* at 159–60.

Petitioner's assertion that "[t]he portions of Corke cited herein are from a single embodiment referenced in both Chapter 3 ('Fundamentals of image capture') and Chapter 4 ('Machine vision' concepts), and used as a baseline for the position-based visual servoing methods discussed in Chapter 5" does not persuade us that one of ordinary skill in the art would have considered using the camera calibration matrix in determining the target's pose with respect to the camera. *See* Pet. 14 n.5. First, Petitioner does not state explicitly that this assertion supports such a usage of the camera calibration matrix. Second, Petitioner does not explain adequately why or how the cited portions describe "a single embodiment." Last, we are not persuaded that the cited portions actually relate to "a single embodiment." Corke is a textbook that "aims to provide a comprehensive coverage of all aspects of the visual servoing problem." Ex. 1004 ix; *see also id.* at vii (stating that Corke "embraces both the theory and the practical problems encountered in adding vision sensing to a robot arm"). As such, Corke is not directed to one or more particular "embodiments" of a visual servoing device or method.

Another problem with Petitioner's obvious analysis is its reliance on the assertion that one of ordinary skill in the art "would have understood that determining the target's pose with respect to the camera is equivalent to the claimed step of <u>determining the object space-to-camera space transformation</u>." Pet. 18. This assertion is not persuasive because Petitioner

fails to explain sufficiently why determining the target's pose with respect to the camera would have been understood as being *equivalent* to determining an object space-to-camera space transformation.

Furthermore, both the '237 patent and Corke define "pose" as "position and orientation." Ex. 1001, 4:8; Ex. 1004, 3 n.2. The '237 patent defines "transformation" as "three-dimensional rotation and translation between two spaces."[6] These definitions do not suggest "pose" and "transformation" are equivalent. Also, the '237 patent indicates that "[t]he 'Object Space→Camera Space' transformation is computed using the 3D position of the features inside this space and the position in the image by computing an extrinsic calibration using the camera calibration from the previous step." Ex. 1001, 5:61–65; *see also id.* at 7:19–23 ("The position . . . of the found features (at least 5) are used to calculate the transformation between the Object Space and the Camera Space using an extrinsic calibration algorithm."), 7:55–57 ("the 'Object Space→Camera Space' transformation is found in the same way as in the previous step (using the feature[']s positions)."). Because the object space-to-camera space transformation is calculated from the position (which defines, in part, the pose) of the features on the target object, these disclosures suggest that the object space-to-camera space transformation is not equivalent to the position or pose of the target object. At best, the '237 patent suggests that there is a correlation between the object space-to-camera space transformation and the pose of the target object.

[6] In this context, "spaces" refer to reference frames. Ex. 1001, 3:8–9, 3:25–26.

For the above reasons, Petitioner fails to persuade us that Corke teaches or suggests limitation [1.3]. Accordingly, we determine Petitioner has not met its burden to show a reasonable likelihood it would prevail with respect to the contention that claim 1 is unpatentable over Corke.

3. Independent Claims 20 and 25

Similarly to claim 1, claim 20 recites "determining an object space-to-camera space transformation based at least in part on a position of at least some of the located features in solely the captured image using an algorithm that employs a known or determinable physical relationship between at least some of the located features," and claim 25 recites "determining an object space-to-camera space transformation based at least in part on a position of at least some of the located features using the captured image without any additional captured images and an algorithm that employs a known or determinable physical relationship between at least some of the located features." Ex. 1001, 13:62–67, 14:46–52.

For these limitations of claims 20 and 25, Petitioner relies on essentially the same arguments made in connection with limitation [1.3]. Pet. 50–55. Thus, Petitioner's challenge to claims 20 and 25 is based on the same deficient assertions regarding Corke as discussed above in the analysis of the challenge to independent claim 1. For these same reasons, we find that Petitioner has not met its burden to show a reasonable likelihood that claims 20 and 25 are unpatentable over Corke.

4. Dependent Claims 2–4, 6–10, 17–19, 24, and 26–28

Claims 2–4, 6–10, and 17–19 depend from claim 1 and, thus, contain all the limitations of claim 1; claim 24 depends from claim 20 and, thus, contains all the limitations of claim 20; and claims 26–28 depend from claim 25 and, thus, contain all the limitations of claim 25. Petitioner's

challenges to dependent claims 2–4, 6–10, 17–19, 24, and 26–28 do not overcome the deficiencies discussed above with respect to the challenge to independent claims 1, 20, and 25. *See* Pet. 22–43, 55–56. Accordingly, for the same reasons discussed above in connection with claims 1, 20, and 25, we find Petitioner has not met its burden to show a reasonable likelihood that claims 2–4, 6–10, 17–19, 24, and 26–28 are unpatentable over Corke.

D. Ground 2: Asserted Obviousness Based on Corke and Wei-I

Petitioner challenges claims 5, 12–16, and 21–24 as unpatentable under 35 U.S.C. § 103 based on the combination of Corke and Wei-I.[7] Pet. 56–79. Each of these claims depends from either independent claim 1 or independent claim 20 and, therefore, contains all the limitations thereof. Thus, Petitioner relies in part on the same assertions presented in the challenge of independent claims 1 and 20 based on Corke, discussed above, in support of its contentions that claims 5, 12–16, and 21–24 would have been obvious over Corke and Wei-I. *See id.* at 59 ("As explained above, Corke discloses or renders obvious all limitations of Claims 1 and 3, from which Claims 5 and 12 depend."), 73 ("For example, as explained above, Corke discloses all limitations in Claim 20 from which Claim 21 depends.").

Accordingly, Ground 2 suffers from the same deficiencies noted above (*see supra* § III.C.2) in connection with Ground 1. Therefore, for the same reasons discussed above, we determine that the information presented in the Petition fails to establish a reasonable likelihood that Petitioner would prevail in showing that claims 5, 12–16, and 21–24 are unpatentable.

[7] Although the Petition includes claim 24 in Ground 2 in the chart on page 5 and the heading on page 56, no analysis of claim 24 is provided for Ground 2. *See* Pet. 56–79.

E. Discretion Under 35 U.S.C. §§ 314(a)

Patent Owner argues that we should exercise our discretion to deny institution in view of the parallel district court proceeding. Prelim. Resp. 30–36. Petitioner argues that discretionary denial is not appropriate in this case. Pet. 79–81. Because we are not persuaded the Petition demonstrates sufficiently a reasonable likelihood that Petitioner will prevail with respect to at least one challenged claim (*see supra* §§ III.C., III.D.), we need not reach Patent Owner's arguments regarding discretionary denial under § 314(a).

IV. CONCLUSION

For the foregoing reasons, we do not institute *inter partes* review.

V. ORDER

In consideration of the foregoing, it is hereby:

ORDERED that the Petition is *denied* as to all challenged claims of the '237 patent; and

FURTHER ORDERED that no *inter partes* review is instituted.

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