

UNITED STATES PATENT AND TRADEMARK OFFICE

BEFORE THE PATENT TRIAL AND APPEAL BOARD

TETRA TECH CANADA INC.,
Petitioner,

v.

GEORGETOWN RAIL EQUIPMENT COMPANY,
Patent Owner.

IPR2019-00619
Patent 7,616,329 B2

Before HUBERT C. LORIN, BENJAMIN D. M. WOOD, and
KRISTINA M. KALAN, *Administrative Patent Judges*.

LORIN, *Administrative Patent Judge*.

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

Granting Patent Owner's and Petitioner's Motions to Seal
37 C.F.R. § 42.54

Dismissing Petitioner's Motion to Exclude
37 C.F.R. § 42.64(c)

I. INTRODUCTION

This is a Final Written Decision in an *inter partes* review challenging the patentability of claims 16, 23, 38, 44, 46, 62, 68, and 70 of U.S. Patent No. 7,616,329 B2 (Ex. 1001, “the ’329 patent”). We have jurisdiction under 35 U.S.C. § 6.

Petitioner has the burden of proving unpatentability of a claim by a preponderance of the evidence. 35 U.S.C. § 316(e). Having reviewed the arguments of the parties and the supporting evidence, we find that Petitioner has demonstrated by a preponderance of the evidence that claims 16, 23, 38, 44, 46, 62, 68, and 70 are unpatentable.

We also deny Petitioner’s Motion to Exclude, and grant Petitioner’s and Patent Owner’s Motions to Seal.

A. Background

Tetra Tech Canada Inc. (“Petitioner”) filed a Petition requesting *inter partes* review of claims 16, 23, 38, 44, 46, 62, 68, and 70 of U.S. Patent No. 7,616,329 B2 (Ex. 1001, “the ’329 patent”). Paper 2 (“Pet.”). Georgetown Rail Equipment Company (“Patent Owner”) filed a Preliminary Response to the Petition. Paper 7 (“Prelim. Resp.”). Pursuant to Board authorization (Paper 8), Petitioner filed a Reply to Patent Owner’s Preliminary Response (Paper 9, “Reply”) and Patent Owner filed a Sur-Reply to Petitioner’s Reply (Paper 11, “Sur-Reply”).

On August 26, 2019, we instituted an *inter partes* review, pursuant to 35 U.S.C. § 314(a). Specifically, we instituted an *inter partes* review of claims 16, 23, 38, 44, 46, 62, 68, and 70 on all asserted grounds of unpatentability. Paper 12 (“DI”).

After institution, Patent Owner filed a Patent Owner Response (Paper 16, “PO Resp.”); Petitioner filed a Reply (Paper 25, “Pet. Reply”); Patent Owner filed a Sur-Reply (Paper 28, “PO Sur-reply”); Petitioner filed a Sur-Sur-Reply (Paper 33, “Pet. Sur-Sur-Reply”); and Patent Owner filed a Sur-Sur-Sur-Reply (Paper 37, “PO Sur-Sur-Sur-Reply”) which, upon request, we authorized Petitioner and Patent Owner to file.¹

On May 18, 2020, the parties presented arguments at oral hearing, the transcript of which is of record. Paper 41 (“Tr.”).

B. Related Proceedings

Petitioner indicates that the ’329 patent has “been asserted in the following pending matter: “*Georgetown Rail Equipment Company v. Tetra Tech Canada Inc.*, (E.D. Tex.) (Tyler) (6:18-cv-377).” Pet. 3. Patent Owner does not contest this assertion.

C. The ’329 Patent (Ex. 1001)

1. Disclosure

The ’329 patent, titled “System and Method for Inspecting Railroad Tracks,” discloses “a system and method for inspecting aspects of a railroad track using a laser, camera, and a processor.” Ex. 1001, code (54), 1:15–18.

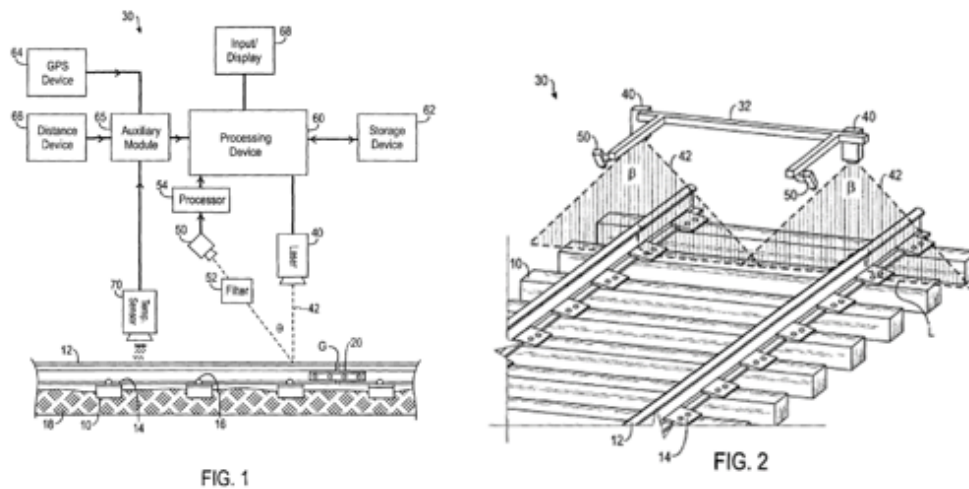
In particular, the ’329 patent discloses a system that includes lasers, cameras, and a processor. The lasers are positioned adjacent to the track. The laser emits a beam of light across the railroad track, and the camera captures images of the railroad track having the beam of light emitted thereon. The processor formats the images so that they can be analyzed to determine various measurable aspects of the railroad track. The disclosed system can include a GPS receiver or a distance device for determining location data. The measurable aspects that can

¹ Paper 32 (Order).

be determined by the disclosed system include but are not limited to: the spacing between crossties, the angle of ties with respect to rail, cracks and defects in surface of ties, missing tie plates, misaligned tie plates, sunken tie plates, missing fasteners, damaged fasteners, misaligned fasteners, worn or damaged insulators, rail wear, gage of rail, ballast height relative to ties, size of ballast stones, and a break or separation in the rail. The system includes one or more algorithms for determining these measurable aspects of the railroad track.

Id. at 2:13–31.

Figures 1 and 2 illustrate “inspection system 30.” *Id.* at 3:33.



Figures 1 and 2 show a system for inspecting railroad track. *Id.* at 3:22–23. As shown in both figures, “[t]he track bed includes crossties 10, rails 12, tie plates 14, spikes 16, and ballast 19.” *Id.* at 3:43–44. The “inspection system 30 includes a light generator such as a laser 40” (*id.* at 3:29–30) which “projects a beam 42 of laser light at the track bed” (*id.* at 3:44–45).

As shown in Figure 2, “beam 42 produces a projected line L.” *Id.* at 3:45–46. Projected line L “follows the contours of the surfaces and components of the track bed” (*id.* at 3:46–47) and, further, projected line L “is substantially straight and extends substantially across the track bed” (*id.*

at 4:13–14). “The light receiver, camera 50, captures an image of the line L of laser light 42 projected on the track bed. The camera 50 sends the captured image to the processing device 60 for processing and analysis.” *Id.* at 3:48–51.

Fig. 3 illustrates “[a]n example image or frame showing the projected line L of the track bed.” *Id.* at 5:35–36.

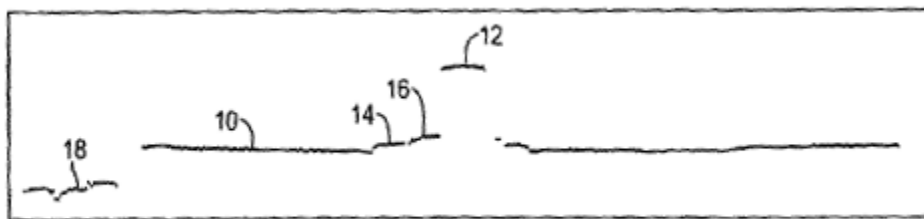


FIG. 3

The image data or frame includes a plurality of pixels given X-Y coordinates and shows a contour of the track bed captured by the cameras 50. Due to filtering and other image processing techniques known in the art, the image includes two pixel values, where the dark pixels represent the contour of the track bed. Every pixel of a given image data is given the same Z-coordinate, which represents the particular position along the length of the track at which the image data was captured. In this manner, a plurality of captured images produce a three-dimensional scan of the track bed in which each image of the scan has X-Y coordinates showing the contour of the track bed and has a Z-coordinate representing the particular position of the contour along the length of rail.

Id. at 5:36–48.

The processing and analysis of the captured image allows “missing tie plates, misaligned tie plates, or sunken tie plates [to] be detected from the image data.” *Id.* at 10:12–13. For example, figure 10, reproduced below, shows an image that can be analyzed in order to determine that a tie plate is

missing.

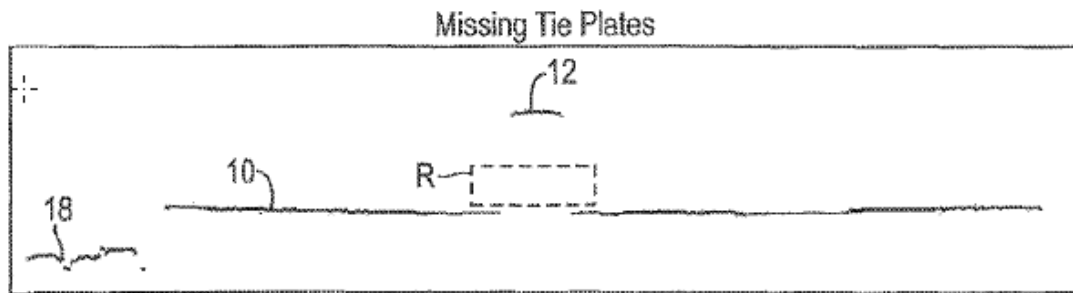


FIG. 10

Figure 10 shows a frame of a railroad track missing a tie plate. *Id.* at 3:50–52. In Figure 10, a “missing or sunken tie plate can be detected . . . by analyzing a region of interest R and determining whether a portion of the contour representing a tie plate occurs or does not occur within the region R.” *Id.* at 10:16–19.

2. Claims

The '329 patent has 80 claims, of which only claims 16, 23, 38, 44, 46, 62, 68 and 70 are challenged. Claims 16, 38, and 62 are independent claims. Claims 23 depends from claims 16; claims 44 and 46 depend from claim 38; and claims 68 and 70 depend from claim 62. Independent claim 16, reproduced below, is illustrative.

16. A system for inspecting a railroad track bed, including the railroad track, to be mounted on a vehicle for movement along the railroad track, the system comprising:

[a] at least one light generator positioned adjacent the railroad track for projecting a beam of light across the railroad track bed;

[b] at least one optical receiver positioned adjacent the railroad track for receiving at least a portion of the light reflected from the railroad track bed and generating a

plurality of images representative of the profile of at least a portion of the railroad track bed; and

[c] at least one processor for analyzing the plurality of images and determining one or more physical characteristics of the said portion of the railroad track bed, [d] the one or more physical characteristics comprising at least a geographic location of the plurality of images along the railroad track bed, [e] wherein the processor includes an algorithm for detecting a misaligned or sunken tie plate of the railroad track bed, the algorithm comprising the steps of:

[f] (a) analyzing a frame of the plurality of images, the frame comprising a region of interest;

(b) determining whether the region of interest contains a tie plate;

[g] (c) if a tie plate is present, determining a crosstie contour and a tie plate contour;

(d) comparing an orientation of the crosstie contour and an orientation of the tie plate contour; and

(e) determining whether the tie plate is misaligned or sunken based upon the comparison.

Ex. 1001, 11:41–12:2 (bracketing added consistent with the parties’ analysis of claim limitations “[a]–[g]”).

D. Asserted References

Petitioner relies on the following references:

Name	Reference	Ex. No.
Davis	D. D. Davis & S. M. Chrismer, “Tie Performance – A Progress Report of the Des Plaines Test Site”	1005
Kowalski	US Patent No. 7,023,539 B2	1006
Bostrom	US Patent No. 6,496,254 B2	1008
Trosino	US Patent No. 6,356,299 B1	1009
Kanade	Takeo Kanade, “Three-Dimensional Machine Vision”	1010
Holmes	US Patent No. 6,647,891 B2	1011

Petitioner relies on the declaration of Dr. Nikos Papanikolopoulos (Ex. 1004) as support of its patentability challenges. Patent Owner relies on the declarations of Dr. Alan Conrad Bovik (Ex. 2003), John Kainer (Ex. 2008), and Gregory T. Grissom (Ex. 2012).

E. Grounds Asserted

Petitioner contends that claims 16, 23, 38, 44, 46, 62, 68, and 70 of the '329 patent are unpatentable under the following grounds:

Ground	Basis	Prior Art	Claims
I	§ 103	Davis, Kowalski, Bostrom, Trosino, Kanade	16, 23, 38, 44, 46, 62, 68, 70
II	§ 103	Holmes, Bostrom, Trosino, Kanade, Davis	16, 23, 38, 44, 46, 62, 68, 70

Pet. 6.

II. ANALYSIS

A. *Principles of Law*

1. *Burden*

“[T]he petitioner has the burden from the onset to show with particularity why the patent it challenges is unpatentable.” *Harmonic Inc. v. Avid Tech., Inc.*, 815 F.3d 1356, 1363 (Fed. Cir. 2016) (citing 35 U.S.C. § 312(a) (3) (requiring *inter partes* review petitions to identify “with particularity . . . the evidence that supports the grounds for the challenge to each claim”)). This burden of persuasion never shifts to Patent Owner. *See Dynamic Drinkware, LLC v. Nat’l Graphics, Inc.*, 800 F.3d 1375, 1378 (Fed. Cir. 2015) (discussing the burden of proof in *inter partes* review).

2. *Obviousness*

A claim is unpatentable under 35 U.S.C. § 103(a) if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which that subject matter pertains. *KSR Int’l Co. v. Teleflex Inc.*, 550 U.S. 398, 406 (2007). The question of obviousness is resolved based on underlying factual determinations including: (1) the scope and content of the prior art; (2) any differences between the claimed subject matter and the prior art; (3) the level of ordinary skill in the art; and (4) objective evidence of nonobviousness, if present. *Graham v. John Deere Co.*, 383 U.S. 1, 17–18 (1966).

In analyzing the obviousness of a combination of prior art elements, it can be important to identify a reason that would have prompted one of skill in the art “to combine . . . known elements in the fashion claimed by the patent at issue.” *KSR*, 550 U.S. at 418. A precise teaching directed to the

specific subject matter of a challenged claim is not necessary to establish obviousness. *Id.* Rather, “any need or problem known in the field of endeavor at the time of invention and addressed by the patent can provide a reason for combining the elements in the manner claimed.” *Id.* at 420. Accordingly, a party that petitions the Board for a determination of unpatentability based on obviousness must show that “a skilled artisan would have been motivated to combine the teachings of the prior art references to achieve the claimed invention, and that the skilled artisan would have had a reasonable expectation of success in doing so.” *In re Magnum Oil Tools Int’l, Ltd.*, 829 F.3d 1364, 1381 (Fed. Cir. 2016) (internal quotation marks and citations omitted). Under the proper inquiry, “obviousness cannot be avoided simply by a showing of some degree of unpredictability in the art so long as there was a reasonable probability of success.” *Pfizer, Inc. v. Apotex, Inc.*, 480 F.3d 1348, 1364 (Fed. Cir. 2007).

We analyze the instituted grounds of unpatentability in accordance with these principles.

B. Level of Ordinary Skill in the Art

In determining the level of ordinary skill in the art, various factors may be considered, including the “type of problems encountered in the art; prior art solutions to those problems; rapidity with which innovations are made; sophistication of the technology; and educational level of active workers in the field.” *In re GPAC Inc.*, 57 F.3d 1573, 1579 (Fed. Cir. 1995) (internal quotation marks and citation omitted).

Petitioner contends, *inter alia*, that

a person of ordinary skill in the art (“POSITA”) for the ’329 patent would have a bachelor’s degree in electrical engineering,

computer engineering, mechanical engineering, computer science, physics, or a related field, and at least four years of experience (or the academic equivalent) in the field of computer or machine vision. Ex-1004, ¶41.

Pet. 19.

Patent Owner states: “For purposes of this response, Patent Owner does not contest Petitioner’s asserted level of ordinary skill in the art. *See* Petition at 19.” PO Resp. 1.

Based on the positions of Petitioner and Patent Owner, we find agreement as to the level of skill of such ordinarily skilled artisans and we are persuaded that one of ordinary skill in the art at the time of the invention would have had a bachelor’s degree in electrical engineering, computer engineering, mechanical engineering, computer science, physics, or a related field, and at least four years of experience (or the academic equivalent) in the field of computer or machine vision.

The level of ordinary skill in the art is also reflected by the references themselves. *See Okajima v. Bourdeau*, 261 F.3d 1350, 1355 (Fed. Cir. 2001) (“[T]he absence of specific findings on the level of skill in the art does not give rise to reversible error ‘where the prior art itself reflects an appropriate level and a need for testimony is not shown.’”).

C. Claim Construction

For petitions filed on or after November 13, 2018 (as in this case), “[claims] of a patent . . . shall be construed using the same claim construction standard that would be used to construe the [claims] in a civil action under 35 U.S.C. § 282(b), including construing the [claims] in accordance with the ordinary and customary meaning of such claims as

understood by one of ordinary skill in the art and the prosecution history pertaining to the patent.”

Furthermore, only those terms that are in controversy need to be construed, and only to the extent necessary to resolve the controversy. *Vivid Techs., Inc. v. Am. Sci. & Eng’g, Inc.*, 200 F.3d 795, 803 (Fed. Cir. 1999).

Petitioner proposes constructions for “misaligned” (Pet. 20), “frame” (*id.*), and “analyzing a frame,” “comparing,” “determining,” “orientation,” “crosstie contour,” “tie plate contour,” and “region of interest” (*id.*). Patent Owner proposes constructions for “tie plate is sunken” (PO Resp. 2) and “across” (*id.* at 3).

On the full record now before us, we determine it is not necessary to construe any claim term expressly to resolve the parties’ dispute. *Vivid Techs., Inc.*, 200 F.3d at 803 (“Only those terms need be construed that are in controversy, and only to the extent necessary to resolve the controversy.”); *Nidec Motor Corp. v. Zhongshan Broad Ocean Motor Co.*, 868 F.3d 1013, 1017 (Fed. Cir. 2017) (applying *Vivid Techs.* in the context of an *inter partes* review).

D. Overview of the Prior Art References

1. Davis (Ex. 1005)

Davis is a report titled “Tie Performance – A Progress Report of the Del Plaines Test Site.” Ex. 1005, 1.² Davis’ report describes railroad track “performance measurements taken” which include “plate cutting” measurements. *Id.* at 6. Plate cutting occurs when a “tie plate, under the action of traffic, moves relative to the tie while in contact with the tie,”

² We refer to the page numbers added to Exhibit 1005 by Petitioner, rather than the page numbers included in certain portions of the original text.

causing the “plate ‘cut[ting]’ through the tie.” *Id.* at 19. A plate cut has been described as a “plate cutting to a depth greater than the plate edge thickness.” Ex. 1044, 15. Davis uses a “plate cutting measuring device” to take “[p]late cutting measurements.” Ex. 1005, 17. The plate cutting measuring device “measur[es] the difference in elevation between the top of the tie plate at a known distance from the edge and the top surface of the tie adjacent to the plate.” *Id.*

2. *Kowalski (Ex. 1006)*

Kowalski is a patent titled “Device for Monitoring the Condition of the Superstructure Especially of Fixed Railroad Tracks.” Ex. 1006, code (54). Kowalski’s device “determin[es] the height position of an anchor clamp and/or of the base of the rail and/or of a railroad tie.” *Id.* at 1:19–21. Kowalski’s device determines the height position of those components by using “height-scanning sensors, preferably a laser scanning system.” *Id.* at 2:20–22. Figures 1 and 2 show the scanning locations on railroad track components and are reproduced below.

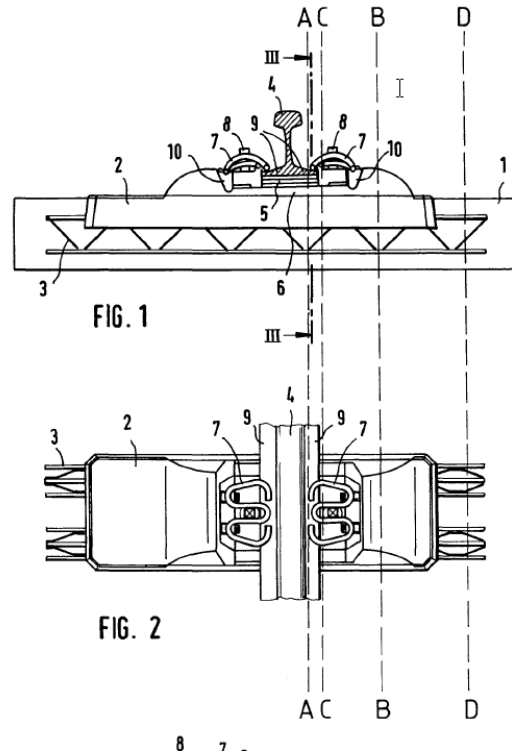


Figure 1 shows a cross section through a fixed railroad track and Figure 2 shows a plan view of the railroad tie section. Ex. 1006, 1:66–2:2. Kowalski’s laser scanning system scans the height of railroad track components “extend[ing] along the line A–A as well as along the line B–B” (*id.* at 2:20–22), “along the scanning line C–C” (*id.* at 2:40–41), and also “along the line D” (*id.* at 2:58–59).

Kowalski further describes using the sensed heights to monitor a railroad track condition. For example, using the sensed heights along scanning lines, “a loosened anchor clamp [can] be detected rapidly and reliably” based on “an appreciable deviation in height from [a] nominal value.” *Id.* at 1:31–34; *see id.* at 2:40–50.

3. *Bostrom (Ex. 1008)*

Bostrom is a patent titled “Method and Device for Inspecting Objects.” Ex. 1008, code (54). Figure 1 shows an embodiment of Bostrom’s device and is reproduced below.

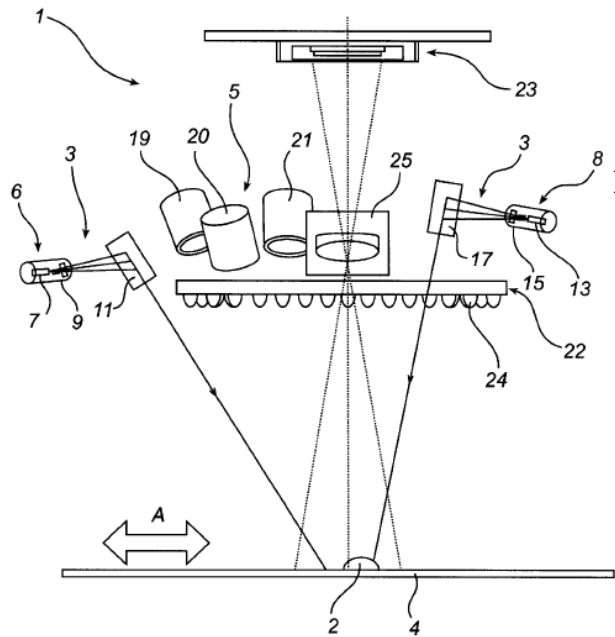


Fig. 1

Figure 1 shows a device for inspecting objects. Ex. 1008, 4:51–52. As shown in Figure 1, radiation “generated by [the device’s] radiation generators 6, 8,” e.g., laser sources 7 and 13, is “reflected or reemitted by [an] object 2” being scanned. *Id.* at 5:20–21, 60–63. Then, when the “radiation originating from the object 2 [is reflected] to the sensor 23,” the “sensor 23 . . . detect[s] an image of the object.” *Id.* at 5:44–47, 57–63. Further, the sensor 23 uses the sensed reflected radiation to “extract[] height information.” *Id.* at 7:1–3; *see id.* at 6:60–67.

4. *Trosino (Ex. 1009)*

Trosino describes inspecting railroad tracks for anomalies, using an automated vehicle.

[A] vehicle is provided for automatically inspecting railroad track to detect an anomaly. The vehicle comprises a car or high-rail truck, preferably self-propelled, for travel on a railroad track and an inspection system. The inspection system further comprises a vision system including a camera mounted on the car for creating an image of the track including the anomaly and a video system. The image is viewed on the video system to detect the anomaly.

Ex. 1009, 3:44–52.

5. *Kanade (Ex. 1010)*

Kanade is a book titled “Three-Dimensional Machine Vision.” Ex. 1010, 2. Kanade describes “vision systems . . . developed for an automatic inspection task,” in particular, “a 3D assembly robot vision system” *Id.* at 546, 557.³ In Kanade, “a light-section waveform is extracted from a gray-scale image obtained by an image detector. Next, the waveform is analyzed, and the data are transformed into more meaningful information, such as, ‘this waveform has some irregularity.’” *Id.* at 550. In particular, “IC solder joints are evaluated by the parameter values obtained from one waveform, and if one of these parameters exceeds an established allowance, the solder joint is judged as a defect[ive]” solder joint. *Id.* at 553; *see id.* Fig. 8.

³ We refer to the page numbers appended to Exhibit 1010, rather than the page numbers included in certain portions of the original text of the Exhibit.

6. *Holmes (Ex. 1011)*

Holmes is a patent titled “Range-Finding Based Image Processing Rail Way Servicing Apparatus and Method.” Ex. 1011, code (54). Holmes describes a computer “vision system 500 [which] identifies features of railway 300” using “a laser emitter 505, an infrared sensor 510 and an image processor.” *Id.* at 3:8, 54–56. In particular, “[l]aser emitter 505 emits an amplitude-modulated laser beam B across surface,” and the surface in turn “radiates some of that energy in the form of infrared electromagnetic waves I.” *Id.* at 3:56–59. Then, “[s]ensor 510 receives some of the infrared electro-magnetic waves I and transmits a signal corresponding to the phase of the received infrared energy to an image processor” which then “generates a virtual surface which corresponds to the actual surface irradiated by laser beam B.” *Id.* at 3:60–67.

The virtual surface may be a “range-based virtual surface” which “exhibits features that correspond to features of railway 300, for example, rails 305, ties 310 and the underlying railway bed 320.” *Id.* at 5:1–5; *see id.* Fig. 1. Using “image comparison software which permits the image processor to compare the data corresponding to a typical railway with the generated virtual surface,” Holmes’ system can “determine whether the actual railway appears to present a specified feature” and, accordingly, “identifi[es] . . . a typical rail, tie, tie plate or other railway features.” *Id.* at 5:12–18.

7. *Prior Art Status of Kanade*

Patent Owner states:

Petitioner fails to prove that Kanade is prior art. Petitioner relies on Exhibit 1045, Pamela Stansbury’s declaration. Petition at 6. Ms. Stansbury vaguely “opin[es]” only to “the best [she] can

determine,” and provides no details how a POSITA could have accessed Kanade. Ex-1045, ¶¶2-3. Multiple PTAB Boards have rejected substantially similar declarations from Ms. Stansbury. See *Intel Corp. v. Alacritech, Inc.*, IPR2017-01395, Decision on Rehearing (Paper 13) at 3-5 (PTAB Jan. 25, 2018); *Cavium, Inc. v. Alacritech, Inc.*, IPR2017-01729, Paper 8 at 3 (PTAB Dec. 5, 2017); see *Hulu v. Sound View Innovations, LLC*, IPR2018-01039 (PTAB Dec. 3, 2018) (Paper 12) at 9-12. Also, the declaration in Ex-1010 does not refer Kanade’s pages 10-610.

PO Resp. 25 n.6.

Petitioner replies, *inter alia*, that

Here, like [*Hulu, LLC v. Sound View Innovations, LLC*, IPR2018-01039 (PTAB Dec. 20, 2019) (Paper 29) (precedential).], the record evidence for Kanade includes a copyright date (1987), an ISBN date (1987), and an established publisher (Kluwer Academic Publishers), all establishing Kanade as prior art. Ex-1045, 2-3. Additionally, this case includes even more evidence than Hulu required, including: (1) Ms. Stansbury’s declaration, (2) a date stamp from Cornell University Engineering Library, (3) a declaration from Ms. Delgado-Jones, and (4) a date stamp from the Library of Congress. Ex-1045, 1, 8; Ex-1010, 1, 7. Together, this evidence overwhelming[ly] confirms the public accessibility of Kanade.

Pet. Reply 5.

Patent Owner responds that “*Hulu* is inapplicable. It applied the standard used at ‘institution’ rather than the standard for ‘trial.’ *Hulu* at 20, 21.” PO Sur-reply 1.

As the parties have observed, *Hulu* clarifies that “the petition must identify, with particularity, evidence sufficient to establish a reasonable likelihood that the reference was publicly accessible before the critical date of the challenged patent and therefore that there is a reasonable likelihood that it qualifies as a printed publication. ” *Hulu*, Paper 29 at 13.

In that regard, we determined, at the institution stage, that Petitioner had made the requisite showing. Dec. 17–19.

At the institution stage, Patent Owner argued that “[t]he Petition lacks evidence that Davis and Kanade are prior art printed publications by the asserted dates;” that is, 1990 and 1987, respectively. Prelim. Resp. 11. We indicated:

In support of Petitioner’s contention that Davis was “published in 1990” (Pet. 5) and that Kanade was “published in 1987” (*id.* at 6), Petitioner relies on evidence in the form of declaration testimony from Michael P. Carney (Ex. 1048) and Pamela J. Stansbury (Ex. 1045), respectively. Specifically, the Petition cites paragraphs 21, 29–30, and 32–33 of the Carney Declaration, which describes certain information Mr. Carney received and reviewed which led him to conclude that the “information available from the UC Berkley Library is consistent with the report being publicly available at least as early as November of 1990.” Pet. 5 (citing Ex. 1048, 21). Similarly, the Petition (Pet. 6) cites the Stansbury Declaration, which describes certain observations made by Ms. Stansbury which led her to conclude that “[Kanade] was cataloged and publicly available at the Engineering Library, in its public stacks, shelved by its Library of Congress classification system number no later than November 11, 1987.” Ex. 1045, 1.

Dec. 17. We stated that:

we are persuaded by the Petition’s reliance on the Carney and Stansbury Declarations to support its contentions with expert testimony. Mr. Carney and Ms. Stansbury’s testimonies clearly lay out the facts on which their opinions are based. Specifically, paragraphs 1–21, 29–30, and 32–33 of the Carney Declaration lay out certain facts about Davis that Mr. Carney has observed that lead him to conclude the Davis report was “publicly available at least as early as November of 1990.” Ex. 1048, ¶ 21. Similarly, the Stansbury Declaration lays out certain facts about Kanade that Ms. Stansbury has observed that lead her to conclude that “[Kanade] was . . . publicly available . . . no later than November 11, 1987.” Ex. 1045. That is precisely what the Petition contends: “Davis, ‘Tie Performance - A Progress Report of the Des Plaines Test

Site,’ published in 1990” (Pet. 5) and “Kanade, ‘Three-Dimensional Machine Vision’ published in 1987” (*id.* at 6).

The same evidence from Petitioner regarding public accessibility is before us on this complete record. See, e.g., Exs. 1010, 1045, 1048. Patent Owner does not address the sufficiency of this evidence. As we further discuss below, we maintain that Petitioner had made the requisite showing, notwithstanding *Hulu* provides a standard that was applied in the context of an institution decision.

Kanade, on its face, has a copyright date of “1987 by Kluwer Academic Publishers” (Ex. 1010, 7), a stamp stating “Library of Congress 5 Mar 23 1987 Copy __ CIP (*id.*), publication data (*id.*), a Library of Congress library stamp (*id.* at 3), a Library Catalog Number (*id.* at 7), additional cataloging notations with the date 1987 (*id.*), and a check-out card indicating that Kanade was in fact checked out on multiple occasions between 1999 and 2002 (Ex. 1045, 8). See *Hulu*, Paper 29 at 9–11, 17–19.

Additionally, Petitioner has taken adequate steps to provide testimony that Kanade was catalogued, shelved, and indexed before the critical date, and made available such that persons of ordinary skill in the art, exercising reasonable diligence, could have located it. Ex. 1010, 1; Ex. 1045.

Ms. Stansbury, a librarian since 1982 with the Cornell University Library, provides details regarding her professional background leading to her current position as Administrative Supervisor in the Original Cataloging Unit. Ex. 1045, 1. She testifies that, based on her knowledge, Kanade was “cataloged and publicly available at the Engineering Library, in its public stacks, shelved by its Library of Congress classification system number no later than November 11, 1987.” *Id.* She further testifies that “based on the

date stamp inside the volume, and my knowledge of the Library's standard procedures relevant to date stamping, cataloging, and shelving items," she has not seen any indication that Kanade would have been an exception to the Library's standard practice, and that "any member of the public could have located this item by searching our catalog by subject matter, author, or title." *Id.* The declaration concludes with an affidavit that Ms. Stansbury is aware that false statements are punishable by fine or imprisonment, or both. *Id.*; 37 C.F.R. § 1.68; 28 U.S.C. § 1746. In our evaluation, Ms. Stansbury provides credible testimony regarding the receipt of Kanade by the Cornell University Library and the cataloging and availability of Kanade.

Patent Owner relies on a number of cases to support its argument that multiple PTAB Boards "have rejected substantially similar declarations from Ms. Stansbury." PO Resp. 25 n. 6. We have reviewed those cases in view of Ms. Stansbury's declaration in this proceeding, and find this proceeding's declaration more thorough than the other declarations and sufficient in its own right. *See* Pet. Reply 5. We, therefore, credit the testimony of Ms. Stansbury supporting Kanade's public accessibility as of the critical date.

Ms. Delgado-Jones certifies that the Library of Congress contains a copy of Kanade, and the reproduced pages in the evidence "are a true representation from that work." Ex. 1010, 1. Ms. Delgado-Jones further testifies that the work is marked with a Library of Congress stamp bearing the date March 23, 1987. *Id.*

The testimony of Ms. Stansbury and of Ms. Delgado-Jones credibly supports Petitioner's assertions of Kanade's public accessibility as of the critical date. *Id.* We are persuaded that the indicia on Kanade itself, and the support provided by the Stansbury and Delgado-Jones declarations,

demonstrate sufficiently that Kanade was publicly accessible as of the critical date.

Patent Owner also argues that “the declaration in Ex-1010 does not refer Kanade’s pages 10-610.” PO Resp. 25, footnote 6.

Petitioner replies that “there is no requirement that Ms. Delgado-Jones’ declaration “refer [to] Kanade’s pages 10-610,” as Patent Owner argues. Response, 25, n.6.” Pet. Reply 6.

Patent Owner responds that “her declaration never refers to pages 10-610 attached to the declaration. Ex-1010 at 1. Thus, those pages are unauthenticated hearsay.” PO Sur-reply 1.

We are unpersuaded by Patent Owner’s argument. Ms. Delgado-Jones certifies that the Library of Congress “contain[s]” Kanade, and the reproduced pages in the evidence “are a true representation from that *work*.” Ex. 1010, 1. Ms. Delgado-Jones further testifies that the “*work* is marked with a Library of Congress Cataloging–In–Publication stamp that bears the date March 23, 1987.” *Id.* (emphasis added). The testimony of Ms. Stansbury and of Ms. Delgado-Jones credibly supports Petitioner’s assertions of the public accessibility of the “work,” i.e., Kanade, as of the critical date. Although Ms. Delgado-Jones does not specifically refer to Kanade’s pages 10-610, her reference to the “work” persuades us that the indicia on Kanade itself, and the support provided by the Stansbury and Delgado-Jones declarations, demonstrate sufficiently that all of Kanade, including pages 10-610, was publicly accessible as of the critical date.

E. Ground II

Petitioner challenges claims 16, 23, 38, 44, 46, 62, 68, and 70 as obvious under 35 U.S.C. § 103 over Holmes, Bostrom, Trosino, Kanade, and Davis. Pet. 64–79.

1. Independent Claim 16

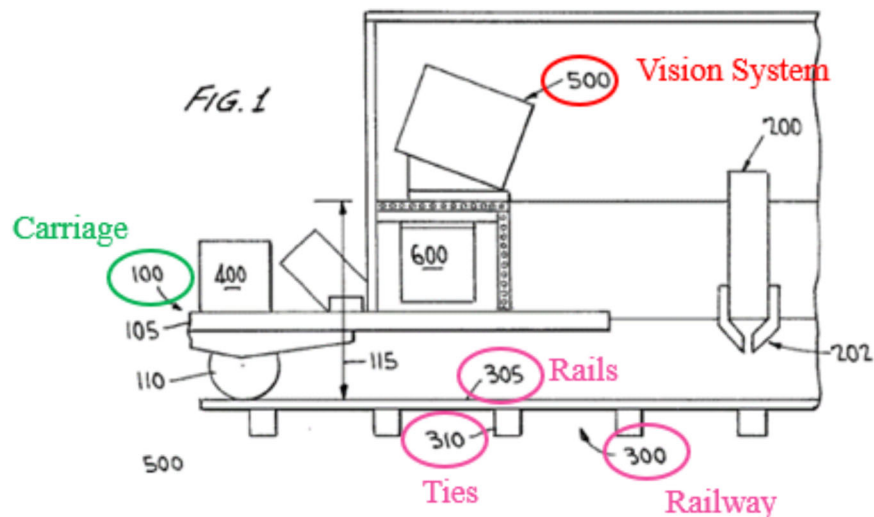
Petitioner contends that claim 16 is unpatentable under 35 U.S.C. § 103 over Holmes, Bostrom, Trosino, Kanade, and Davis.

Preamble

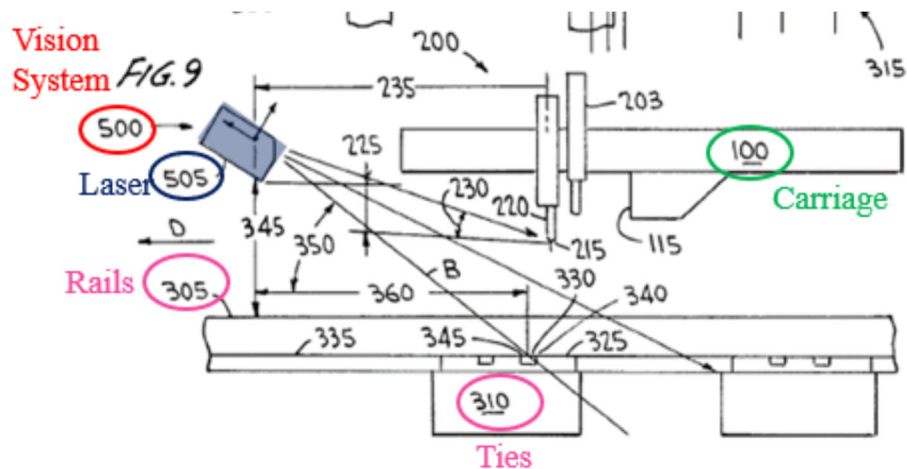
The preamble calls for “[a] system for inspecting a railroad track bed, including the railroad track, to be mounted on a vehicle for movement along the railroad track.” Ex. 1001, 11:41–43.

Petitioner contends that Holmes discloses such a system. Pet. 64–65.

Petitioner provides an annotated version of Figs. 1 and 9 of Holmes, reproduced below. Pet. 65.



Petitioner’s annotated version of Fig. 1 of Holmes.



Petitioner's annotated version of Fig. 9 of Holmes.

Petitioner argues:

As shown [above] in annotated FIGS. 1 and 9, Holmes discloses a range-finding based image processing railway servicing system for identifying and inspecting features of a railway 300 (fuchsia), including rails 305, ties 310, tie plates 315, underlying railway bed 320, and other railway features. Holmes, 3:4-22, 4:1-6, 5:2-5, 5:20-23. The system includes a vision system 500 (red) transported by a carriage 100 (green) along the railway 300. Holmes, 3:4-41. Holmes thus discloses the limitations of this claim element.

Pet. 64–65.

Patent Owner has provided no argument challenging Petitioner's contention. *See generally* PO Resp. 41–58.

We have reviewed the evidence.

As shown on Petitioner's annotated version of Fig. 1, Holmes's vision system (marked in red) inspects a railway, thereby disclosing “[a] system for inspecting” as claimed.

As shown on annotated versions of Figs. 1 and 9, Holmes discloses a “railway” and “ties” and “rails” (marked in fuchsia) that one of ordinary skill would associate with a railroad “track bed” and these are shown as the subject of its vision system. Accordingly, Petitioner shows that Holmes

discloses “[a] system for inspecting [i.e., its vision system] a railroad track bed, including the railroad track” as claimed.

As shown on Petitioner’s annotated version of Fig. 1, Holmes’s vision system (marked in red) is mounted in a carriage (marked in green) that is supported on “wheels 110 that engage rails 305” (Ex. 1011, 3:13).

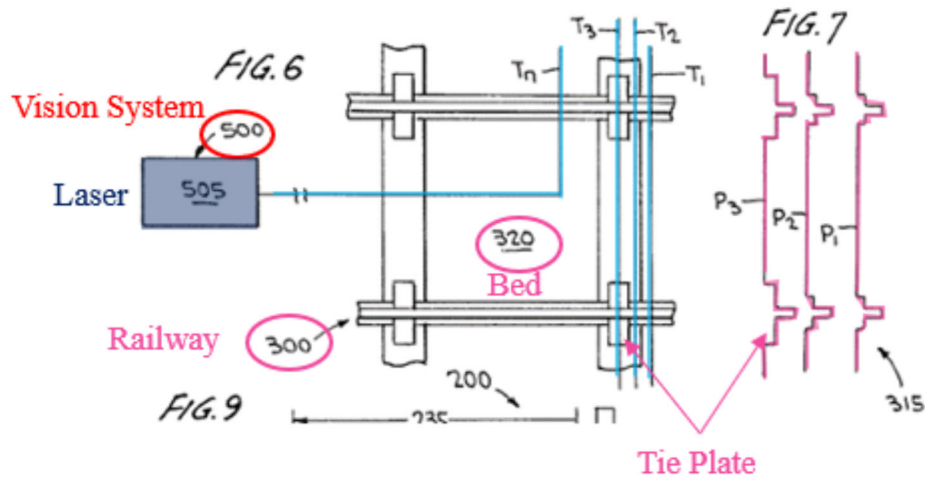
Accordingly, Petitioner shows that Holmes discloses “[a] system for inspecting [i.e., its vision system] ... mounted on a vehicle for movement along the railroad track” as claimed.

Accordingly, based on our review of the evidence of record, Petitioner has shown that Holmes discloses “[a] system for inspecting a railroad track bed, including the railroad track, to be mounted on a vehicle for movement along the railroad track” (Ex. 1001, 11:41–43) as claimed.

[a] “at least one light generator positioned adjacent the railroad track for projecting a beam of light across the railroad track bed”

Petitioner contends that Holmes discloses a light generator positioned as claimed. Pet. 65–66.

Petitioner provides an annotated version of Fig. 6 of Holmes, reproduced below:



Petitioner's annotated versions of Figs. 6 and 7 and a portion of Fig. 9 of Holmes highlight the vision system, laser, railway, railway bed and tie plates in the figures. *Id.* at 66.

According to Petitioner:

As shown [above] in annotated FIG. 6, the vision system 500 includes a laser emitter 505 (navy) positioned adjacent the railway 300 for projecting an “amplitude-modulated laser beam B” (blue) across the railway 300 (fuchsia) Holmes, 3:52-5:5. The emitted laser beam B defines traces T1-Tn (blue) across railway 300, which correspond to profiles P1-Pn (fuchsia, FIG. 7). *See id.*

Id. at 65.

Patent Owner has provided no argument challenging Petitioner's contention. *See generally* PO Resp. 41–58.

We have reviewed the evidence.

As shown on Petitioner's annotated version of Holmes Fig. 6, Holmes's vision system (marked in red) comprises a laser 505, which is a “light generator.” The laser, as shown, is adjacent a railroad track bed and therefore Petitioner has shown Holmes discloses “at least one light generator positioned adjacent the railroad track” as claimed.

Petitioner further accurately explains, as shown on Petitioner's annotated versions of Holmes Figs. 6 and 7, that "[t]he emitted laser beam B defines traces T1-Tn (blue) across railway 300, which correspond to profiles P1-Pn (fuchsia, FIG. 7)." Pet. 65. Accordingly, Holmes discloses "projecting a beam of light across the railroad track bed" as claimed.

Based on our review of the evidence of record, Petitioner has shown that Holmes discloses "at least one light generator positioned adjacent the railroad track for projecting a beam of light across the railroad track bed" (Ex. 1001, 11:44–46) as claimed.

[b] "at least one optical receiver positioned adjacent the railroad track for receiving at least a portion of the light reflected from the railroad track bed and generating a plurality of images representative of the profile of at least a portion of the railroad track bed"

Petitioner contends that Holmes discloses an optical receiver positioned as claimed or, in the alternative, it would have been obvious over the combination of Holmes and Bostrom. Pet. 66–68.

[1] Holmes

According to Petitioner, Holmes discloses "at least one optical receiver positioned adjacent the railroad track for receiving at least a portion of the light reflected from the railroad track bed" as claimed because "Holmes' vision system 500 includes a sensor 510 positioned adjacent the railway 300 for receiving some of the resultant light waves reflected from the beam of light projected across the surface of the railway 300 by the laser emitter 505." Pet. 66 (citing 3:54-56; 4:34-44, and FIG. 10 of Holmes).

Petitioner further contends that Holmes also discloses the optical receiver “generating a plurality of images representative of the profile of at least a portion of the railroad track bed” because, according to Petitioner:

The sensor 510 transmits a corresponding signal conveying the phase information to an image processor 515 that “compares the phase of the irradiated laser beam with the phase of the corresponding infrared energy” and “generates a corresponding, *range-based* virtual surface.” Holmes, 3:52-5:5 (emphasis added).

Id.

Patent Owner has provided no argument challenging Petitioner’s contention. *See generally* PO Resp. 41–58.

We have reviewed the evidence.

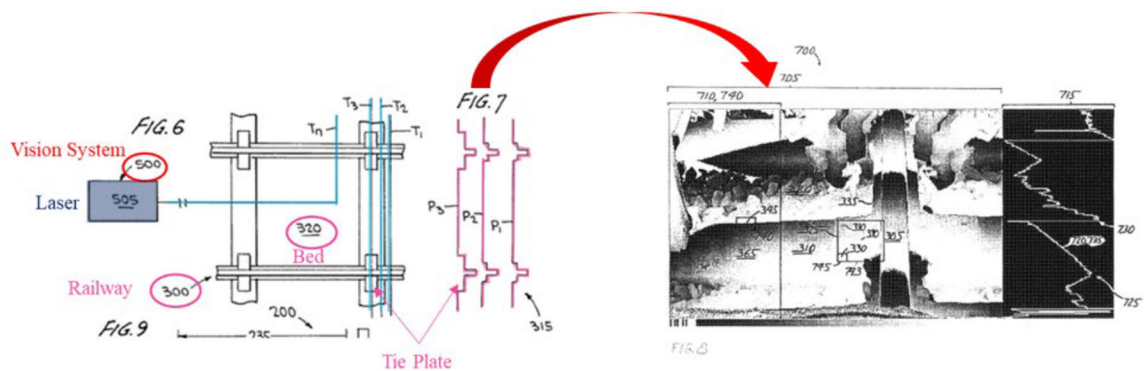
Consistent with Petitioner’s contention, Holmes discloses:

vision system 500 employs light infrared detection and ranging (LIDAR) *for identifying features of a railway 300 in a manner similar to radar*. Vision system 500 includes a laser emitter 505, *an infrared sensor 510* and an image processor (not shown). Laser emitter 505 emits an amplitude-modulated laser beam B across surface S. Surface S absorbs energy from laser beam B and radiates some of that energy in the form of infrared electromagnetic waves I. Sensor 510 receives some of the infrared electromagnetic waves I and transmits a signal corresponding to the phase of the received infrared energy to an image processor.

Ex. 1011, 3:52–62 (emphasis added). Accordingly, Petitioner shows that Holmes discloses “at least one optical receiver positioned adjacent the railroad track for receiving at least a portion of the light reflected from the railroad track bed” as claimed.

Regarding the optical receiver positioned “for ... generating a plurality of images representative of the profile of at least a portion of the railroad track bed” as claimed, Dr. Papanikolopoulos states that:

Holmes’ range-based virtual surface exhibits features that correspond to features of the railway 300, such as the rails 305, ties 310, tie plates 315, railway bed 320, and other railway features from along the profiles (i.e., P1-Pn) of the actual surfaces irradiated by the laser beam. *See id.* FIG. 8 below shows one of a plurality of range-based virtual surfaces representative of the profile of the scanned portion of the track bed from along the profiles (i.e., P1-Pn) of the actual surfaces irradiated by the laser beam (FIGS. 6-7).



Petitioner’s annotated versions of Figs. 6, 7, 8 and a portion of Fig. 9 of Holmes. Ex. 1004, ¶ 138, Pet. 67. Figure 8, which shows one of a plurality of range-based virtual surfaces, depicts a composite image based on emitted laser beam B that defines traces T1-Tn (blue) across railway 300, which correspond to profiles P1-Pn (fuchsia, FIG. 7).

Accordingly, Petitioner shows that Holmes discloses “at least one optical receiver positioned adjacent the railroad track *for* ... generating a plurality of images [i.e., composite images of a plurality of range-based virtual surfaces] representative of the profile of at least a portion of the railroad track bed” as claimed.

Based on our review of the evidence of record, Petitioner has shown that Holmes discloses “at least one optical receiver positioned adjacent the railroad track for receiving at least a portion of the light reflected from the railroad track bed and generating a plurality of images representative of the profile of at least a portion of the railroad track bed” (Ex. 1001, 11:47–51) as claimed.

[2] Holmes and Bostrom

Petitioner states that

To the extent Patent Owner were to argue that *Holmes’ sensor 510 does not “generate” the corresponding, range-based virtual surfaces* representative of the actual surfaces or profiles of the railway 300 irradiated by the laser beam B because the image processor 515 is not integrated with the sensor 510, it would have been obvious to integrate Holmes’ sensor 510 with the image processor 515. Ex-1004, ¶139.

Pet. 67 (emphasis added).

Patent Owner has provided no such argument. *See generally* PO Resp. 41–58.

Be that as it may, according to Petitioner:

Bostrom discloses a vision system sensor 23 “arranged for detecting an image of the object 2.” Bostrom, 5:44-45. Bostrom explains that the sensor “[p]referably” has on-chip signal processing capability and generates “height profiles of the object 2.” Bostrom, 5:47-49. 7:50-56. Bostrom’s device 1 also includes a control means, such as a CPU, arranged to determine geometric properties of the object 2 from digital representations of the profile of the object 2. Bostrom, 8:56-62. Ex-1004, ¶140.

Pet. 67–68. “It would have been obvious to a POSITA to integrate Holmes’ sensor 510 and image processor 515 to allow the sensor to generate the virtual images representative of the actual surfaces or profile of the railway

300 irradiated by the laser beam B, as taught by Bostrom. Ex-1004, ¶141.”
Id. at 68.

Consistent with Petitioner’s characterization, Bostrom discloses a vision sensor (element 23 in Bostrom Fig. 1 reproduced in Section II.D.3.). Bostrom states that “[p]referably, the sensor 23 is a two-dimensional matrix sensor having on-chip signal processing capability.” Ex. 1008, 5:47–48. As Dr. Papanikolopoulos explains, “Bostrom suggests integrating the CPU’s signal processing capabilities to the sensor 23. Bostrom, 8:67-9:7, 9:30-41.” Ex. 1004, ¶140, citing Bostrom, 8:67–9:7 (reproduced below), 9:30–41.

Due to the on-chip hardwired and/or programmed signal processing capabilities of the sensor 23, the amounts of data exchanged between the sensor 23 and the control means are reduced, enabling a faster object inspection process. When using an advanced sensor such as MAPP2200 the on-chip capabilities are complex enough to assert that the signal processing performed on-chip is an image processing.

Ex. 1008, 8:67–9:7.

Combining Holmes’ sensor 510 and image processor 515 into a single unit yields no more than one would expect from combining said elements each performing their respective functions. “[W]hen a patent ‘simply arranges old elements with each performing the same function it had been known to perform’ and yields no more than one would expect from such an arrangement, the combination is obvious.” *KSR*, 550 U.S. at 416.

Furthermore, one of ordinary skill in the art would have been led to combine Holmes’ sensor 510 and image processor 515 given the reasonable expectation that the resulting unit would enable a faster object inspection process as Bostrom discloses for its integrated sensor and signal processor.

Accordingly. Petitioner's reasoning is sufficient to support its position that, if one were to argue that the claim requires the sensor to generate the plurality of images and Holmes' sensor 510 does not "generate" the corresponding, range-based virtual surfaces, it would nevertheless have been obvious to one of ordinary skill in the art to combine Holmes' sensor 510 and image processor 515 thereby yielding a unit "for ... generating a plurality of images representative of the profile of at least a portion of the railroad track bed" (Ex. 1001, 11:47–51) as claimed.

[c] "at least one processor for analyzing the plurality of images and determining one or more physical characteristics of the said portion of the railroad track bed"

Petitioner contends that Holmes discloses a processor as claimed. Pet. 68–69.

Petitioner contends that

To identify target railway features including ties 310 and tie plates 315, from the range-based virtual images, Holmes' image processor 515 "recogniz[es] an attribute" of the target feature from images constituting the range-based virtual surface representative of the profile of the scanned portion of the railroad track bed. Holmes, 4:4-6, 5:6-43.

Pet. 68–69.

Patent Owner has provided no argument challenging Petitioner's contention. *See generally* PO Resp. 41–58.

We have reviewed the evidence.

Consistent with Petitioner's characterization, Holmes' image processor 515 (*see* Petitioner's annotated version of Fig. 1 of Holmes above), which identifies features of a plurality of range-based virtual surfaces on a composite virtual image (*see* Fig. 8 reproduced above and

associated discussion), “ascertains a location, in three-dimensional space, of an actual target feature of a rail, tie or other element of a railway” (Ex. 1011, 4:4–6).

Accordingly, based on our review of the evidence of record, Petitioner has shown that Holmes discloses “at least one processor for analyzing the plurality of images and determining one or more physical characteristics of the said portion of the railroad track bed” (Ex. 1001, 11:52–54) as claimed.

[d] “the one or more physical characteristics comprising at least a geographic location of the plurality of images along the railroad track bed”

Petitioner concedes that “Holmes does not appear to disclose determining a geographic location of the plurality of images.” Pet. 69.

In that regard, Petitioner relies on two disclosures in Trosino.

First, “Trosino discloses determining the geographic location of images of components taken along the railroad track.” *Id.* More particularly,

Trosino’s system [] includes a track geometry measuring system 80 (TGMS) that provides a distance measurement or milepost location for the images and detected anomalies. Trosino, 10:17-22, 10:28-59, 13:42-57. The TGMS also identifies exceptions to predetermined track geometry thresholds and upon identification of such exceptions, facilitates recording of images including the exception. Trosino, 10:22-27, 12:8-10.

Id. at 44. Said cited passages are reproduced below:

In addition to the detection of anomalies by the driver and the inspector as described, vehicle 10 includes additional redundant systems to facilitate the detection of anomalies. Specifically, the track geometry measuring system 80 (TGMS) is utilized to provide a distance measurement or milepost location for the right-of-way video images and for the detected anomalies. Additionally, the TGMS will identify exceptions to

predetermined track geometry thresholds. Upon identification of such exceptions, the TGMS will signal to the vision system 60, which will respond by recording the plan view images including the exception to be reviewed by the analyst.

The TGMS and the vision system 60 will interface with each other so that milepost location, anomaly triggering and additional signal channels can be recorded and displayed with the video information. For instance, upon milepost detection, the TGMS may pass an ASCII text string or TTL (teletype language) pulse identifying the milepost information to the vision system over a computer interface.

To support the vehicle's operation by either driver station, the TGMS must be capable of measuring when the vehicle is traveling in either the forward or reverse direction without adjustment or recalibration. The TGMS may either directly measure the track geometry parameters or provide raw transducer signals to a processing system for calculation of these parameters as the vehicle moves along the track. Other preferred features of the processing system of the TGMS include control of a graphic display system, preferably through the vision system monitor 24 used by the inspector; recordation of all data collected by the TGMS for later retrieval and analysis in a playback mode; identification of exceptions to the predetermined track geometry thresholds and communication in real-time of the presence of exceptions forming anomalies; providing printed reports for the track which has been measured; and monitoring of the status of the measuring instruments and related devices and displaying warning messages in the event of malfunction. Advantageously, the graphic display system will display the last milepost passed and the distance from the last milepost, the current track number, the posted class of track and posted track speed, the operating speed of the vehicle, any exceptions to the posted class of track, and messages indicating the status of the various components of the TGMS.

Ex. 1009, 10:17–59. The various reference numerals refer to Fig. 1, reproduced below:

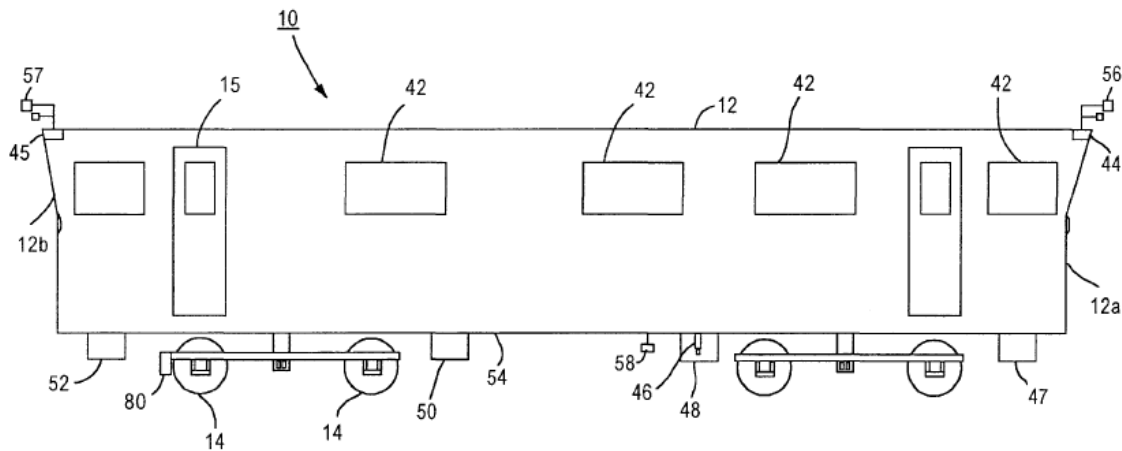


FIG. 1

Fig. 1 of Trosino illustrating an embodiment of Trosino's automated track inspection vehicle (10).

Second, Petitioner also points out that “Trosino further explains that the track inspection vehicle 10 includes ‘global positioning systems for time stamping and geolocation.’ Trosino, 11:1-5.” Pet. 69.

According to Petitioner:

It would have been obvious to implement Holmes and Bostrom's vision system to determine the geographic location of images of railroad components to ascertain the location of the image of the defected railroad track component along the railroad track and provide real-time information and/or a track inspection report identifying “at least the type and location of anomal[ies] and the required remedial action,” as taught by Trosino. Trosino, Abstract; *accord id.*, Abstract, 7:43-49, 10:7-15, 42-59. Ex-1004, ¶143. Holmes and Trosino thus render obvious this limitation of claim 16. Ex-1004, ¶143.

Id. at 69.

Regarding the first Trosino disclosure Petitioner relies upon, Patent Owner argues that “Holmes expressly teaches away from using [Trosino's] type of measurement system.” PO Resp. 43.

Patent Owner's position is largely based on the following passage in Holmes:

An advantage of the range finding based correlation of equipment 200 and railway feature positions is that no cumulative positioning errors can accrue, as occurs with systems that rely on physical measurement of service surfaces, which eventually lead to erroneous positioning of equipment relative to a service surface and faulty servicing thereof. For example, systems that ascertain carriage position relative to a railway by physically measuring the length of rail passing thereunder, directly or via a wheel traversing the rail, even if calibrated carefully, accrue slight positional errors between successive actual and measured positions

Ex. 1011, 6:24–34; PO Resp. 44. Patent Owner also cites to Ex. 1011, 1:38–41, 1:49–55 which, according to Patent Owner, shows that “prior art devices that ‘index a tamping mechanism according to a distance traveled by the tamping mechanism along the rail’ do not ‘accurately locate target features of a railroad bed.’” PO Resp. 44.

According to Patent Owner, “Trosino measures “distance travelled” to provide track image “location[s],” while Holmes expressly teaches away from devices that measure “distance traveled” or that “physically measur[e]” distance or track image positions because they provide “erroneous positioning.” PO Resp. 44. In support thereof, Dr. Bovik explains that

Trosino measures “distance travelled” to provide a “location” for its track images, while Holmes expressly teaches away from using devices that measure “distance traveled” or that otherwise “physically measur[e]” distance or position of the track images because they provide “erroneous positioning” for railroad track servicing. Holmes thus explicitly criticizes, discredits, and discourages use of the type of system in Trosino. Moreover, combining this aspect of Trosino with Holmes, as the Petition and Dr. Papanikolopoulos urge, runs directly contrary to

Holmes's purpose of measuring only a range between the servicing tool and the part to be serviced to obtain the requisite accuracy.

Ex-2003 ¶ 166; PO Resp. 44.

Petitioner replies, *inter alia*, that

The Petition does not propose bodily incorporating Trosino's "measuring system [that] measures distance travelled by the car and provides a distance marker representing distance travelled" into Holmes, as GREX argues. Nor is the test whether Trosino's features may be physically or bodily incorporated into Holmes. Instead, the appropriate test is what the combined teachings of those references would have suggested to those of ordinary skill in the art. *In re Keller*, 642 F.2d 413, 425 (CCPA 1981).

Pet. Reply 9. According to Petitioner,

as presented in the Petition, the combined teachings of Holmes and Trosino would have suggested to a POSITA to implement Holmes' vision system to determine geographic locations of railroad component images (i.e., the claimed invention) to ascertain locations of defected railroad track components along the track and provide real-time information and/or a track inspection report identifying "at least the type and location of anomal[ies] and the required remedial action," as taught by Trosino. *Id.*, 69 (citing Trosino, Abstract, 7:43-49, 10:7-15, 42-59; Ex-1004, ¶143).

Id. at 9-10.

Patent Owner responds, *inter alia*, that

Petitioner's argument is beside the point. GREX made a caselaw-based "teaching away" argument amply supported by the references and other evidence. GREX never argued whether Trosino could or could not be "physically" or "bodily incorporated" into Holmes. See Response at 42-45. Neither the phrase "bodily incorporate," "physically incorporate," nor any variations appears in GREX's Response. *See id.* Petitioner otherwise never addresses that Holmes teaches away from

Trosino's distance-traveled measurement technique, nor provides any counterevidence. See Reply at 7-13.

PO Sur-reply 4.

We have considered the respective positions of the parties and reviewed the supporting evidence. We find that, based on the evidence, Petitioner has the stronger position.

We are unpersuaded by Patent Owner's teaching away argument.

If a person of ordinary skill in the art reviewing a prior art reference would be discouraged from pursuing the claimed solution because the reference "suggests that the developments flowing from its disclosures are unlikely to produce the objective of the applicant's invention," the reference is said to "teach away." *Syntex (U.S.A.) LLC v. Apotex, Inc.*, 407 F.3d 1371, 1380 (Fed. Cir. 2005) (citing *In re Gurley*, 27 F.3d 551, 553 (Fed. Cir. 1994)). A prior art reference evidences teaching away if it "criticize[s], discredit[s], or otherwise discourage[s] the solution claimed." *In re Fulton*, 391 F.3d 1195, 1201 (Fed. Cir. 2004).

In re Brandt, 886 F.3d 1171, 1178 (Fed. Cir. 2018).

The difficulty with Patent Owner's "teaching away" argument is that it "alleges only that [distance travelled measurements] may be inferior for certain purposes [i.e., positional accuracy]." *In re Mouttet*, 686 F.3d 1322, 1334 (Fed. Cir. 2012).

We agree with Patent Owner's contention that Holmes indicates that there are alternative modes of determining positional accuracy in servicing a railroad track, and suggests that Trosino's mode of determination would be less suitable. However,

the "mere disclosure of alternative designs does not teach away." *In re Fulton*, 391 F.3d 1195, 1201 (Fed. Cir. 2004). This court has further explained that just because better alternatives exist in the prior art does not mean that an inferior combination is inapt

for obviousness purposes. [*In re Gurley*, 27 F.3d 551, 553 (Fed. Cir. 1994).]

Mouttet, 686 F.3d at 1334. *See also Bayer Pharma AG v. Watson Labs., Inc.*, 874 F.3d 1316, 1327 (Fed. Cir. 2017) (“the teaching away inquiry does not focus on whether a person of ordinary skill in the art would have merely favored one disclosed option over another disclosed option.”)

Further, “[a] prior art reference evidences teaching away if it “criticize[s], discredit[s], or otherwise discourage[s] *the solution claimed.*” *In re Fulton*, 391 F.3d 1195, 1201 (Fed. Cir. 2004) (emphasis added). Arguably Holmes dissuades one from employing Trosino’s mode for determining positional accuracy for servicing a railroad track. But that alone does not constitute a “teaching away” from including a distance marker in an image as Trosino discloses “for inspecting a railroad track bed” (Ex. 1001, 11:41); *cf. Pregis Corp. v. Kappos*, 700 F.3d 1348, 1355 (Fed. Cir. 2012) (“The mere fact that Troy ’285 teaches creation of bubble-wrap as a preferred embodiment does not constitute “teaching away” from other reasonable uses of the Troy ’285 machine.”).

Patent Owner agrees that “Trosino’s measurement system determines geographic location of track images [albeit] on a much broader (and imprecise) scale. Ex-2003, ¶164.” PO Resp. 43. Specifically, Trosino discloses:

the measuring system measures distance travelled by the car and provides a distance marker representing distance travelled, and the vehicle further comprises *an interface* between the measuring system and the vision system *for including the distance marker in the image.*

Ex. 1009, 4:21–26; PO Resp. 43 (emphasis added). Thus, Trosino discloses including a geographic location of a portion of the railroad track bed in the image.

Combining Holmes’s processor for determining “physical characteristics of *[a] portion* of the railroad track bed” and Trosino’s including a geographic location of a portion of the railroad track bed yields, predictably, a “processor for . . . determining one or more physical characteristics of *[a] portion* of the railroad track bed . . . *[that includes]* a geographic location of the plurality of images along the railroad track bed.” Claim 16. “The combination of familiar elements according to known methods is likely to be obvious when it does no more than yield predictable results.” *KSR*, 550 U.S. at 416.

Regarding the second Trosino disclosure Petitioner relies upon, Patent Owner argues that incorporating GPS, as Trosino discloses, in the Holmes system would provide a less precise positional accuracy. *See* PO Resp. 45.

according to Dr. Bovik, a POSITA would not have combined that aspect of Trosino with Holmes because of the lack of accuracy of GPS. Ex-2003, ¶167. Petitioner applies a “June 30, 2004” “priority date” for the claims. Petition at 5. In 2004, the actual GPS global average user range error (“URE”) performance was 2.2 meters 95% of the time. Ex-2003, ¶168; Ex-2006 at 3 & Fig. 1; *see* Ex-2005 at 48 (Figs. A-5-1, A-5-2).

However, positional accuracy obtained by a GPS device is less precise. A reasonable approximation of position accuracy is actual URE multiplied by dilution of precision (“DOP”). A high level of precision for DOP in 2004 was between 1.5 and 3. Accordingly, a high level of GPS accuracy in 2004 was between 3.3 and 6.6 meters (10.83 and 21.65 feet) 95% of the time. Ex-2003, at ¶169; *see* Ex-2007 at 36, 365.

Id. See also PO Sur-reply 5 (“Petitioner fails to rebut GREX’s evidence that GPS systems were far too inaccurate for Holmes’s objective.”)

The difficulty with this argument is that we do not see how either Holmes or Trosino teaches away from incorporating GPS in the Holmes system.

Patent Owner’s position is that one of ordinary skill in the art would have been led away from using Trosino’s GPS because it would yield a less precise positional accuracy than a POSITA would expect from using the Holmes system without it. The fact that measurements taken via GPS at the time the application was filed were imprecise does not undermine Petitioner’s position that including GPS measurements for geographically locating a portion of the railroad track bed in an image would have been obvious over the combination of Holmes and Trosino. As we have stated, “just because better alternatives exist in the prior art does not mean that an inferior combination is inapt for obviousness purposes.” *Mouttet*, 686 F.3d at 1334.

Combining Holmes’s processor for determining “physical characteristics of *[a]* portion of the railroad track bed” and Trosino’s “global positioning systems for time stamping and geolocation” yields, predictably, a “processor for . . . determining one or more physical characteristics of *[a]* portion of the railroad track bed . . . *[that includes]* a geographic location of the plurality of images along the railroad track bed.” Claim 16. “The combination of familiar elements according to known methods is likely to be obvious when it does no more than yield predictable results.” *KSR*, 550 U.S. at 416.

Accordingly, we agree with Petitioner's argument, "Holmes and Trosino thus render obvious this limitation of claim 16." Pet. 69.

[e] "processor including an algorithm for detecting a misaligned or sunken tie plate of the railroad track bed"

With respect to this claim limitation, both parties rely on their positions as to limitations [f] and [g].

Petitioner contends that

A POSITA would have understood that processors execute algorithms, and thus, the vision system processor of *Holmes* and *Bostrom* renders obvious an algorithm for detecting a misaligned or sunken tie plate, in combination with *Kanade* and *Davis*, in accordance with the steps performed as explained below in claim 16[f]-[g]. Ex-1004, ¶144.

Pet. 70. Patent Owner responds:

Petitioner asserts that "the vision system processor of *Holmes* and *Bostrom* renders obvious an algorithm for detecting a misaligned or sunken tie plate, in combination with *Kanade* and *Davis*," with the steps "explained below in claim 16 [f]-[g]." *Id.* Petitioner's argument thus relies entirely on its contention that those references render elements [f]-[g] unpatentable. *Id.*

PO Resp. 47.

Accordingly, we now turn to limitations [f] and [g].

[f] "(a) analyzing a frame of the plurality of images, the frame comprising a region of interest; (b) determining whether the region of interest contains a tie plate"

Petitioner's Position

Petitioner contends that "Holmes' image processor 515 permits identification and the location of target railway 300 features, including ties 310 and tie plates 315 from the range-based virtual surface representative of the profile of the scanned portion of the railroad track bed. *Holmes*, 3:66-4:6." Pet. 70.

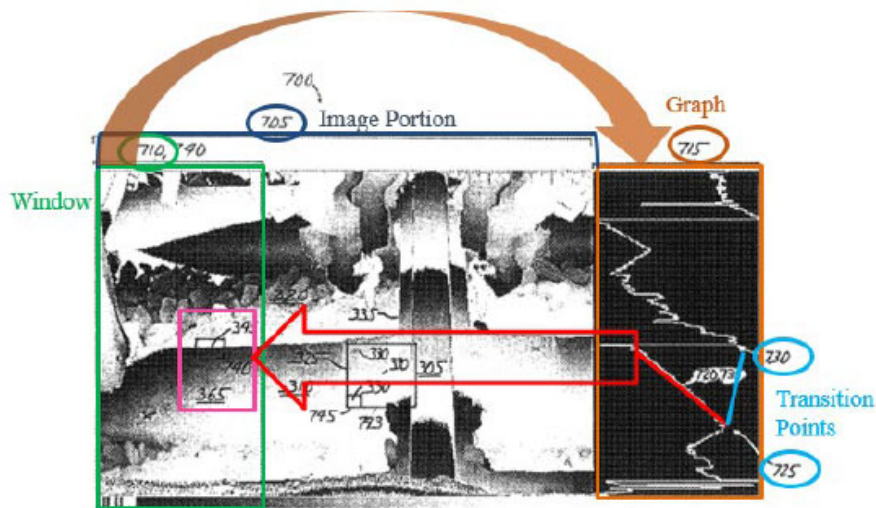
Petitioner provides an annotated version of Figure 8 which Petitioner indicates is “an example”

show[ing] Holmes’ image processor 515 identifying a railroad tie from an image portion 705 (navy) (the claimed “plurality of images”) constituting range-based virtual surfaces representative of the profile of the scanned portions of the railroad track bed 705.

Id.

According to Petitioner,

The processor 515 first analyzes a graph 715 (orange rectangle, the claimed “frame”) of a window 710 (green) from the image portion 705. Holmes, 5:6-37. The graph 715 has a “profile 720, which has contours that correspond to distinguishable elements in window 710.” Holmes, 5:25-29. Graph 715 includes a collection or data structure of pixels forming a 2D representation. Ex-1004, ¶145.



Petitioner’s annotated version of Fig. 8 of Holmes depicts an analysis of a railway image. *Id.* at 70–71.

Furthermore, according to Petitioner:

Image processor 515 then extracts contour information from the profile 720 and compares it with known range-based data of

typical railway features to determine whether the actual railway appears to present a specified feature. *Holmes*, 5:8-12, 29-37. For example, image processor 515 extracts transition points 725 and 730 (blue) and curve 735 (red line) information from the profile contour 715 (orange). *See id.* It then compares the extracted contour information with known contour range-based data tie information (such as, e.g., the distance between transition points 725 and 730 (blue line), the slope of curve 735 (red line)). *See id.* Based on the comparison, the processor 515 identifies (red arrow) leading and trailing edges 340 and 345 and upper surface 365 as surface “attributes” of the target feature tie 310 (fuchsia). *See id.*

Id. at 71.

Petitioner concedes that “Holmes does not expressly disclose that the graph 715 [i.e., the claimed “frame”] includes a region of interest.” *Id.* at 72. In that regard, “Kanade discloses an image processing application involving 2D line-wise examination using an evaluation zone (the claimed ‘region of interest’) to detect defects in the inspected object. Ex-1010, 549-557, FIG. 7. Ex-1004, ¶147.” *Id.* Fig. 7 of Kanade is reproduced below.

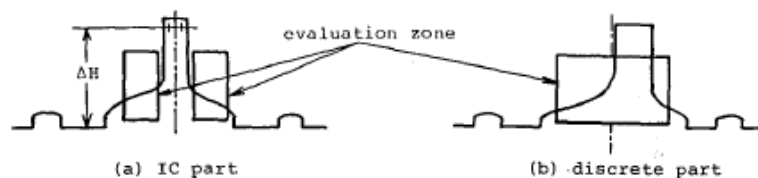


Figure 7: Establishment of Evaluation Zone. (a) IC Part; (b) Discrete Part

Fig. 7 of Kanade showing evaluation zones for an IC [i.e., Integrated Circuit] Part and a Discrete Part.

According to Petitioner, “[i]t would have been obvious to implement Holmes’ processor with a region of interest software application to

accelerate identification of the profile 720 to target railroad features. *Id.*,

¶147.” Pet. 71. As Dr. Papanikolopoulos explains:

Holmes does not expressly disclose that the graph 715 includes a region of interest. Kanade discloses an image processing application involving 2D line-wise examination using an evaluation zone (the claimed “region of interest”) to detect defects in the inspected object. Ex-1010, 549-557, FIG. 7. It would have been obvious to implement Holmes’ processor with a region of interest software application to accelerate identification of the profile 720 to target railroad features.

Ex. 1004 ¶ 147.

We observe that Petitioner directs our attention to a section of Kanade titled “3. Automatic Inspection of Solder Joints on Printed Circuit Boards” (Ex. 1010, 548). This section concerns an “automatic visual inspection technique or solder joints on printed circuit boards” (*id.*) that provides an explanation of the different types of solder joint defects (*id.* at 549), a method of detecting the shape of the solder joint correctly (*id.* at 549–50), and algorithms “to detect defects and to judge their types” (*id.* at 551). Regarding the algorithms, Kanade discusses an operation whereby a light-section waveform is produced from an image (*id.* at 552), the preprocessing of the waveform “consist[ing] of histogramming and noise cleaning (*id.* at 552), and “[t]he final process is the evaluation of [the] waveform” (*id.* at 553). The final evaluation process “is done by checking several parameters. In calculating these parameters, a particular evaluation zone is set up for each parameter, as shown by the rectangles in Figure 7 (reproduced above), *and the counting is done only in these zones.*” *Id.* at 553 (emphasis added). Kanade explains the four parameters for evaluation that “are useful to detect the four fundamental defect types” (*id.* at 553). Figure 8 (reproduced below)

of Kanade depicts the four parameters and the evaluation zones (the rectangles) that facilitate their calculation. *Id.* at 554.

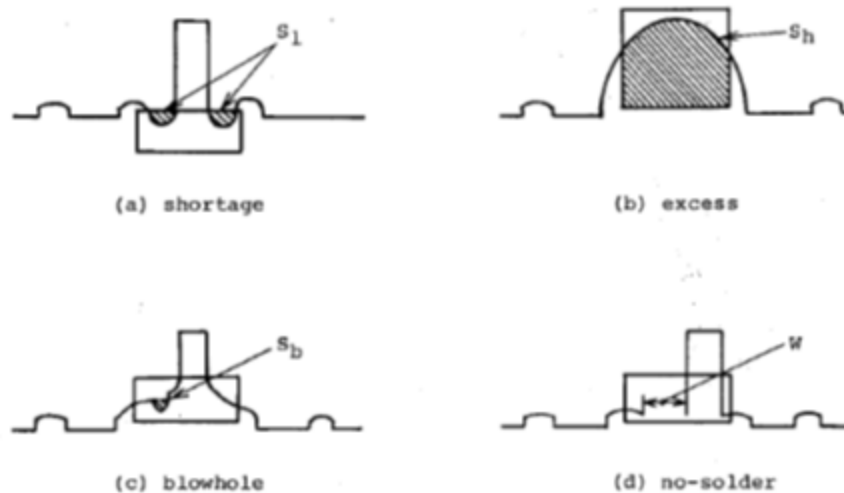


Fig. 8 of Kanade showing parameters of judgment: (a) shortage; (b) excess; (c) blowhole; and, (d) no-solder.

Given this disclosure, Petitioner’s contention that, “as shown [above] in FIG. 8, [Kanade] teaches using evaluation zone/regions of interest to accelerate identification of a particular part/region of a profile” (Pet. Reply 17–18) has sufficient support.

Patent Owner’s Position

In evaluating Patent Owner’s arguments, we observe that Patent Owner has not challenged Petitioner’s equating of Holmes’s graph 715 (outlined by an orange rectangle on Petitioner’s annotated version of Fig. 8 reproduced above) to the claimed “frame of the plurality of images.” *See generally* PO Resp.

Nor has Patent Owner challenged Petitioner’s statement that “[t]he processor 515 first analyzes a graph 715 (orange rectangle, the claimed

“frame”) of a window 710 (green) from the image portion 705. Holmes, 5:6-37.” Pet. 70.

That being said, we have reviewed said disclosure in Holmes that Petitioner relies upon and find that it supports Petitioner’s statement. It explains in pertinent part that:

FIG. 8 shows a composite virtual image and feature analysis graph display 700 of the image processor. An image portion 705 of display 700 shows rail 305, extending vertically with respect to the page, tie 310, tie plate 315 and railway bed 320. . . . The image processor analyzes a window 710 of image portion 705 and generates a corresponding graph 715 having a profile 720. . . . *The image processor*, having been provided data as to the distance between transition points 725 and 730, the slope of curve 735 or other defining relationships [of profile 720], identifies leading and trailing edges 340 and 345, upper surface 365 and so forth [of image portion 705] *from image analysis of graph 715*.

Ex. 1011, 5:32–38 (emphasis added).

Furthermore, Patent Owner indicates that “Holmes’s image processor already analyzes images and can ‘detect[]’ and ‘identif[y]’ ‘worksite feature[s],’ including a ‘tie’ or ‘tie plate.’ Ex-1011 at 2:5-7; 5:17-18; 7:15-18.” PO Resp. 50. Patent Owner explains:

The image processor applies either a “catalog of images” of the “desired target feature,” or “image data associated with” that feature and its “attributes.” *Id.* at 7:18-21. If the target feature is, for example, a crosstie, the image processor “compare[s] the anticipated tie image with features of the generated virtual surface” in the analyzed image. *Id.* at 7:32-34. The tie is “identified” if the “processor determines the existence of correspondence between the virtual surface corresponding to the actual tie and the anticipated tie image.” *Id.* at 7:36-41; *see id.* at 7:22-24; 8:62-67.

Accordingly, in Dr. Bovik's opinion, Holmes already achieves the objective of identifying and locating image features, including tie plates, and there was no need to look elsewhere to attain that objective.

Id.

By these statements Patent Owner agrees with Petitioner that Holmes discloses a processor that determines whether there is a tie plate; that is, Holmes discloses a processor "analyzing a frame [i.e., graph 715] of the plurality of images" and "determining" whether the frame "contains a tie plate."

Accordingly, there is no dispute that Holmes discloses a processor for "(a) analyzing a frame of the plurality of images, . . . , [and] (b) determining . . . [whether there is] a tie plate."

That leaves only the question of whether it would have been obvious over the combination of Holmes and Kanade to include a "region of interest" (i.e., Kanade's evaluation zone) in the frame (i.e., Holmes' graph 715) and "determining whether the region of interest contains a tie plate."

As far as the "region of interest" is concerned, Patent Owner does not challenge Petitioner's contention that Kanade discloses an evaluation zone or Petitioner's characterization of Kanade's evaluation zone as corresponding to the "region of interest" of the claim. *See* Pet. 72; PO Resp. *generally*.

Patent Owner presents three arguments.

First Patent Owner Argument

Patent Owner argues that Kanade's region of interest concerns solder joints of electrical components on a circuit board which cannot be applied to Holmes, which concerns railroad track components.

[I]n Dr. Bovik’s opinion, “[i]t is not generally obvious to convert a computer vision system already programmed to identify an object or feature in an image to a system that uses the ROI approach to identify some other object or feature.” Ex-2003, ¶178. “As a result, implementing an ROI disclosure from the prior art provides *the potential for improvement or efficiency only if the prior art discloses or suggests the specific size and shape of the ROI to be used in the new application*, and the specific location in the images where the ROI will be located based on the relationship of an object or feature in the image to other objects or features in the image.” Ex-2003, ¶180.

PO Resp. 48 (emphasis added). According to Patent Owner:

Kanade’s technique relies on identifying circuit board projections (Ex-1010 at 550-53), assumes that they are “positions of a lead” from electrical components and, based on that assumption, confines the image analysis to certain “evaluation zones” of a very specific size and shape around that projection where it expects a solder joint to be. It further assumes that the material in those zones is solder and, based on the shape detected in that zone, determines whether the presumed joint has “no solder,” a “shortage” or “excess” of solder, or a “blowhole.” Ex-2003, ¶190; Ex-1010 at 553-54, Figs 7-8, 11-13.

In Dr. Bovik’s opinion, “[t]he details of the application of ROI in Kanade demonstrate that it would not have been obvious to apply the concept from Kanade to Holmes” “because the problems addressed by them are not adequately similar. Nothing in Kanade discloses or suggests how it might be adapted for use in the context of identifying a tie plate in Holmes’ railway images.” Ex-2003, ¶¶191, 186. Kanade’s circuit board “components are an extremely small size as compared to the relatively large size of components used in a railroad track bed.” Ex-2003, ¶186. “The sizes and shapes of the ROIs in Kanade are expressly created to work only for the solder joints of electrical components on a circuit board, and the ROI locations are based on the relative positions of an electrical lead to the solder joint. None of those features are useful for application of ROI in the context of a railroad track bed or, more specifically, for

determining if a tie plate is present in an image. The size and scale are totally different, the object and features to locate are different, and the relationship of each object or feature to other objects and features are different.”

PO Resp. 48–49. In the same vein, Patent Owner states the following:

According to Dr. Bovik, “[t]o a POSITA, Kanade’s approach would have appeared unsuitable to combine with Holmes.” Ex-2003, ¶192. Because Kanade’s application is narrowly focused to a specific type of circuit board analysis, at most it can detect the existence of a circuit board projection; it cannot identify a component in an image. It assumes that a projection is an electrical component “lead” and assumes that certain areas around the lead are solder in the joint, but it cannot detect the component or identify its type, as element [f] requires and as Holmes already discloses.

PO Resp. 51-52.

Petitioner replies:

GREX attacks the purported differences in “size,” “scale,” “the objects and features to locate,” and “the relationship of each object or feature to other objects and features.” Response, 49. But the test is not whether Kanade’s particular ROI application to solder joints of electrical components may be physically or bodily incorporated into Holmes. Instead, the appropriate test is what the combined teachings of those references would have suggested to those of ordinary skill in the art. *In re Keller*, 642 F.2d at 425.

Pet. Reply 15. Petitioner adds that

as presented in the Petition, the combined teachings of Holmes and Kanade would have suggested to a POSITA to implement Holmes’ automated track inspection vision system with Kanade’s ROI image processing tools, not the physical or bodily incorporation of the specific size, scale, or specific application of Kanade’s ROI application to electrical component solder joints. In fact, the ’329 patent itself appreciates that the processing device “can have image processing tools *known in the art* for

analyzing image data from the cameras 50 *such as Region of Interest (ROI) tools.*”). ’329 patent, 5:11-15 (emphases added).
Id. at 15–16.

We have considered the parties’ positions.

We appreciate that circuit board components are certainly smaller than components of a railroad track bed. If, however, one of ordinary skill in the art would recognize that Kanade’s evaluation zone would improve the detection of errors when inspecting railroad track components, then it would have been obvious to apply Kanade’s evaluation zone in Holmes unless the actual application is beyond his or her skill. *See KSR*, 550 U.S. at 416. “[I]f a technique has been used to improve one device, and a person of ordinary skill in the art would recognize that it would improve similar devices in the same way, using the technique is obvious unless its actual application is beyond his or her skill.”

In that regard, Dr. Bovik testifies that “*implementing an ROI disclosure from the prior art provides the potential for improvement or efficiency* only if the prior art discloses or suggests the specific size and shape of the ROI to be used in the new application.” Ex. 2003 ¶180; PO Resp. 48.

Thus, Dr. Bovik suggests that implementing Kanade’s region of interest tools in the Holmes system “provides the potential for improvement or efficiency.” Ex. 2003 ¶180; PO Resp. 48. Dr. Bovik’s subsequent assertion that the prior art must “disclos[e] or suggest[e] the specific size and shape of the ROI to be used in” Holmes is not buttressed by other evidence or elaborated upon. This testimony is inadequate in explaining why it would have been beyond the skill of one of ordinary skill in the art to apply

Kanade's region of interest to Holmes's graph 715 (the "frame"), notwithstanding, as Dr. Bovik suggests, that in doing so it "provides the potential for improvement or efficiency" (*id.*).

Second Patent Owner Argument

Patent Owner argues that "nothing in either Holmes or Kanade provides a *sufficient reason* for a POSITA to implement Kanade's 'evaluation zones' in Holmes *to locate and identify a tie plate*." PO Resp. 49–50, citing Ex. 2003 ¶ 182. Emphasis added. The argument has two sub-arguments; the first argues that there is no reason to do so and the second challenges Petitioner's reliance on Kanade as purportedly "'accelerat[ing] identification' of the target feature" PO Resp. 51.

First, Patent Owner argues, *inter alia*, that "Holmes's image processor *already* analyzes images and can "detect[]" and "identif[y]" "worksite feature[s]," including a "tie" or "tie plate." Ex-1011 at 2:5-7; 5:17-18; 7:15-18." PO Resp. 50 (emphasis added).

[I]n Dr. Bovik's opinion, Holmes already achieves the objective of identifying and locating image features, including tie plates, and there was no need to look elsewhere to attain that objective. Using Kanade's "evaluation zones" to locate a feature is unnecessary. Kanade at best merely provides an alternative technique. Ex-2003, ¶183.

Id. "Indeed, Holmes's device already identifies a component in an image without assuming the identity of any component." *Id.* at 52.

Petitioner replies that

GREX ignores the specific motivation presented in the Petition, namely, implementing region of interest software to accelerate identification of profile 720 within graph 715, to target railroad features. Pet., 72. Implementing such regions of interest would not be "unnecessary," nor does it "merely provide[]" an

alternative technique,” as GREX argues. Response, 50. Instead, the technique would improve identification of targeted railroad features in Holmes’ system.

Pet. Reply 16.

We have considered the parties’ positions and supporting evidence and find the Petitioner has the stronger argument.

Patent Owner’s argument that Holmes *already* achieves the objective of identifying and locating image features, including tie plates, does not affect Petitioner’s position, because Petitioner’s position goes to *improving* what the Holmes process already does. As Petitioner points out, the Petition states that “[i]t would have been obvious to implement Holmes’ processor with a region of interest software application *to accelerate identification* of the profile 720 to target railroad features. [Ex. 1004] ¶147.” Pet. 72 (emphasis added). That Holmes already identifies a tie plate does not undermine Petitioner’s position that the combination of Holmes and Kanade would “accelerate [said] identification.”

Second, Patent Owner challenges Petitioner’s assertion that “Kanade purportedly ‘accelerate[s] identification’ of the target feature.” PO Resp. 51, citing Pet. 72 For the following reasons, this, too, fails to undermine Petitioner’s position.

According to Patent Owner,

Kanade has no disclosure of “accelerating identification.” If anything, it suggests that zone evaluation slows down, rather than accelerates, processing. Ex-2003, ¶185. Kanade’s lengthy process uses the original image, the video signal’s brightness graph, and peak evaluation rules, to create a “light-section waveform.” Ex-1010 at 551. The waveform is “preprocessed” by “histogramming and noise cleaning” to determine the circuit board’s top surface (“base level”), interpolating to fill in

waveform gaps, and smoothing out irregularities. *Id.* at 552. The center of each electronic part's lead is identified. Only then is the "evaluation zone" applied. *Id.* at 553-54.

Id.

Petitioner replies as follows:

According to GREX and its expert, Kanade's evaluation zone would, allegedly, "slow down, rather than accelerate[], processing," because "Kanade's lengthy process uses the original image, the video signal's brightness graph, and peak evaluation rules, to create a 'light-section waveform'" before the "evaluation zone" is applied. Response, 51. But the Petition relies on Holmes, not Kanade, for its profile of scanned portions of railroad track bed 705. Thus, GREX's attempt to discredit Kanade's disclosure of converting the original image into a waveform fails because one cannot show [nonobviousness] by attacking references individually, where, as here, the rejection is based on a combination of references. *See In re Keller*, 642 F.2d at 426. Moreover, GREX provides no credible evidence in support of its argument that the use of an evaluation zone on a profile—particularly one similar to that described and shown in the '329 patent, 8:13-24, FIGS. 4A-C, 6A-C, 7A-B, 8-10—would be slower than not using the evaluation zone.

Pet. Reply 18–19.

Patent Owner responds, *inter alia*, as follows:

Petitioner deliberately ignores the fundamental basis for its Petition. In its Petition and Reply, Petitioner contends that a POSITA would have been motivated to combine Holmes and Kanade because Kanade's technique would supposedly "accelerate identification" of the target feature. Petition at 72; Reply at 16-18. Thus, GREX's proof that *Kanade's technique would slow down, rather than accelerate, processing* directly undercuts the fundamental basis of Petitioner's contention. To the extent Petitioner suggests that it purportedly relied solely on Holmes' "profile of scanned portions of railroad track bed" to show unpatentability of element [f], without reference to use of Kanade's evaluation zone technique, Petitioner's suggestion is

nonsensical. Petitioner cannot invoke the use of Kanade's technique while simultaneously claiming to ignore that technique.

PO Sur-reply 14-15 (emphasis added).

According to Patent Owner, the "technique [i.e., of Kanade] has many steps that, if anything, slows down rather than accelerating component identification." *Id.* at 15, *referring to* PO Resp. 51. According to Patent Owner,

Notably, Petitioner never attempts to rebut Dr. Bovik's explanation why Kanade's technique would not accelerate processing. *See* Reply at 18. Petitioner merely claims the explanation is somehow not "credible" because it means that the ROI technique disclosed in the '329 patent and currently used by GREX would also be slower. *Id.* at 18-19. However, for patentability purposes, Kanade's disclosure is at issue, not the '329 patent's disclosure.

Indeed, Petitioner's choice not to depose Dr. Bovik means that Petitioner has no contrary testimony from him regarding element [f]. Petitioner's assertion that his opinions are "unsupported" (Reply at 14) is baseless. Ironically, the only thing "unsupported" is Petitioner's assertion in that regard, made without any accompanying support. *See* Reply at 14-19. A review of his testimony demonstrates that his opinions are amply detailed and supported.

Id. at 16.

We have reviewed the evidence. The evidence Patent Owner relies upon does not undercut Petitioner's position.

Patent Owner seeks to show that "Kanade's technique would slow down, rather than accelerate, processing" (PO Sur-reply 14) which, according to Patent Owner, is contrary to Petitioner's position that implementation of Kanade's region of interest would accelerate

identification. In order to show this, Patent Owner relies on Dr. Bovik's testimony which states the following:

Kanade has no disclosure of "accelerating identification." If anything, it suggests that zone evaluation slows down, rather than accelerates, processing. Kanade's lengthy process uses the original image, the video signal's brightness graph, and peak evaluation rules, to create a "light-section waveform." Ex-1010 at 551. The waveform is "preprocessed" by "histogramming and noise cleaning" to determine the circuit board's top surface ("base level"), interpolating to fill in waveform gaps, and smoothing out irregularities. *Id.* at 552. The center of each electronic part's lead is identified. Only then is the "evaluation zone" applied. *Id.* at 553-54.

Ex. 2003, ¶ 185; PO Resp. 51.

According to Petitioner, "implement[ing] Holmes' processor with a region of interest software application [would] accelerate identification of the profile 720 to target railroad features." Pet. 72.

Whether "accelerat[ing] identification" would have been a sufficient reason for one of ordinary skill in the art to include Kanade's evaluation zone in Holmes to identify a tie plate (i.e., to include a "region of interest" in the frame (i.e., Holmes' graph 715) and "determining whether the region of interest contains a tie plate" as claimed) does not depend on Kanade expressly reciting the words "accelerating identification." *See KSR*, 550 U.S. at 419 ("The obviousness analysis cannot be confined by a formalistic conception of the words teaching, suggestion, and motivation, or by overemphasis on the importance of published articles and the explicit content of issued patents.")

Patent Owner points to disclosure in Kanade describing "us[ing] the original image, the video signal's brightness graph, and peak evaluation

rules, to create a ‘light-section waveform.’” (PO Resp. 51, citing Ex. 1010, 551) and that “[t]he waveform is ‘preprocessed’ by ‘histogramming and noise cleaning’ to determine the circuit board’s top surface (‘base level’), interpolating to fill in waveform gaps, and smoothing out irregularities” (*id.*, citing Ex. 1010, 552). However, said disclosures refer to the “Extraction of Light–Section Waveform” (Ex. 1010 at 551, Section 3.3.1.) and “Preprocessing of the Waveform” (*id.* at 552, Section 3.3.2.). Then Kanade describes the “Evaluation of the Waveform.” *Id.* at 553, Section 3.3.3. It is this last section that describes setting up an evaluation zone. “[A] particular evaluation zone is set up ... as shown by the rectangles in Figure 7 [reproduced above].” *Id.* That is to say, Kanade’s “Evaluation of the Waveform” is a separate procedure.

We agree with Petitioner that “the Petition relies on Holmes, not Kanade, for its profile of scanned portions of railroad track bed 705.” Pet. Reply 18. Kanade’s “Extraction of Light–Section Waveform” and “Preprocessing of the Waveform” sections go to extracting a light–section waveform from an image. However, Petitioner relies on Holmes for this aspect. According to Petitioner:

Holmes’ image processor 515 permits identification and the location of target railway 300 features, including ties 310 and tie plates 315 from the range-based virtual surface representative of the profile of the scanned portion of the railroad track bed. Holmes, 3:66-4:6. As an example, annotated FIG. 8 below shows Holmes’ image processor 515 identifying a railroad tie from an image portion 705 (navy) (the claimed “plurality of images”) constituting range-based virtual surfaces representative of the profile of the scanned portions of the railroad track bed 705. The processor 515 first analyzes a graph 715 (orange rectangle, the claimed “frame”) of a window 710 (green) from

the image portion 705. Holmes, 5:6-37. The graph 715 has a “profile 720, which has contours that correspond to distinguishable elements in window 710.” Holmes, 5:25-29.

Pet. 70 (referring to Petitioner’s annotated version of Fig. 8, reproduced above). Accordingly, Patent Owner’s focus on Kanade’s “Extraction of Light–Section Waveform” and “Preprocessing of the Waveform” sections in arguing that Kanade’s “zone evaluation slows down, rather than accelerates, processing” (PO Resp. 51), is misplaced.

Also, Petitioner argues that Patent Owner “attempt[s] to discredit Kanade’s disclosure of converting the original image into a waveform fails because one cannot show nonobviousness by attacking references individually, where, as here, the rejection is based on a combination of references.” Pet. Reply 18, citing *Keller*, 642 F.2d at 426. In that regard, and in support of Petitioner, the Petition clearly indicates Petitioner’s position as being that “[i]t would have been obvious to implement Holmes’ processor with [Kanade’s] region of interest software application to accelerate identification of the profile 720 to target railroad features. Id., ¶147.” Pet. 72.

For these reasons, this argument does not undercut Petitioner’s position.

Third Patent Owner Argument

Patent Owner argues that there is no “‘predictable use’ of Kanade’s evaluation zones according to their ‘established functions,’ and it would not have been obvious[] to apply those zones in Holmes.” PO Resp. 52, Ex. 2003, ¶ 193, quoting *KSR*, 550 U.S. at 416.

Patent Owner explains:

Indeed, as Dr. Bovik opines, although no record evidence supports it, even if a POSITA had sufficient reason to make the mental leap required to implement Kanade's technique in Holmes, it would require generating a different algorithm that determines entirely distinct locations, sizes, and shapes of evaluation zones. Ex-2003, ¶194. A tie plate is normally located where a crosstie and rail intersect. Using a markedly different variant of Kanade's technique (taught only by element [f]), the evaluation zone could be placed at that intersection. However, that approach requires the image processor to first identify and locate a crosstie, a rail, and their intersection point. Only then could the evaluation zone's location be determined, appropriately sized and shaped, and applied near the intersection. Because the applied algorithm is decidedly different from Kanade's, it is not a "predictable use" of Kanade's approach according to its "established functions." *Id.*

PO Resp. 52–53.

Petitioner replies that

the test is not whether Kanade's particular ROI application to solder joints of electrical components may be physically or bodily incorporated into Holmes. Instead, the appropriate test is what the combined teachings of those references would have suggested to those of ordinary skill in the art. *In re Keller*, 642 F.2d at 425. And as presented in the Petition, the combined teachings of Holmes and Kanade would have suggested to a POSITA to implement Holmes' automated track inspection vision system with Kanade's ROI image processing tools, not the physical or bodily incorporation of the specific size, scale, or specific application of Kanade's ROI application to electrical component solder joints. In fact, the '329 patent itself appreciates that the processing device "can have image processing tools *known in the art* for analyzing image data from the cameras 50 *such as Region of Interest (ROI) tools*."). '329 patent, 5:11-15 (emphases added).

Pet. Reply 15–16 (a similar argument is made at Pet. Reply 18 with respect to the second Patent Owner argument discussed above).

Patent Owner responds:

Petitioner's related, yet fleeting, argument—that "GREX's attempt to discredit Kanade's disclosure" "fails because one cannot show nonobviousness by attacking references individually" because obviousness is "based on a combination of references" (Reply at 18)—is likewise meritless. Petitioner seeks to tear down an approach that GREX never employed. GREX demonstrated only that the underlying basis, and supposed motivation, for Petitioner's combination of Holmes and Kanade—that Kanade's technique would "accelerate" identification of a target feature—was fatally flawed. Response at 51. Consequently, only Petitioner's contention of unpatentability "fails."

PO Sur-reply 17. Patent Owner adds that

Petitioner notes that "the '329 patent itself appreciates that the processing device 'can have image processing tools known in the art for analyzing image data from the cameras 50 such as Region of Interest (ROI) tools.'" Reply at 16 (emphasis original). Petitioner's assertion is immaterial. The reason for making the combination must come from the "teachings of the prior art references," not from the patent at issue. *Intelligent Bio-Sys.*, 821 F.3d at 1367-68.

Id. at 18.

We have considered the respective positions.

We agree with Petitioner that Patent Owner's focus on Kanade, to the exclusion of Holmes, ignores the issue; that is, whether the combination of Holmes and Kanade would have led one of ordinary skill in the art to the claimed region of interest.

As we noted above in addressing Patent Owner's first argument, Dr. Bovik suggests that implementing Kanade's region of interest tools in the Holmes system "provides the potential for improvement or efficiency." Ex. 2003 ¶180; PO Resp. 48. This aligns with Petitioner's position. Thus, it

would seem accepted that Kanade's region of interest has an established function; that is, to improve the detection of defects. Combining Holmes and Kanade would yield, predictably, a region of interest on Holmes' graph, thereby improving the detection of defects as it relates to railroad track components. "The combination of familiar elements according to known methods is likely to be obvious when it does no more than yield predictable results." *KSR*, 550 U.S. at 416.

Relying on Dr. Bovik's testimony, Patent Owner contends that including Kanade's region of interest in Holmes "would require generating a different algorithm that determines entirely distinct locations, sizes, and shapes of evaluation zones." PO Resp. 52, Ex-2003, ¶194.

Even if a different algorithm would have to be generated in order for Kanade's region of interest to facilitate detection of defects in the context of Holmes's system, this does not undermine Petitioner's position, because providing a different algorithm does not alone establish that actual application of Kanade's region of interest in Holmes was beyond the skill of one of ordinary skill in the art. *KSR*, 550 U.S. at 416. "[I]f a technique has been used to improve one device, and a person of ordinary skill in the art would recognize that it would improve similar devices in the same way, using the technique is obvious unless its actual application is beyond his or her skill." *Id.* at 417.

We determine that Petitioner sufficiently demonstrates that, given Kanade, one of ordinary skill would have been motivated to implement Holmes's processor with a region of interest software application such that the algorithm comprises the steps of [f] "(a) analyzing a frame of the plurality of images, the frame comprising a region of interest; and

(b) determining whether the region of interest contains a tie plate” (Ex. 1001, 11:60–63).

[g] “(c) if a tie plate is present, determining a crosstie contour and a tie plate contour; (d) comparing an orientation of the crosstie contour and an orientation of the tie plate contour; (e) determining whether the tie plate is misaligned or sunken based upon the comparison.”

Petitioner’s Position

Relying on Davis, Petitioner contends that it was well known to compare a crosstie and tie plate in order to “determin[e] whether the tie plate is misaligned or sunken based upon the comparison” (Ex. 1001, 12:1–2). In support thereof, Dr. Papanikolopoulos testifies that

It was well-known in the art to determine the depth that a tie plate has cut into a tie by measuring elevation differences between top height surfaces of tie plates and ties, as evidenced by *Davis*.

Ex. 1004 ¶ 148; Pet. 72.

Petitioner explains that

Davis determines tie plate cutting to provide an objective performance measure of crosstie health: “extensive plate cutting is a good visual indicator that a tie has, at least, lessened capabilities. And, it may likely be internally damaged (i.e., decayed).” *Davis*, 19. And because extensive tie plate cutting is a reliable indicator of overall tie deterioration, the measured tie plate cutting “depth” has “long been used as a criteria for tie renewal marking.” *Id.*, 18. To measure tie plate cutting, Davis discloses measuring the depth the tie plate has cut into the tie “by measuring the difference in elevation between the top of the tie plate at a known distance from the edge and the top surface of the tie adjacent to the plate.” *Id.*, 17.

Pet. 73. “This measured tie plate cut “depth” would indicate whether the tie plate is misaligned, sunken, or both, ...” *Id.*

According to Petitioner,

[o]ne would have been motivated to implement Davis' tie plate cutting algorithm into Holmes' vehicle-mounted automated railroad inspection system, because the degree of tie plate cut provides an important and reliable objective performance measure of crosstie health, which can be used to address and correct (or renew) the crosstie, as taught by *Davis*, 18-19. Ex-1004, ¶150. Holmes appreciates the need to identify and assess a variety of railway track components, including ties and tie plates for defects and servicing. Ex-1004, ¶150. Thus, implementing Holmes with Davis' tie plate cutting teaching would simply provide another tie performance measurement for Holmes' system to automatically identify and correct in furtherance of increasing railroad safety. *Id.*, ¶150.

Id. at 73–74.

Given this, Petitioner argues that

[i]t would have been obvious to implement Holmes' processor with Davis' algorithm measuring and comparing the difference in elevation between the top of the tie plate and the top surface of the tie adjacent to the plate to determine the depth of tie plate cut, further in light of Kanade's image processing techniques. Ex-1004, ¶150.

Id. at 73.

Relying on Kanade, for example, Petitioner contends that it was well known to evaluate and compare features of contours. In support thereof, Dr. Papanikolopoulos testifies that

it is was also well-known to evaluate and compare features of contours of a 2D range image to determine potential defects through various image processing tools, as evidenced by, e.g., Kanade and many others, as discussed above. *Davis*, 17-19; Kanade, 553-557, FIGS. 7-8, 13; Ex-1021, 5-8, FIG. 11; Ex-1014, 132-134, 80-81, FIGS. 6.3, 4.1; Ex-1027, 149-152, 227-229, FIGS. 5.10, 5.11; '329 patent, 5:7-14, 8:30-31.).

Ex. 1004 ¶ 148; Pet. 72.

Given this, Petitioner argues that “it [] would have been obvious to a POSITA to implement Holmes’ system to extract tie and tie plate contour information from the profile 720 and compare the orientations of the tie and tie plate height contour information to determine whether the tie plate is misaligned or sunken based on the comparison. *Id.*, ¶148.” Pet. 72.

Patent Owner’s Position

Patent Owner does not disagree that “Davis discloses a mechanism for determining if a tie plate is improperly positioned.” PO Resp. 54.

However,

according to Dr. Bovik, “Davis does not disclose or suggest an algorithm,” because Davis “does not disclose a series of programming steps to be executed to determine tie plate cut.” Ex-2003, ¶200; see Ex-1005 at 17-19.

As Dr. Bovik explains, even if Davis’ tie plate cutting determination suggests creating an algorithm, the algorithm is very limited. Petitioner admits (Petition at 73) that, in accord with Davis’ disclosure, the algorithm would use one height measurement obtained on each tie plate and adjacent crosstie to determine tie plate cutting “by measuring the difference in elevation between the top of the tie plate at a known distance from the edge and the top surface of the tie adjacent to the plate.” Ex-1005 at 17-18. Accordingly, when combined with Holmes (with or without Kanade), the resulting system could, like element [g], “determin[e] whether a tie plate is ... sunken.” It would not, however, make that determination using the claimed steps, nor can it render element [g] obvious. Ex-2003, ¶201.

PO Resp. 54–55.

Thus, Patent Owner does not disagree with Petitioner’s position that [i]t would have been obvious to implement Holmes’ processor with Davis’ algorithm measuring and comparing the difference in elevation between the top of the tie plate and the top surface

of the tie adjacent to the plate to determine the depth of tie plate cut, further in light of Kanade's image processing techniques. Ex-1004, ¶150.

Pet. 73.

The disagreement is over whether the combination of Holmes, Davis, and Kanade renders obvious including the contour-determining and contour-orientation-comparing steps and their employment in determining whether a tie plate is misaligned or sunken; that is, "[e]lement [g] requires determining the crosstie and tie plate 'contours,' obtaining and 'comparing' the 'orientation' of those contours, and then using that 'comparison' to 'determin[e] whether the tie plate is misaligned or sunken.'" PO Resp. 55.

According to Patent Owner, "Petitioner provides no reason to further modify the combined system, let alone to implement element [g]'s additional distinct steps." PO Resp. 56 (citing Ex. 2003 ¶ 204).

Petitioner's evidence provides no basis to extend the combination to include the claimed algorithm's distinct steps. *See* Petition at 72-73. In particular, Petitioner reasons that "motivat[ion]" exists "because the degree of tie plate cut provides an important and reliable objective performance measure of crosstie health," and combining Holmes and Davis "provide[s] another tie performance measurement for Holmes' system to automatically identify and correct in furtherance of increasing railroad safety." *Id.* at 73, 74.

As Dr. Bovik explains, however, once Davis' technique of determining plate cut is implemented into Holmes, this alleged reason for combining the references has been fully achieved. Ex-2003, ¶204. Petitioner provides no reason to further modify the combined system, let alone to implement element [g]'s additional distinct steps. *Id.*

PO Resp. 55–56.

By this passage, again, Patent Owner expresses no disagreement that the combination of Holmes and Davis renders obvious “(e) determining whether the tie plate is misaligned or sunken based upon” (the depth of tie plate cut, for the reasons given by the Petitioner.

However, Patent Owner disputes that there is reason for including the contour-determining and contour-orientation-comparing steps and their employment in determining whether a tie plate is misaligned or sunken given the combination of Holmes, Davis, and Kanade. Patent Owner presents four arguments for why it believes the combination of Holmes, Davis, and Kanade would *not* suggest the contour-determining and contour-orientation-comparing steps of element [g].

First Patent Owner Argument

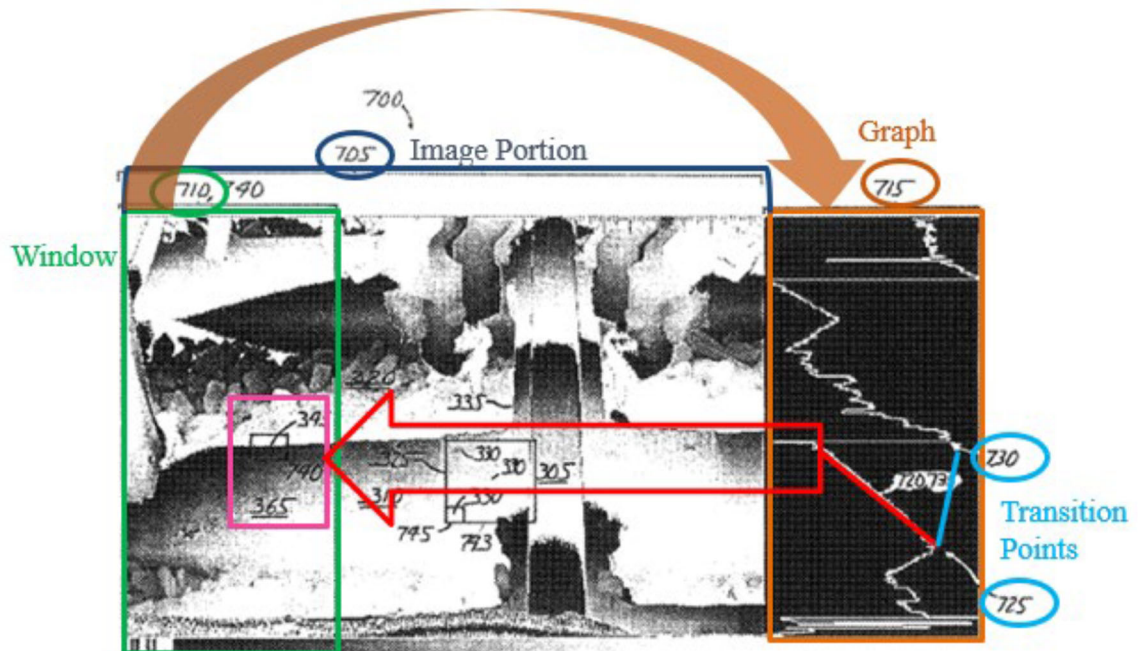
The first argument goes to the claim limitation “(c) if a tie plate is present, determining a crosstie contour and a tie plate contour.” Ex. 1001, 11:64–65. According to Patent Owner,

no reference teaches or suggests a processor executing an algorithm that “determin[es] a crosstie contour and a tie plate contour.” Petitioner relies on Holmes for this step. *See* Petition at 70-72. However, *Holmes’ processor and algorithm create a “profile” with “contours” only for some “distinguishable elements.”* Ex-1011 at 4:60-5:38. It refers only to the “edges” of the “crosstie”—a very large component—as having “distinguishable elements.” *Id.* Holmes does not teach that the system can distinguish the much smaller tie plate’s contour. *See id.*

PO Resp. 56 (emphasis added).

Petitioner disagrees that Holmes creates a “profile” with “contours” *only for some* “distinguishable elements”.

That is incorrect and plainly contradicted by the record evidence. As shown below, FIG. 8 of Holmes depicts a profile 720 with “contours” of “distinguishable” railroad track bed components, including ties and tie plates. Holmes, 5:25-29 (Holmes explaining that the graph 715 has a “profile 720, which has contours that correspond to distinguishable elements in window 710.”); *see also id.*, 7:15-42.



Petitioner’s annotated version of Fig. 8 of Holmes, depicting an analysis of a railway image.

Pet. Reply 20–21.

Patent Owner responds that Figure 8, which Petitioner relies upon as evidence showing determining contours, does not show “determining ... a *tie plate* contour” (Ex. 1001, 11:64–65 (emphasis added)); that is, the “distinguishable elements” for which Figure 8 shows contours is limited to crossties.

Although admitting that Holmes discloses only determining the “contours” of “distinguishable elements,” Petitioner erroneously

claims—pointing to Figure 8—that such “elements” include “tie plates.” Reply at 20, 21-22.

Holmes has no such disclosure. Figure 8 is reproduced below:

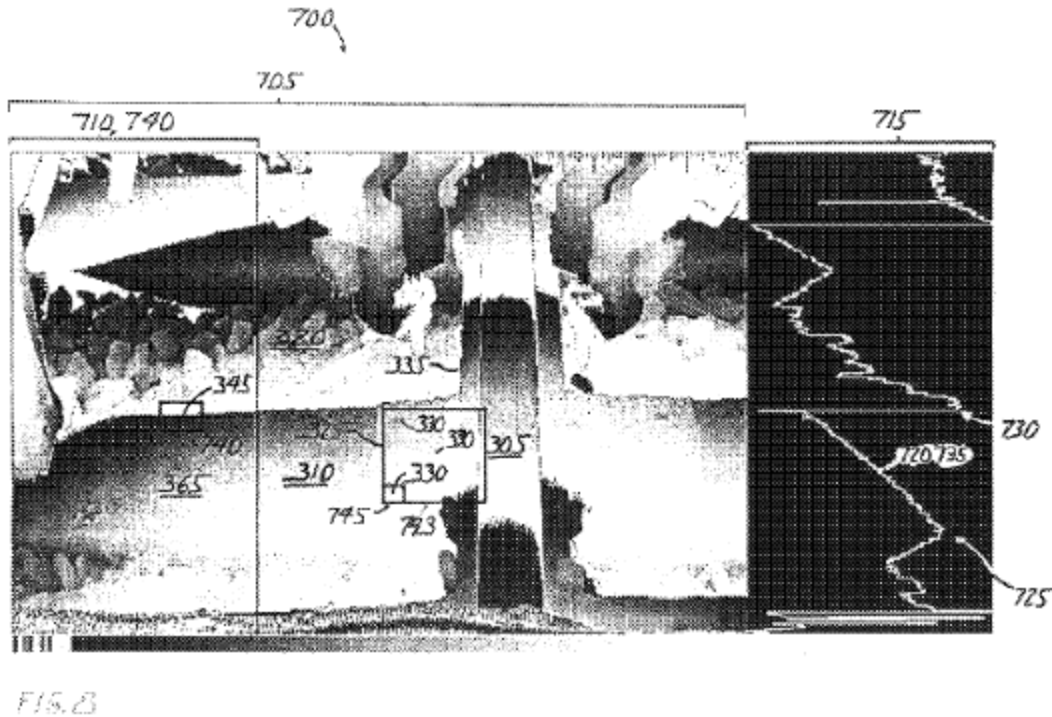


Figure 8 is a “composite” of a virtual “image portion 705” (the left $\frac{3}{4}$ of the figure) and a processor-generated “corresponding graph 715 having a profile 720” (the right $\frac{1}{4}$ portion). Ex-1011 at 5:19-21, 26-28.

Holmes states that “[p]rofile 720 has contours that correspond to distinguishable elements”; the “transition points 725 and 730” and “curve 735” correspond, respectively, to “leading and trailing edges 340 and 345” and the “upper surface 365” of “tie 310.” Ex-1011 at 5:28-32 (emphasis added). Holmes thus identifies creating a “contour” only for the crosstie (“tie 310”). Nowhere in Figure 8 or related text does Holmes disclose creating a graph, profile, and contour for the much smaller tie plate (labeled 325 in Figure 8 and 315 in the text). See Ex-1011 at 5:19-37.

PO Sur-reply 19-21.

We have analyzed Figure 8 and the associated disclosure in Holmes and find that it supports Petitioner's view.

As explained in Section II.D.6., Holmes discloses a vision system comprising a laser emitter emitting a laser beam, an infrared sensor, and an image processor. The infrared sensor

receives some of the resultant infrared electromagnetic waves and transmits a corresponding signal conveying the phase information thereof to an image processor [] which generates a corresponding, range-based virtual surface. With sufficient resolution, the virtual surface exhibits features that correspond to features of railway 300, for example, rails 305, ties 310 and the underlying railway bed 320.

Ex. 1011, 4:65–5:5. The image processor generates a range-based virtual surface of that for which it has received a signal. Holmes specifically identifies “ties 310” as a feature the virtual surface exhibits.

Holmes further explains that the image processor is

provided with range-based data corresponding to features of a typical railway or other user-designated features. Such data includes, for example, characteristic range values, like the height of a rail above which no other element of a railway occurs, typical slopes between points of a range-based image, and distances between typical slope changes. The image processor also is provided with image comparison software which permits the image processor to compare the data corresponding to a typical railway with the generated virtual surface to determine whether the actual railway appears to present a specified feature. *Thus, the image processor permits identification of a typical rail, tie, tie plate or other railway features.*

Id. at 5:6–18 (emphasis added).

Accordingly, Holmes discloses that *tie plates* can be identified via its generated range-based virtual surface. Holmes then turns to Figure 8 to explain the identifying process in more detail.

“Fig. 8 shows a composite virtual image and feature analysis graph display 700 of the image processor.” *Id.* at 5:19–20.

Figure 8, as reproduced by the parties, depicts a virtual image 700 having a portion 705. It also “shows rail 305, extending vertically with respect to the page, tie 310, tie plate 315 [sic, 325] and railway bed 320. Shading of image portion 705 relates to ranges of depicted features from the infrared sensor, as opposed to the luminescence or coloration thereof.” *Id.* at 5:21–25. Figure 8 shows a square placed on the image that identifies tie plate 325.

Figure 8 shows a window 710⁴ that marks off a region of image 700 within window 710 for further analysis. The analysis yields a graph. The graph has a profile. “The image processor analyzes a window 710 of image portion 705 and generates a corresponding graph 715 having a profile 720.” *Id.* at 5:25–27. “Profile 720 has contours that correspond to distinguishable elements in window 710.” *Id.* at 5:28–29.

It is clear that graph 715 will change depending on where window 710 is positioned on the composite virtual image. Figure 8 shows where the tie plate 325 is located in the image. It is bounded by a square, which also marks a position for “an analysis window 743” (*id.* at 9:12). While it may be true, as Patent Owner argues, that Figure 8 shows creating a profile having contours for a crosstie without expressly showing creating contours for tie plates, this is so only because analysis window 710 is positioned over a location on the image that does not include tie plates.

⁴ Figure 8 also includes reference numeral “740,” which according to Holmes, refers to “an analysis window 740” (Ex. 1011, 7:54).

Holmes does not, however, “identif[y] creating a “contour” *only* for the crosstie (“tie 310”).” PO Sur-reply 20 (emphasis added). In our view, as Petitioner has argued, Figure 8 represents “an example” (Pet. 71) of a composite virtual image the Holmes vision system can generate, and how the system can analyze a portion of the image. Holmes expressly states that “the image processor permits identification of a typical rail, tie, *tie plate* or other railway features” (Ex. 1011, 5:17–18). One of ordinary skill in the art reading this would understand that Figure 8 is an example of how to apply its analytical technique. That technique is applicable to identifying tie plates and not, as Patent Owner suggests, limited to large components such as railroad ties.

Since one of ordinary skill in the art would understand from reading Holmes that Figure 8 exemplifies an analytical technique that can be applied to identifying tie plates, and given that graph 715 shows a profile 720 having contours “that correspond to distinguishable elements in window 710,” we find the evidence supports Petitioner’s contention that “Holmes appreciates the need to identify and assess a variety of railway track components, including ties and tie plates for defects and servicing. Ex-1004, ¶150.” Pet. 73. The evidence does not support Patent Owner’s argument that Holmes is concerned “only [with] the ‘edges’ of the ‘crosstie’—a very large component—as having ‘distinguishable elements.’” PO Resp. 56.

For the foregoing reason, Patent Owner’s first argument is unpersuasive in undermining Petitioner’s position that Holmes discloses the claim limitation “(c) if a tie plate is present, determining a crosstie contour and a tie plate contour.” Ex. 1001, 11:64–65.

Second Patent Owner Argument

The second argument goes to the claim limitation “(d) comparing an orientation of the crosstie contour and an orientation of the tie plate contour.” Ex. 1001, 11:66–67.

According to Patent Owner,

Petitioner cites nothing from any reference that teaches or suggests obtaining an “orientation” of the crosstie or tie plate “contours” (*see* Petition at 70-72) because there is none. As Dr. Bovik explains, Holmes does not determine any contour’s “orientation.” Ex-2003, ¶206. The word “orientation,” nor any similar word, appears in Holmes. Davis’ single point measurements cannot determine orientation. Kanade analyzes a 2D profile. It does not suggest determining orientation of solder joint height profiles. *Id.*

PO Resp. 56–57.

Petitioner points out that its Petition argued that the combination of Holmes, Kanade, and Davis renders obvious the obtaining and comparing of crosstie and tie plate contours, not that any one of the references individually teaches said limitations.

GREX attacks each of Holmes, Kanade, and Davis individually in support of its argument that none of the references teaches determining and comparing an “orientation” of crosstie and tie plate contours. Response, 56-57. GREX’s attack of the references individually, however, improperly applies the legal standards for obviousness because it ignores and fails to address Petitioner’s position, which is based on the combination the references. *In re Keller*, 642 F.2d at 426.

As explained in the Petition, Holmes discloses determining contours of railroad track bed components, including ties and tie plates, by extracting contour information from a profile of a scanned portion of the railroad track bed and comparing the contour information with known range-based data of typical railway features to determine the attributes and

presence of a specified railroad component. Pet., 70-71 (citing Holmes, 3:66-4:6, 5:6-37, FIG. 8; Ex-1004, ¶145.).

Davis teaches that tie plate cut, a well-known objective performance measure of crosstie health, can be determined by measuring elevation differences between the top height surfaces of ties and tie plates. Pet., 72-73 (citing Davis, 17-19, Ex-1004, ¶148). And Kanade and many others evidence evaluating and comparing features of contours of a 2D range image to determine potential defects through various image processing tools. *Id.* (citing Kanade, 553-557, FIGS. 7-8, 13; Ex-1021, 5-8, FIG. 11; Ex-1014, 132-134, 80-81, FIGS. 6.3, 4.1; Ex-1027, 149-152, 227-229, FIGS. 5.10, 5.11; '329 patent, 5:7-14, 8:30-31.).

As the Petition further presents, based on these combination of teachings, it would have been obvious to implement Holmes' processor to extract tie and tie plate contour information from the scanned railroad track profile and compare the difference in elevation between the top height surface of the tie plate contour (i.e., the orientation of the tie plate contour) and the top height surface of the tie contour (i.e., the orientation of the tie contour) adjacent to the plate to determine the depth of tie plate cut (and thus whether a tie plate is misaligned or sunken) based on the comparison, as taught by Davis, further in light of Kanade's image processing techniques. Pet., 73-74 (citing Ex-1004, ¶150). GREX's individual attacks on Davis (as purportedly measuring only single point measurements) and Holmes (as purportedly not using the word "orientation") fail to take into account the combination of teachings provided in the Petition as a whole, and thus, fail to rebut the obviousness of the claimed features.

Pet. Reply 21–23.

We understand Petitioner's position to be that the combination of Holmes, Kanade, and Davis renders obvious the obtaining and comparing of crosstie and tie plate contours. *See* Pet. 72–74. We agree that Patent Owner's second argument does not address Petitioner's position and, accordingly, fails to undermine it.

Patent Owner adds that

Petitioner [] erroneously argues that Holmes “compar[es] the contour information with known range-based data of typical railway features to determine” the “presence of a specified railroad component.” Reply at 21-22. However, Holmes does not apply a “contour” “comparison” to identify components. For a crosstie, Holmes’s processor “compare[s]” “features of the generated virtual surface” to a “catalog of images” of the “desired target feature,” or “image data associated with” that feature. Ex-1011 at 7:32-34, 18-21. The tie is “identified” if the processor determines “correspondence between the virtual surface corresponding to the actual tie and the anticipated tie image.” *Id.* at 7:36-41; *see id.* at 7:22-24; 8:62-67.

PO Sur-reply 21.

If we understand Patent Owner correctly, Patent Owner is disputing Petitioner’s argument that Holmes “determine[s]” the presence of a railroad component. According to Patent Owner, Holmes instead discloses “identifying” a component.

The difference between “determin[ing]” the presence of a component and “identifying” a component is not clear to us based on Patent Owner’s argument. It would seem that once the Holmes system identifies a component its presence is necessarily determined.

For the foregoing reasons, Patent Owner’s second argument is unpersuasive in undermining Petitioner’s position that the combination of Holmes, Kanade, and Davis teaches the claim limitation “(d) comparing an orientation of the crosstie contour and an orientation of the tie plate contour.” Ex. 1001, 11:66–67.

Third Patent Owner Argument

The third argument goes to the claim limitation “(e) determining whether the tie plate is misaligned or sunken based upon the comparison [i.e., by ‘(d) comparing an orientation of the crosstie contour and an orientation of the tie plate contour’].” Ex. 1001, 12:1–2.

According to Patent Owner,

it necessarily follows that no reference discloses or suggests “determining whether the tie plate is misaligned or sunken based on the comparison” of those “orientation[s].” According to Dr. Bovik, even if Holmes somehow suggests determining crosstie and tie plate contours, it does not disclose “comparing” any components’ “contours.” Ex-2003, ¶207. Even if Holmes were generously deemed to suggest comparing component contours, including tie plates, there is no suggestion to obtain and compare “orientations” tie plate and crosstie contours, or to determine whether the tie plate is misaligned or sunken based on comparing those “orientations.” Consequently, there is no reason to combine the references to obtain element [g]’s steps because those steps are not disclosed or suggested by the references. *Id.*

PO Resp. 57. Patent Owner adds in Patent Owner’s Sur-reply that:

“Notably, Petitioner never denies and thus, effectively admits, that none of the references discloses determining or comparing “orientation” of tie plates and crosstie “contours.” PO Sur-reply 21–22.

There is no dispute that the term “orientation” is not expressly recited in the prior art references. But that is not dispositive of whether the prior art combination renders obvious comparing contour orientations and determining whether a tie plate is misaligned or sunken based on that comparison.

The parties agree that the Board should construe the term “orientation” “according to its plain and ordinary meaning, as the Patent

Owner and district court did in the Holland litigation for claim 16; that is, “the position or location of.” Ex-1028, 11-16; Ex-1029, 14-17; Ex-1030, 11-21; Ex-1031, 12-23; Ex-1032, 11-24.” Pet. 20. *See* PO Response 4 (“Patent Owner agrees with Petitioner (Petition at 20) that plain and ordinary meanings apply to these terms [e.g., “orientation”] in claims 16, 38, and 62.”). In Patent Owner’s “Opening Markman Claim Construction Brief” in the Holland litigation, Patent Owner indicates that “orientation means the position or location of”. Ex. 1030, 21.

Petitioner relies on Davis as comparing “position[s] or location[s] of” (i.e., “orientations of”) the tie plate and tie. As we pointed out above, Petitioner contends that Davis “discloses measuring the depth the tie plate has cut into the tie ‘by measuring the difference in elevation between the top of the tie plate at a known distance from the edge and the top surface of the tie adjacent to the plate.’ *Id.*, 17.” Pet. 73. Consistent with its Petition, Petitioner’s Reply states: “Davis teaches that tie plate cut, a well-known objective performance measure of crosstie health, can be determined by measuring elevation differences between the top height surfaces of ties and tie plates. Pet., 72-73 (citing Davis, 17-19, Ex-1004, ¶148).” Pet. Reply 22.

Accordingly, contrary to Patent Owner’s argument and consistent with Petitioner’s position, Davis suggests obtaining and comparing the positions of a tie plate and crosstie (i.e., their “orientations”) in order to determine tie plate cut and thereby crosstie health.

As far as evaluating and comparing contours, Petitioner relies on Kanade. As we stated earlier, relying on Kanade, for example, Petitioner contends that it was well known to evaluate and compare features of contours. In support thereof, Dr. Papanikolopoulos testifies that it was

also well-known to evaluate and compare features of contours of a 2D range image to determine potential defects through various image processing tools, as evidenced by, e.g., *Kanade* and many others, as discussed above. Davis, 17-19; *Kanade*, 553-557, FIGS. 7-8, 13; Ex-1021, 5-8, FIG. 11; Ex-1014, 132-134, 80-81, FIGS. 6.3, 4.1; Ex-1027, 149-152, 227-229, FIGS. 5.10, 5.11; '329 patent, 5:7-14, 8:30-31.).

Ex. 1004 ¶ 148; Pet. 72; *see also* Pet. Reply 22.

Patent Owner does not appear to dispute that *Kanade*, for example, evaluates and compares features of contours.

Accordingly, the evidence supports, and Patent Owner's third argument does not persuasively undermine, Petitioner's position; that is,

it would have been obvious to implement Holmes' processor to extract tie and tie plate contour information from the scanned railroad track profile and compare the difference in elevation between the top height surface of the tie plate contour (i.e., the orientation of the tie plate contour) and the top height surface of the tie contour (i.e., the orientation of the tie contour) adjacent to the plate to determine the depth of tie plate cut (and thus whether a tie plate is misaligned or sunken) based on the comparison, as taught by Davis, further in light of *Kanade's* image processing techniques.

Pet. Reply 22 (citing Pet., 73–74 and Ex. 1004 ¶ 150).

For the foregoing reasons, Patent Owner's third argument is unpersuasive in undermining Petitioner's position that the combination of Holmes, *Kanade*, and Davis teaches the claim limitation “(e) determining whether the tie plate is misaligned or sunken based upon the comparison [i.e., by ‘(d) comparing an orientation of the crosstie contour and an orientation of the tie plate contour’].” Ex. 1001, 12:1–2.

Fourth Patent Owner Argument

Patent Owner's fourth argument goes to the fact that Davis discloses a manual inspection method and whether implementing Davis's algorithm into Holmes's machine vision system would have been "beyond" the skill of a person of ordinary skill in the art. Patent Owner argues that, given Davis's manual method, one would not have been led to modify the algorithm employed in Holmes's machine vision system to create a system that measures tie plate cut using the claimed algorithm.

According to Patent Owner,

In Dr. Bovik's opinion, "a POSITA would not have modified Holmes with Davis in any event because there is a vast chasm between Davis's manual method and" a "machine vision" system "like in Holmes." Ex-2003, ¶208. "A special amount of invention and creativity is necessary" "to write an algorithm to implement a manual method because" "implementing even the simplest concept into machine vision is very difficult and time consuming." *Id.* "For that reason, combining [Davis's] technique for measuring tie plate cut" "with a computer vision system to create a computer vision system that measures tie plate cut would not have been obvious, let alone creating a system that measures tie plate cut using the claimed algorithm. That conclusion is especially apt here because Holmes's machine vision disclosure is very high level, and it thus does not provide the basis for a combination with Davis's extremely specific task." *Id.*

PO Resp. 57–58. "In addition, as Dr. Bovik explains, a POSITA had no reason to believe that Holmes' sophisticated technique should be augmented with Davis' simple mechanical device and manual technique. Ex-2003, ¶209." *Id.* at 58.

Petitioner disagrees, for three reasons.

First, Petitioner takes issue with Dr. Bovik's assertion that "implementing even the simplest concept [e.g., Davis's algorithm] into machine vision [e.g., Holmes] is very difficult and time consuming." Pet. Reply 23.

Patent Owner responds that

Petitioner takes issue with Dr. Bovik's opinion that a POSITA would not have combined Holmes and Davis. Reply at 23-25. Petitioner incorrectly claims as "without support" his opinion that "a POSITA had no reason to believe that Holmes' sophisticated technique" based on its "very high level" machine vision disclosure "should be augmented with Davis' simple mechanical device and manual technique" that addresses an "extremely specific task." *Id.* at 23. He explained that "Davis employs a simple technique using human visual inspection to locate a tie plate followed by manual placement of a device to obtain one height measurement each on the tie plate and adjacent crosstie," while "Holmes is a vastly more complicated technique involving automated imaging of every object inspected and all surrounding areas, recording an image of the height of every object's entire surface and of the surrounding areas, to create multiple images, and analyzing those images to locate certain objects, such as a crosstie." Ex-2003, ¶¶ 208-209.

Po Sur-reply 22.

Second, Petitioner argues, *inter alia*, that Patent Owner provides insufficient reasoning explaining why "implementing Holmes' automated track inspection system with Davis' tie plate cut algorithm would be difficult, time-consuming, or require special expertise beyond that which a POSITA would find obvious." Pet. Reply 23.

GREX provides no credible reason explaining why implementing Holmes' automated track inspection system with Davis' tie plate cut algorithm would be difficult, time-consuming, or require special expertise beyond that which a POSITA would find obvious. The Board has discretion to ignore

these conclusory opinions without scrutiny. *Ericsson*, 890 F.3d at 1346. That integration may be “difficult and time consuming,” as GREX argues, is irrelevant to whether integration would have been obvious to a POSITA.

Id. at 23–24.

Patent Owner responds that

Petitioner likewise incorrectly contends that “GREX provides no credible reason explaining why implementing” Davis’s technique into Holmes “would be difficult, time-consuming, or require special expertise beyond that which a POSITA would find obvious.” Reply at 23. Dr. Bovik explained this concept in detail stating, among other things, that “[p]eople in the art of computer or machine vision typically study at great length and work for many years, or frequently most of their careers, on small tasks or very specific tasks because implementing even the simplest concept into computer vision is a difficult and extremely time-consuming process.” Ex-2003, ¶44. “For that reason, it generally would not be obvious to a POSITA to combine a task or technique performed by a manual or automated method, apparatus, or system disclosed in a prior art reference that does not use machine vision with a prior art reference that discloses the use of machine vision, unless the vision[] system already performs that task or technique.” Ex-2003, ¶45. “Referring to a prior art reference, like Davis,” “that perform[s] the task of manually measuring tie plate cut,” “and then referencing prior art that implements computer or machine vision, such as Holmes” “would not have made it obvious to implement the measurement of tie plate cut” “in a computer vision system. The content of a prior art reference that utilizes computer vision simply would not have been helpful to a POSITA in implementing those tasks” “in computer vision.” Ex-2003, ¶46; *see also id.*, ¶208; Response at 7-8, 57-58. Notably, Petitioner did not depose Dr. Bovik, and thus has no contrary evidence from him.

PO Sur-reply 23.

Third, Petitioner argues that the record evidence contradicts Dr. Bovik's position, and that automating manual inspection tasks was a well-known expedient. According to Petitioner, Patent Owner's argument is

contradicted by the record evidence demonstrating that automating manual inspection tasks have been the target of extensive research efforts and sensing methodologies for railroad inspection well before 2004 to "achieve a high inspection rate and high reliability in inspection," and obviate time, accuracy, and safety issues associated with manual inspection. Ex-1010, 545-546, *see also id.*, 73, 107, 248-250, 361, 406; Ex-1007, 5; Ex-1012, 15; Ex-1014, 18; Ex-1018, 9; Ex-1019, 6; Ex-1021, 3; Ex-1047, 4.

In fact, the '329 patent itself—admits that, as of 2004, automated railroad track inspection systems implementing manual inspection tasks were "known in the art." '329 patent, 1:66-2:6. The '329 patent also explains that its system can have any suitable image processing tools and software known in the art, including algorithms and programmable steps to identify and determine defects and other measurable aspects of railroad track components. *Id.*, 7:27-31; 8:61-9:4, 5:5-15. Finally, GREX fails to account for record evidence concerning the improved hardware performance advances in high-speed CMOS sensors and field-programmable gate sensor array technology providing further solutions to laser 3D range vision systems allowing utility—i.e., the ability to identify, inspect, and evaluate an object, including its geometric properties—in "virtually all machine vision applications." Pet., 12 (citing Ex-1019, 3, 6; Ex-1023, 16-19; Ex-1012, 19-20; Ex-1004, ¶¶32-33).

Pet. Reply 24–25.

Patent Owner responds that

Petitioner finally contends that Dr. Bovik's opinion is somehow "contradicted by" evidence of "extensive research efforts" into "automating manual inspection tasks" "well before 2004" to "obviate time, accuracy, and safety issues associated

with manual inspection” and “fails to account for” advances in “improved” “sensor” technology. Reply at 24-25. However, his opinions are based on what would have been obvious to a POSITA in view of the prior art as of the critical date, and thus considered all such knowledge. Ex-2003, ¶¶25-26, 3, 36. Moreover, Petitioner overreaches by, in effect, suggesting that automating any task in machine vision was obvious in 2004 because of such “extensive research” and “improved” hardware. More appropriately, that evidence represents only general machine vision improvements, not anything significant to the claimed features.

PO Sur-reply 22-24

We have reviewed the parties’ opposing positions and the respective supporting evidence. In our view, on balance, the evidence weighs in favor of Petitioner’s position that implementing Davis’s algorithm into Holmes’s machine vision system would not have been “beyond” the skill of a person of ordinary skill in the art.

There is no dispute that Davis discloses a technique for determining whether a tie plate is misaligned or sunken. The question is whether the actual application of using said technique to improve the Holmes system is “beyond” the skill of a person of ordinary skill in the art. *See KSR*, 550 U.S. at 417 (“if a technique has been used to improve one device, and a person of ordinary skill in the art would recognize that it would improve similar devices in the same way, using the technique is obvious unless its actual application is beyond his or her skill.”)

We acknowledge Dr. Bovik’s explanation that Holmes’ provides for a technique that is based on a “very high level” machine vision and that “Davis’ simple mechanical device and manual technique” addresses an “extremely specific task.” We also acknowledge Patent Owner’s position

that “implementing Holmes’ automated track inspection system with Davis’ tie plate cut algorithm would be difficult [and] time-consuming.” However, we are unpersuaded that modifying Holmes’s automated track inspection system to implement Davis’ tie plate cut algorithm would require special expertise.

Petitioner directs us to a number of documents said to show automating manual inspection tasks. *See* Pet. Reply 24 (“Ex-1010, 545-546, *see also id.*, 73, 107, 248-250, 361, 406; Ex-1007, 5; Ex-1012, 15; Ex-1014, 18; Ex-1018, 9; Ex-1019, 6; Ex-1021, 3; Ex-1047, 4.”). We have reviewed the evidence. Consistent with Petitioner’s view, they disclose automating a wide variety of manual inspection tasks. For example, the paper “A Survey of Automated Visual Inspection,” by Timothy S. Newman, published in 1995, provides a section entitled “General Benefits of Automated Inspection” that explains, *inter alia*, that “[a]utomatic inspection is desirable because human inspectors are not always consistent evaluators of products.” Ex. 1047, 4. This paper and the other cited documents evidence a familiarity by those in the machine vision field with automating manual tasks.

While modifying Holmes’s automated track inspection system to implement Davis’ tie plate cut algorithm might be difficult and time-consuming as Dr. Bovik testifies, the evidence suggests that the actual application of using Davis’s technique to improve the Holmes system would not have been “beyond” the skill of a person of ordinary skill in the art. *KSR*, 550 U.S. at 417.

For the foregoing reasons, Patent Owner’s fourth argument is unpersuasive in undermining Petitioner’s position that the combination of Holmes and Davis teaches the claimed processor employing an algorithm as

recited for “(e) determining whether the tie plate is misaligned or sunken based upon the comparison [i.e., by ‘(d) comparing an orientation of the crosstie contour and an orientation of the tie plate contour’].” Ex. 1001, 12:1–2.

2. The motivation to combine Holmes, Bostrom, Trosino, Kanade, and Davis with a reasonable expectation of success

We have reviewed the evidence and find, for the reasons discussed, that it supports Petitioner’s position that Holmes discloses the claimed subject matter but for (a) “a geographic location of the plurality of images along the railroad track bed” (Ex. 1001, 11:55–57), which Trosino discloses; (b) a region of interest (*id.* at 11:61), which Kanade discloses; and (c) obtaining and comparing the positions of a tie plate and crosstie (i.e., their “orientations”) in order to “determin[e] whether the tie plate is misaligned or sunken” (*id.* at 12:1–2) which Davis suggests.

With respect to limitation [g] in particular, given Davis’ obtaining and comparing the positions (i.e., orientations) of a tie plate and crosstie to determine the depth of tie plate cut and thereby to provide an objective performance measure of crosstie health and Kanade’s image processing tools (e.g., a region of interest) for evaluating and comparing features of contours of a 2D range image to determine potential defects, one of ordinary skill in the art would have been motivated to modify Holmes’ processor in order to “determin[e] a crosstie contour and a tie plate contour; (d) compar[e] an orientation of the crosstie contour and an orientation of the tie plate contour; [and] (e) determin[e] whether the tie plate is misaligned or sunken based upon the comparison.” Ex. 1001, 11:64–12:2. Given the combination of references, one of ordinary skill in the art would have been led to the

claimed system because, as Petitioner argues, it would “simply provide another tie performance measurement for Holmes’ system to automatically identify and correct in furtherance of increasing railroad safety.” Pet. 74.

Accordingly, we find Petitioner has articulated a sufficient rationale for combining the teachings of the references with a reasonable expectation of success in arriving at the claimed subject matter.

We note Patent Owner argues that

even assuming a sufficient reason to combine references, any resulting algorithm would be “very different” from the claimed algorithm, “include[] none of the claimed steps,” and a POSITA would have no reason to further modify it to achieve element [g]. *Id.* at 54-57.

PO Sur-reply 19.

The argument is unpersuasive because, as has been shown, the evidence supports Petitioner’s position that all the steps of the claimed algorithm were known. Providing another “tie performance measurement for Holmes’ system to automatically identify and correct in furtherance of increasing railroad safety” (Pet. 74) is a reason a POSITA would have to modify Holmes’s processor given the references and thereby reach the claimed processor so as to “include[] [the] algorithm for detecting a misaligned or sunken tie plate of the railroad track bed, the algorithm comprising the steps” (Ex. 1001, 57–59) as claimed.

3. Dependent Claim 23

We have considered Petitioner’s and Patent Owner’s arguments regarding dependent claim 23.

Claim 23 depends from claim 16 and calls for

the processor [to] include[] an algorithm for determining at least one of a presence of a crosstie of the railroad track bed; a

presence of a missing, misaligned, damaged, or defective fastener components of the railroad track bed; a wear of the rails of the railroad track; a spacing of the rails of the railroad track; a height of ballast a spacing of the rails of the railroad track; a height of ballast relative to a crosstie of the railroad track bed; a size of ballast stones of the railroad track bed; or a gap size between sections of the railroad track.

Ex. 1001, 49–57.

Petitioner relies on its position relative limitation [e] of claim 16. *See* Pet. 74:

As discussed in claim 16[e], automating Holmes’ system to determine tie plate cut would necessarily include determining “a presence of a crosstie of the railroad track bed” as recited by claim 23, because Davis’ tie plate cut algorithm includes determining and comparing tie and tie plate top surface height contours. Ex-1004, ¶152.

We addressed Petitioner’s discussion relative limitation [e] of claim 16 in Section II.E.[e].

Patent Owner responds that

Petitioner asserts that “[a]utomating *Holmes*’ system to determine tie plate cut would necessarily include determining ‘a presence of a crosstie of the railroad track bed’” “because Davis’ tie plate cut algorithm includes determining and comparing tie and tie plate top surface height contours.” *Id.* However, as Dr. Bovik opines, Davis neither discloses nor suggests any “algorithm,” nor determines or compares “height contours.” Ex-2003, ¶212; see Ex-1005 at 17-18. Petitioner cites nothing from Davis or Holmes to support its contentions. *See* Petition at 74.

PO Resp. 58–59.

The difficulty with Patent Owner’s position is that Petitioner is not relying on Davis to show a processor executing an algorithm, i.e., a series of

programming steps. Petitioner is relying principally on Holmes for this limitation. *See* Pet. 70:

A POSITA would have understood that processors execute algorithms, and thus, the vision system processor of *Holmes* and *Bostrom* renders obvious an algorithm for detecting a misaligned or sunken tie plate, in combination with *Kanade* and *Davis*, in accordance with the steps performed as explained below in claim 16[f]-[g] Ex-1004, ¶144.

See supra Section II.E.1.[e].

Another difficulty is that Petitioner is not solely relying on Davis or Holmes to show *contour* evaluation. Petitioner argues that “it [] would have been obvious to a POSITA to implement Holmes’ system to extract tie and tie plate contour information from the profile 720 and compare the orientations of the tie and tie plate height contour information to determine whether the tie plate is misaligned or sunken based on the comparison. *Id.*, ¶148.” Pet. 72. In support thereof, Dr. Papanikolopoulos testifies that

it is was also well-known to evaluate and compare features of contours of a 2D range image to determine potential defects through various image processing tools, as evidenced by, e.g., *Kanade* and many others, as discussed above. *Davis*, 17-19; *Kanade*, 553-557, FIGS. 7-8, 13; Ex-1021, 5-8, FIG. 11; Ex-1014, 132-134, 80-81, FIGS. 6.3, 4.1; Ex-1027, 149-152, 227-229, FIGS. 5.10, 5.11; ’329 patent, 5:7-14, 8:30-31.).

Ex. 1004 ¶ 148; Pet. 72. Petitioner’s position is that the *combination* of Davis’s measuring elevation differences with well-known systems, such as Holmes’s, to evaluate and compare features of contours of a 2D range image to determine potential defects renders obvious implementing a method using a processor to carry out the steps of the challenged claims. *See supra* Section II.E.1.[g].

Accordingly, for the relevant reasons discussed with respect to claim 16, we find a preponderance of the evidence supports Petitioner's position that the combination of Holmes, Trosino, Kanade, and Davis discloses or suggests the subject matter of claim 23 and has articulated a sufficient rationale for combining the teachings of the references with a reasonable expectation of success in arriving at the claimed subject matter.

4. Independent Claim 38 and Claims 44 and 46 Dependent Thereon, and Independent Claim 62 and Claims 68 and 70 Dependent Thereon

We have also considered Petitioner's and Patent Owner's arguments regarding the remainder of the independent and dependent claims challenged under this ground, namely, claims 38, 44, 46, 62, 68, and 70.

Petitioner addresses each limitation in independent claim 38 by directing us to the relevant discussion corresponding to a similar limitation in claim 16. Pet. 74–76.

Patent Owner does not provide substantive arguments challenging Petitioner's position except to say that Petitioner's "reasoning fails for the reasons stated above." PO Resp. 59.

Claim 44 further limits the subject matter of claim 38, from which it depends, by adding a step of "providing the geographical location data from a GPS receiver or an encoder." Ex. 1001, 14:1–3.

According to Petitioner:

Trosino's TGMS 80 provides a distance measurement or milepost location for captured images and detected anomalies. *Trosino*, 10:17-22, 28-59, 13:42-57. *Trosino's* system also includes "*global positioning systems* for time stamping and geolocation." *Trosino*, 11:1-5 (emphasis added). A POSITA would have understood that global positioning systems must necessarily include GPS receivers to provide "geolocation"

location data, as taught by Trosino. Ex-1004, ¶162. Thus *Holmes, Bostrom, Davis, and Trosino* render obvious these limitations of claim 44. Ex-1004, ¶162.

Pet. 76–77.

Patent Owner does not provide substantive arguments challenging Petitioner’s position, except to say that “[a]s stated above, [Petitioner’s] argument fails.” PO Resp. 59.

Claim 46 further limits the subject matter of claim 38, from which it depends, by adding the steps of

the steps of determining at least one of a presence of a crosstie of the railroad track bed; a presence of a missing, misaligned, damaged, or defective fastener component of the railroad track bed; wear of the rails of the railroad track; spacing of the rails of the railroad track; a height of ballast relative to a crosstie of the railroad track bed; a size of ballast stones of the railroad track.

Ex. 1001, 14:6–14.

According to Petitioner, “[a]s discussed in claims 16 and 23, *Holmes, Bostrom, and Davis* render obvious these limitations of claim 46. Ex-1004, ¶163.” Pet. 77.

Patent Owner does not provide substantive arguments challenging Petitioner’s position, except to say that “[a]s stated above, [Petitioner’s] argument fails.” PO Resp. 59.

Petitioner addresses each limitation in independent claim 62 by directing us to the relevant discussion corresponding to a similar limitation in claim 16. Pet. 77–78.

Patent Owner does not provide substantive arguments challenging Petitioner’s position, except to say that Petitioner’s “reasoning fails for the reasons stated above.” PO Resp. 60.

Claim 68 further limits the subject matter of claim 62, from which it depends, by adding a step of “providing the geographical location data from a GPS receiver or an encoder.” Ex. 1001, 15:51–53.

According to Petitioner, “[c]laim 68 depends upon independent claim 62 and recites the same limitations as in claim 44. As discussed in claims 16[d] and 44, Holmes, Bostrom, Davis, and Trosino render obvious these limitations of claim 68. Ex-1004, ¶173.” Pet. 79.

Patent Owner does not provide substantive arguments challenging Petitioner’s position, except to say that “[a]s stated above, those argument[s] fail.” PO Resp. 60.

Claim 70 further limits the subject matter of claim 62, from which it depends, by adding the steps of

determining at least one of a presence of a crosstie of the railroad track bed; a presence of a missing, misaligned, damaged, or defective fastener component of the railroad track bed; wear of the rails of the railroad track; spacing of the rails of the railroad track; a height of ballast relative to a crosstie of the railroad track bed; a size of ballast stones of the railroad track bed; or a gap size between sections of the railroad track.

Ex. 1001, 15:57–64.

According to Petitioner, “[a]s discussed in claims 16, 23, and 46, Holmes, Bostrom, and Davis render obvious these limitations of claim 70. Ex-1004, ¶174.” Pet. 79.

Patent Owner does not provide substantive arguments challenging Petitioner’s position, except to say that “[a]s stated above, those argument[s] fail.” PO Resp. 60.

5. *Objective Indicia*

Before we make a final obviousness determination, we must consider the evidence of obviousness in light of any evidence of secondary considerations of nonobviousness presented by Patent Owner. *See Graham*, 383 U.S. at 17–18 (“Such secondary considerations as commercial success, long felt but unsolved needs, failure of others, etc., might be utilized to give light to the circumstances surrounding the origin of the subject matter sought to be patented. As indicia of obviousness or nonobviousness, these inquiries may have relevancy.”); *Transocean Offshore Deepwater Drilling, Inc. v. Maersk Drilling USA, Inc.*, 699 F.3d 1340, 1349 (Fed. Cir. 2012) (“This objective evidence must be ‘considered as part of all the evidence, not just when the decisionmaker remains in doubt after reviewing the art.’” (quoting *Stratoflex, Inc. v. Aeroquip Corp.*, 713 F.2d 1530, 1538–39 (Fed. Cir. 1983))).

Patent Owner argues that a nexus exists in this case, and that long-felt but unresolved need, commercial success, industry skepticism/industry praise, and copying by others demonstrate the nonobviousness of the challenged claims. PO Resp. 60–68; PO Sur-reply 25–38; PO Sur-Sur-Sur-Reply 1–5. Petitioner disagrees. Pet. Reply 18–31; Pet. Sur-Sur-Reply 1–5.

i. Nexus

Patent Owner argues that a “nexus exists here between the Patent Owner’s ‘Aurora’ track inspection system and the claims.” PO Resp. 62.

Specifically, Patent Owner relies on the declaration of John Kainer, which concludes that “Aurora includes every claimed element.” *Id.* at 62 (citing Ex. 2008 ¶¶ 4–17, 25–32).

Patent Owner also relies on the district court litigation. *Id.* (“Also, a district court noted that “Aurora is a commercial embodiment from the ’329 patent,” “practice[s] claim 16” and “is the commercial embodiment of claim 16.” Ex-2021 at 26, 41.”)

Petitioner argues that Patent Owner “has not attempted to prove nexus directly” but that it “asserts that it is entitled to a presumption of nexus.” Pet. Reply 26. This, Petitioner argues, “completely ignores the coextensiveness requirement of a proper presumption of nexus analysis.” *Id.* Petitioner argues that the “Aurora system is not coextensive with the challenged claims because it comprises many different critical components and algorithms, not recited in the challenged claims—but instead claimed in other” patents. *Id.* Moreover, Petitioner argues, the “Aurora system does not even embody the challenged claims.” *Id.* at 32. Finally, Petitioner argues that no direct nexus exists between Patent Owner’s secondary considerations evidence and the challenged claims. *Id.* at 34.

Patent Owner replies that, regardless “of whether a presumption of nexus applies, there is evidence that a direct nexus exists.” PO Sur-reply 25. Patent Owner reiterates that “direct nexus evidence exists for all GREX’s objective indicia.” *Id.*

Objective evidence of nonobviousness is relevant only if there is a nexus between the evidence and the claimed invention. *Fox Factory, Inc. v. SRAM, LLC*, 944 F.3d 1366, 1373 (Fed. Cir. 2019). A presumption of nexus applies if the asserted objective evidence “is tied to a specific product and that product ‘embodies the claimed features, and is coextensive with them.’” *Id.* (quoting *Polaris Indus., Inc. v. Artic Cat, Inc.*, 882 F.3d 1056, 1072 (Fed. Cir. 2018)). To the extent that a presumption of nexus does not apply,

Patent Owner may still prove nexus “by showing that the evidence of secondary considerations is the ‘direct result of the unique characteristics of the claimed invention.’” *Id.* at 1373–74 (quoting *In re Huang*, 100 F.3d 135, 140 (Fed. Cir. 1996)).

The ’329 patent’s challenged claims are directed to a method or system for “inspecting a railroad track bed” that involves, *inter alia*, “analyzing a frame of [a] plurality of images, the frame comprising a region of interest; [] determining whether the region of interest contains a tie plate” and ultimately “determining whether the tie plate is misaligned or sunken.” *See, e.g.*, Ex. 1001, 11:59–12:2 (claim 16), 13:46–55 (claim 38), 15:29–38 (claim 62). Patent Owner’s Aurora system, however, comprises many more features than simply the determination of a sunken or misaligned tie plate, as Petitioner recognizes. Pet. Reply 26, 29–32; Pet. Sur-Sur-Reply 2–3. For example, in addition to the tie plate determination feature, the Aurora system includes “many important track inspection technologies and algorithms not recited in the challenged claims,” including

X-ray technology (which does not use lasers) to image internal defects, such as cracks and decay in wooden ties (Ex-1062, 20:14–21:6, 64:1–18), enhanced GPS technology to better locate track defects (*id.*, 67:9–69:10), algorithms to detect ballast obstruction of ties and tie plates (*id.*, 71:17–72:23), algorithms to calibrate its lasers and cameras (*id.*, 87:18–88:13), and algorithms to detect rail base corrosion (*id.*, 32:7–20, 39:5–17).

Pet. Reply 29.

According to Petitioner, Patent Owner represents that all these features, which are not necessarily related to the tie plate cut features of the challenged claims, are important to the Aurora system and impact its functionality. *Id.* (citing Ex. 1062, 59:3–11, 64:1–72:23). Moreover, the

advertisements for the Aurora system indicate that it uses “25 variables,” of which tie plate cut measurement is only one of the variables. Ex. 2015, 54; Ex. 2017, 38. Petitioner asserts that the other 25 variables pertinent to wooden tie condition assessment include “splitting, warpage, surface roughness, missing fasteners, spike height, skew angle, curvature, decay, cracking, tie length, and tie width, among others.” Pet. Reply at 30 (citing Ex-1062, 44:3-45:7, 52:1-54:7, 56:15-60:10; Ex-1063, 27:20-28:4, 30:15-34:1, 47:19-48:7, 55:19-61:21; *see also* Ex-1062, 44:3-14, 73:17-74:16, 79:11-18, 81:7-21, 83:15-84:15; Ex-1063, 30:15-33:23). Some of these features of the Aurora system are covered by other patents owned by Patent Owner, as identified in advertisements for the Aurora system. Ex. 1062, 119:12–120:19; Ex. 1053; *see also Fox Factory*, 944 F.3d at 1377 (“Where a product embodies claims from two patents, a presumption of nexus can be appropriate only if the claims of both patents generally cover the same invention.”).

With the exception of the tie plate cut feature, none of these other features of the Aurora are claimed in the ’329 patent, at least not to the level of specificity presented in the advertisements showing these features and their operation. *See* Ex. 2014, 39 (“Analyze the surface of wood ties,” “Assign up to four wood tie grades,” “Measure vertical plate cut,” “Locate rail base corrosion,” “Identify signs of rail seat abrasion,” “Perform virtual track walks safely from your office”); Ex. 2015, 53 (advertising “Rail Seat Abrasion Real Time Processing,” “Rail Base Corrosion,” and “Virtual Track Walk” in addition to “Wood Tie Grading”); Ex. 2016, 2–3 (discussing handling of ballast coverage); Ex. 2017, 38 (advertising “Rail Seat Abrasion,” “Wood Tie Grading,” “Rail Base Corrosion,” and “Virtual Track

Walk”). There is no indication in the record of how much if any contribution these features have to the asserted objective indicia of nonobviousness.

Patent Owner indicates that “a district court determined that Aurora ‘practice[s]’ and is the ‘commercial embodiment of claim 16’ and the ’329 patent. Response at 62; Ex-2021 at 26, 41.” PO Sur-reply 35. But that does not affect the evidence clearly showing the Aurora has many more features than are claimed in the ’329 patent. While the Aurora system may practice and be an “embodiment” of the claim 16 system, the evidence demonstrates that claim 16 describes but a very few of the many components attached to the Aurora system.

A presumption of nexus does not apply “[w]hen the thing that is commercially successful is not coextensive with the patented invention—for example, if the patented invention is only a component of a commercially successful machine or process.” *Polaris Indus.*, 882 F.3d at 1072. Here, the tie plate cut diagnostic system and method of the challenged claims of the ’329 patent is merely one of many features of Patent Owner’s Aurora system, and the submitted evidence does not indicate how to allocate objective indicia of nonobviousness to the tie plate cut diagnostics claimed in ’329 patent relative to the Aurora system overall.

Accordingly, we do not apply a presumption of nexus that the ’329 patent’s claims are linked to the objective indicia of nonobviousness, because Petitioner has successfully shown that the Aurora system is not coextensive with the claims. Even if we did apply the presumption, however, our result would not be different, because the presumption is rebuttable and Petitioner has presented sufficient evidence to show that

objective indicia of nonobviousness does not outweigh the showing of obviousness, for reasons explained further in the following sections.

ii. Long-Felt but Unresolved Need

Patent Owner contends there was a “long-felt need to automate railroad track bed inspection, including detection of tie plate cutting and misalignment.” PO Resp. 63. This need “included automated evaluation of crosstie condition, which includes tie plate cut and misalignment.” *Id.* (citing Ex. 2017, 16; Ex. 2019, 3, Ex. 2012 ¶ 8). Patent Owner further contends ““customers had been asking for”” the plate-cut measurement feature since about 2006–2007. *Id.* at 64 (quoting Ex. 2020 ¶¶ 31–32). Patent Owner also relies on a competitor’s creation of an automated system for detecting plate cut to address “industry need.” *Id.* (citing Ex. 2018, 4–8).

Petitioner argues that Patent Owner’s evidence “fails to show a specific long-felt but unresolved need for the automated *tie plate cut* algorithm of the challenged claims.” Pet. Reply 35. Petitioner criticizes Patent Owner’s evidence as directed to automated track inspection systems in general and not the claimed tie plate cut algorithm. *Id.*; *see also* Tr. 26:23–27:2 (“We don’t have any statements from a single customer saying that there was a long felt need for the tie plate cut and GREX’s Aurora system brought it to be and, you know, saved the world.”).

Patent Owner replies that, specifically, its “customers requested automated tie plate cut measurements” and, when Patent Owner added this to its Aurora system, “all the major railroads were interested.” PO Sur-reply 26 (citing Ex. 2020, 23–24, 30–32). Patent Owner also faults Petitioner for not providing rebuttal evidence. *Id.*

Establishing long-felt need requires objective evidence that an art-recognized problem existed in the art for a long period of time without solution. *Newell Cos. v. Kenney Mfg. Co.*, 864 F.2d 757, 768 (Fed. Cir. 1988); *Orthopedic Equip. Co. v. All Orthopedic Appliances, Inc.*, 707 F.2d 1376, 1379 (Fed. Cir. 1983). Establishing long-felt need also requires objective evidence that the invention satisfies the long-felt need. *In re Cavanagh*, 436 F.2d 491, 496 (CCPA 1971). We agree with Petitioner that Patent Owner's evidence does not show that a long felt need for the particular tie plate cut algorithm of the claims existed for a long period of time without a solution, because the period of time discussed appears to be relatively short, and the evidence of a specific need for automated tie plate cut measurement system is thin. Also, as Petitioner notes, Patent Owner's evidence in this regard is directed to automated track inspections generally, rather than to any specific algorithm. Pet. Reply 35.

Accordingly, the evidence does not show a long-felt but unresolved need existed in the industry for what is claimed in the '329 patent.

iii. Commercial Success

Patent Owner, relying *inter alia* on confidential information about “increasing revenue,” argues that “the Aurora system has achieved great commercial success.” PO Resp. 65. Patent Owner also argues that it has “dramatically increased its market share because of the Aurora system” and “currently has such inspection contracts with five of the seven Class 1 railroads, and very soon will have a contract with a sixth.” *Id.* (citing Ex. 2012 ¶¶ 16–18).

Petitioner faults Patent Owner for failing “to present any evidence showing that the purported commercial success of the Aurora system is

because of the claimed tie plate cut algorithm.” Pet. Reply 36. Petitioner also argues that none of the evidence or argument “provides any analysis explaining why any apparent commercial success was directly attributable to the tie plate cut algorithm of the challenged claims, as opposed to, e.g., automated machine track inspection, in general, or any one of the many other different unclaimed algorithms and features of Aurora’s track inspection system.” *Id.*

“When a patentee can demonstrate commercial success, usually shown by significant sales in a relevant market, and that the successful product is the invention disclosed and claimed in the patent, it is presumed that the commercial success is due to the patented invention.” *J.T. Eaton & Co. v. Atl. Paste & Glue Co.*, 106 F.3d 1563, 1571 (Fed. Cir. 1997); *WBIP, LLC v. Kohler Co.*, 829 F.3d 1317, 1329 (Fed. Cir. 2016). “[I]f the unclaimed features amount to nothing more than additional insignificant features, presuming nexus may nevertheless be appropriate. Put differently, the degree of correspondence between a product and a patent claim falls along a spectrum.” *Fox Factory*, 944 F.3d at 1374. To establish a proper nexus between a claimed invention and the commercial success of a product, a patent owner must offer proof that the sales were a direct result of the unique characteristics of the claimed invention, and not a result of economic and commercial factors unrelated to the quality of the patented subject matter. *In re Applied Materials, Inc.*, 692 F.3d 1289, 1299–1300 (Fed. Cir. 2012).

Here, even assuming there is sufficient nexus, we still find Patent Owner’s evidence insufficient to establish commercial success.

Patent Owner points its “market share” for its Aurora system, but does not provide sufficient evidence regarding the Aurora system’s market share. Patent Owner does not make clear what it believes the relevant market to be, nor the size or volume of the relevant market.

Regarding the “increasing revenue,” no context for its revenue relative to the relevant market is provided. PO Resp. 65. While revenue figures may be evidence suggestive of commercial success, here in the absence of a defined market, it is alone inadequate to establish commercial success. *See Ex parte Jellá*, 90 USPQ 1009, 1012 (BPAI 2008) (precedential) (“[G]ross sales figures do not show commercial success absent evidence as to market share . . . or as to the time period during which the product was sold, or as to what sales would normally be expected in the market”). According to the Federal Circuit, “the more probative evidence of commercial success relates to whether the sales represent ‘a substantial quantity in th[e] market.’” *Applied Materials*, 692 F.3d at 1300 (quoting *In re Huang*, 100 F.3d at 140).

Patent Owner also represents that it had inspection contracts with five or six of the seven Class 1 railroads, but provides no context for the significance of its number and type of contracts relative to the market as a whole. PO Resp. 65. Without more information, it is difficult to tell how significant the number of contracts awarded to Patent Owner is compared to the industry overall.

It is even more difficult to discern what proportion of any commercial success is attributable to inclusion of tie plate cut feature as recited in the ’329 patent’s claims.

Patent Owner contends that there is “sufficient record evidence that much of Aurora’s commercial success is attributable to its tie plate cut measurement technology, the claimed invention” (PO Sur-reply 30).

However, Petitioner argues that the record testimony demonstrates that tie plate cut is simply one of many important features.

Now, in its Sur-Reply, 30-35, GREX attributes the success of the Aurora system to tie plate cut, alleging, e.g., “without Aurora’s claimed algorithm for identifying misaligned or sunken tie plates, Aurora could not evaluate tie condition for anyone.” *Id.* at 34. GREX provides no credible evidence to support this claim other than biased, conclusory statements of its own employees. Worse, the statements conflict with record testimony demonstrating that tie plate cut was simply one of many important inspection features of the Aurora system, including, e.g., algorithms to detect rail seat abrasion, ballast obstruction, rail base corrosion, Ex-1062, 39:18-41:2 (referring to rail seat abrasion as “an important feature” of the Aurora system due to derailments in 2006, 2007), 71:17-72:23 (referring to the ballast obstruction detection algorithm as “key”), 32:7-20, 39:5-17, 85:4-86:15; Ex-1063, 27:12-34:5, 36:19-38:10, and various technologies for enhancing detection of track defects, including X-ray, GPS, and laser and camera calibration technologies, Ex-1062, 20:14-21:6, 59:3-11, 64:1-72:23, 87:18-88:13. Moreover, tie plate cut is merely one of 25 tie condition variables identified by the Aurora system when evaluating the condition of wooden ties—with many variables considered “important” or “significant” to tie condition grading. Ex-2015, 54-55; Ex-2017, 18; Ex-1062, 44:3-45:7, 52:1-54:7, 56:15-60:10, 73:17-74:16, 79:11-18, 81:7-21, 83:15-84:15; Ex-1063, 27:20-28:4, 30:15-34:1, 47:19-48:7, 55:19-61:21. GREX’s new direct nexus case is further contradicted by its own marketing materials and third-party publications, which tout, e.g., the “rail-seat abrasion,” “ballast delivery system,” “x-ray technology,” “rail base corrosion assessment,” “GPS,” “real time processing,” and “upgraded wood-tie grading system” features of the Aurora system. Ex-2017, 18, 38; Ex-2014, 38; Ex-2015, 53-55; Ex-

2016, 2-3; Ex-1050-1052. In any case, the alleged importance of a feature, even if it is the “most important,” as GREX alleges, does not equate to the commercial success of a product being directly attributable to that feature, as a proper direct nexus analysis requires.

Pet. Sur–Sur–Reply 2–3.

We have reviewed the evidence and find it persuasive and give it substantial weight. The evidence shows, as we pointed out earlier, that the tie plate cut diagnostic system and method of the challenged claims of the ’329 patent is merely one of many features of Patent Owner’s Aurora system.

Patent Owner submits no further evidence from consumers indicating that the tie plate cut feature, rather than the totality of the Aurora system features, is the reason for the Aurora system’s success. Tr. 45:23–46:4 (Board: “But there’s no information in the record from customers otherwise saying the only reason they buy the product is because of the technology we’re discussing in the patents at issue today?” Patent Owner: “There’s no testimony from customers as to that, no.”).

Patent Owner also admits that it did not present any sales figures from before the addition of the tie plate cut measurement technology, giving us inadequate basis to determine whether commercial success can be ascribed to this technology. *See id.* at 42:21–43:1 (Board: “Before the tie plate cut measurement feature was added to the Aurora system, were sales substantially less?” Patent Owner: “We didn’t go back before that feature was added.”).

Consequently, from the evidence submitted in this case, we are aware of no way to determine how much if any commercial success stems from the

claimed tie plate cut assessment feature, as opposed to the other features of Patent Owner's Aurora system, or other unrelated factors. Patent Owner submits that "without Aurora's claimed algorithm for identifying misaligned or sunken tie plates, Aurora could not evaluate tie condition for anyone" (PO Sur-reply 34) and that is the most important information (*id.*). But that still does not help us understand how much if any commercial success stems from the claimed tie plate cut assessment feature. While identifying misaligned or sunken tie plates might be of primary importance, it is nevertheless possible that the commercial success is attributable to the combination of all the features the Aurora system can provide.

Thus, we determine that the evidence of record fails to show that the commercial success is attributable to what is claimed in the challenged claims of the '329 patent.

iv. Industry Skepticism/Industry Praise

Regarding industry skepticism, Patent Owner contends the "industry was initially skeptical about automated inspection systems, and concerning Aurora's automated plate cut measurement system in particular." PO Resp. 66. Patent Owner relies on a statement by Mr. Turner, Patent Owner's retired Vice President, that in "2005, railroads dismissed as novelty, the thought of using machine vision technology for tie inspection and grading." *Id.* (citing Ex. 2016, 41); *see also* Ex. 2020, 30–31, 32–33 (Mr. Turner stating that "there were doubters" among the railroads about plate-cutting technology). Patent Owner also relies on a competitor's statement that "automated tie and ballast assessment is going to replace the walking tie and ballast inspectors. It's just a question of when." *Id.* (citing Ex. 2015, 54).

Regarding industry praise, Patent Owner relies on several exhibits to argue that the “Aurora system received praise by being featured in various industry publications.” *Id.* at 66 (citing Ex. 2012 ¶ 20; Ex. 2014, 36, 35; Ex. 2015, 52–53; Ex. 2016, 40–42; Ex. 2017, 16).

Petitioner replies that these statements are “also not specific to the claimed tie plate cut algorithm but instead to automated versus manual systems in general.” Pet. Reply 36. According to Petitioner, there is “no evidence suggesting that any industry skepticism/praise was directly related to the tie plate cut algorithm.” *Id.* Regarding praise, Petitioner argues that “the mere fact that GREX’s automated system ‘includes’ tie plate cut detection does not show that that particular feature was praised by the industry.” *Id.* at 37.

Patent Owner responds, *inter alia*, that “a nexus exists if the industry is generally skeptical of automated tie plate cut measurement; such skepticism applies to all such technology (and ‘algorithms’).” PO Sur-reply 29.

We have reviewed the evidence. In our view, Patent Owner’s “skepticism” argument and relied-upon evidence insufficiently demonstrates skepticism of the claimed invention. The competitor’s statement relied upon by Patent Owner treats the developments in machine vision as “just a question of when,” and in inevitable rather than skeptical terms. Ex. 2015, 54. Patent Owner’s “praise” evidence is in the nature of magazine articles and the testimony is from Patent Owner’s agents generally describing the Aurora system and its various attributes rather than “praise” by the industry at large of the claimed tie plate cut algorithm. *Cf.* PO Resp. 66–67; *see also* Tr. 41:1–4 (asked if this evidence could be “separated out in a way that you

discern how much of the praise is directed to the plate cut” feature, Patent Owner responding, “No, Your Honor.”). The evidence supports Petitioner’s position that Patent Owner’s evidence points to the Aurora system as a whole as the subject for industry praise, rather than specifically the tie plate cut algorithm. Ex. 2012 ¶ 20; Ex. 2014, 36, 35; Ex. 2015, 52–53; Ex. 2016, 40–42; Ex. 2017, 16.

Accordingly, Patent Owner has not established a nexus between the reason for the industry skepticism/industry praise of the Aurora system and the claims of the ’329 patent.

v. Copying

Patent Owner argues that the Aurora system “has been copied.” PO Resp. 67. Pointing to a patent infringement lawsuit concerning the ’329 patent, Patent Owner notes that the court “awarded enhanced damages in part based on finding of ‘strong evidence of copying’ of the Aurora system.” *Id.* (citing Ex. 2021, 37–38, 45). Petitioner does not address the evidence of copying in its Reply, which Patent Owner notes. PO Sur-reply 30. Petitioner faults Patent Owner for not conducting any analysis to show the required nexus. Pet. Sur-Sur-Reply 5.

Copying requires evidence of “efforts to replicate a specific product, which may be demonstrated through internal company documents, direct evidence such as disassembling a patented prototype, photographing its features, and using the photograph as a blueprint to build a replica, or access to the patented product combined with substantial similarity to the patented product.” *Wyers v. Master Lock Co.*, 616 F.3d 1231, 1246 (Fed. Cir. 2010); *accord Tokai Corp. v. Easton Enters., Inc.*, 632 F.3d 1358, 1370 (Fed. Cir. 2011). Case law requires a showing of efforts to replicate a specific

product, such as Patent Owner's Aurora system, and here, Patent Owner does not provide evidence to support such replication. *Id.*; *see also Iron Grip Barbell Co. v. USA Sports, Inc.*, 392 F.3d 1317, 1325 (Fed. Cir. 2004) ("Not every competing product that arguably falls within the scope of a patent is evidence of copying. Otherwise every infringement suit would automatically confirm the nonobviousness of the patent. Rather, copying requires the replication of a specific product.").

On this record, we are not persuaded by Patent Owner's argument, and we accord minimal weight to Patent Owner's evidence of copying. Patent Owner's evidence indicates that another court determined that another competitor copied the Aurora system. Ex. 2021, 37–38, 45. Although we recognize and credit the findings of other courts in certain circumstances, we cannot take this testimony at face value in this instance. We are not presented with any direct evidence of internal company documents, direct evidence such as disassembling a patented prototype, photographing its features, and using the photograph as a blueprint to build a replica, or access to the patented product combined with substantial similarity to the patented products. The findings presented in the district court's opinion do not let us review or weigh the evidence relied upon, and we cannot independently determine whether copying occurred based on the evidence of copying evaluated by the district court. Moreover, the findings of copying of the Aurora system as a whole are not necessarily evidence of copying of the claimed tie plate cut feature. The claims at issue here are not directed to the Aurora system as a whole, but instead are directed to a particular system and method with certain characteristics, and we are not presented with

significant evidence regarding copying of this challenged aspect of the Aurora system.

Taking all of these facts into consideration, Patent Owner's evidence of copying is entitled to minimal weight.

6. Conclusion

For the reasons discussed, we find a preponderance of the evidence supports Petitioner's position that the combination of Holmes, Trosino, Kanade, and Davis discloses or suggests the subject matter of claims 16, 38, 44, 46, 62, 68, and 70, and that Petitioner has articulated a sufficient rationale for combining the teachings of the references with a reasonable expectation of success in arriving at the claimed subject matter.

We have reviewed Petitioner's obviousness grounds, including proffered evidence, and Patent Owner's arguments and proffered evidence, including evidence of objective indicia, in determining that claims 16, 23, 38, 44, 46, 62, 68, and 70 as challenged under Ground 2 are unpatentable by a preponderance of the evidence. On balance, in view of the strength of the evidence in favor of obviousness for each of claims 16, 23, 38, 44, 46, 62, 68, and 70, and the deficiencies in the evidence relied on as supporting the contended objective indicia of patentability, we determine that Petitioner has established by a preponderance of the evidence that the subject matter of claims 16, 23, 38, 44, 46, 62, 68, and 70 is unpatentable.

Accordingly, for the reasons discussed, that a preponderance of the evidence supports Petitioner's position that the combination of Holmes, Trosino, Kanade, and Davis renders obvious the subject matter of claim 16 as whole to one of ordinary skill in the art.

F. Ground I

Petitioner challenges claims 16, 23, 38, 44, 46, 62, 68, and 70 as obvious under 35 U.S.C. § 103 over Davis, Kowalski, Bostrom, Trosino, and Kanade. Pet. 24–64.

The PO Response presents arguments addressing the contentions made in the Petition. *See* PO Resp. 9–41.

However, Petitioner’s Reply does not provide a response to Patent Owner’s arguments. In fact, Ground I is not mentioned at all in the Reply. *See generally* Pet. Reply.

According to Patent Owner, “Petitioner’s Reply argues only Ground 2 (based on the primary reference Holmes). Reply at 6-18. Petitioner thus, effectively relinquishes Ground 1.” PO Sur-reply 4.

When asked at the start of the hearing whether Petitioner had “relinquished the Kowalski-based grounds [i.e., Ground I],” Petitioner responded “They have not been relinquished whatsoever.” Tr. 9: 13–14. But Petitioner did not elaborate and Ground I was not further discussed.

The Response repeats, much of it verbatim, the arguments presented in the Preliminary Response. *Cf.* Resp. 9–41; Prelim. Resp. 18–57. The main difference is that, in the Response, Patent Owner now additionally relies on the Bovik Declaration to further support its arguments.

Accordingly, the parties’ contentions and arguments vis-a-vis Ground I at this stage of the proceeding are effectively the same as those presented during the preliminary stage that we addressed in the Institution Decision.

Moreover, as explained above, we find that Petitioner has met its burden of showing that claims 16, 23, 38, 44, 46, 62, 68, and 70 would have

been obvious under 35 U.S.C. § 103 over Holmes, Bostrom, Trosino, Kanade, and Davis (Ground II). We also note that Petitioner has not supplemented or augmented its Ground 1 arguments since we decided, at institution and under a lower standard, that Petitioner had not shown a reasonable likelihood of prevailing on its Ground 1 arguments. We therefore adopt our previous position in the Decision on Institution. Therefore, a preponderance of the evidence does not support Petitioner's position.

Accordingly, having reached a conclusion on obviousness regarding claims 16, 23, 38, 44, 46, 62, 68, and 70 on the basis of Petitioner's Ground 2, and having received no new reasoning or argument to persuade us that we erred in our institution-stage determination regarding Ground 1, we do not further address Petitioner's arguments regarding obviousness of claims 16, 23, 38, 44, 46, 62, 68, and 70 over Davis, Kowalski, Bostrom, Trosino, and Kanade.

III. PETITIONER'S MOTION TO EXCLUDE

Petitioner moves to exclude Exhibits 2006, 2007, 2008, and 2020. (Paper 36, "Mot. Excl.") 1–7. Patent Owner filed an Opposition (Paper 38, "Opp. Mot. Excl.") and Petitioner filed a Reply (Paper 39, "Reply Mot. Excl.").

Exhibit 2006 appears to be a document which, on the first page, includes: "Sam Pullen and Per Enge, 'A Civil User Perspective on Near-Term and Long-Term GPS Modernization,' Department of Aeronautics and Astronautics, Stanford University." Ex. 2006, 1. Exhibit 2007 appears to be a document which, on the first page, includes "Real-Time Kinematic Surveying Training Guide Trimble September 2003." Ex. 2007, 1.

According to Petitioner,

GREX relies on Exhibits 2006 and 2007 to show the alleged “accuracy of GPS” in 2004. Response, 45; Ex-2003, ¶¶167-170; Sur-Reply, 6-10. In response to Petitioner’s objections, GREX served a purported authenticity certification declaration from its expert, Dr. Bovik. Ex-2023 (served only). But the declaration fails to properly authenticate Exhibits 2006 and 2007, which are not otherwise self-authenticating under FRE 902. Accordingly, the Board should exclude Exhibits 2006 and 2007.

Mot. Excl. 1.

Patent Owner responds, *inter alia*, that “Ex-2006 is authentic under Rule 901(b)(4) because its appearance, contents, substance, internal patterns, and distinctive characteristics demonstrate that it bears all the earmarks of an authentic scientific article” (Opp. Mot. Excl. 2) and “[s]imilarly, Ex-2007 is authentic under that rule because its appearance, contents, substance, internal patterns, and distinctive characteristics demonstrate that it bears all the earmarks of an authentic published GPS booklet or training guide from a California company.” *Id.* at 3. As for Dr. Bovik’s authenticity certification declaration, Patent Owner responds, *inter alia*, that “the only requirements of the rule [i.e., Rule 902(13)] —that a ‘qualified person’ show that ‘[a] record generated by an electronic process or system that produces an accurate result’—are more than amply met by Dr. Bovik’s detailed declaration.” *Id.* at 6, also reproducing ¶ 9 from Ex. 2023.

Petitioner replies, *inter alia*, that Patent Owner “completely ignores missing key earmarks of authenticity, including publication, copyright, and author contact information.” Reply Mot. Excl. 1. As for Dr. Bovik’s authenticity certification declaration, Petitioner replies, *inter alia*, that “there is no evidence that Dr. Bovik was the one who printed out the webpages,

when he (or someone else) printed them, and what they looked like when they were printed. Mot., 4.” *Id.* at 2.

We need not consider the merits of Petitioner’s Motion to Exclude with respect to these exhibits, because although we considered the disputed evidence, it nevertheless fails to persuade us that Patent Owner has prevailed in its argument.

As Petitioner (Mot. Excl. 1) points out, these exhibits were submitted to support Patent Owner’s argument challenging the Petitioner’s reliance on Trosino is arguing that the claim limitation [d] “the one or more physical characteristics comprising at least a geographic location of the plurality of images along the railroad track bed” would have been obvious over the combination of Homes and Trosino. *See* discussion in Section II.E.1.[d]. Specifically,

In 2004, the actual GPS global average user range error (“URE”) performance was 2.2 meters 95% of the time. Ex-2003, ¶168; Ex-2006 at 3 & Fig. 1; *see* Ex-2005 at 48 (Figs. A-5-1, A-5-2).

However, positional accuracy obtained by a GPS device is less precise. A reasonable approximation of position accuracy is actual URE multiplied by dilution of precision (“DOP”). A high level of precision for DOP in 2004 was between 1.5 and 3. Accordingly, a high level of GPS accuracy in 2004 was between 3.3 and 6.6 meters (10.83 and 21.65 feet) 95% of the time. Ex-2003, at ¶169; *see* Ex-2007 at 36, 365.

PO Resp. 45.

We determined that “[t]he fact that measurements taken via GPS at the time the application was filed were imprecise does not undermine Petitioner’s position that including GPS measurements for geographically locating a portion of the railroad track bed in an image would have been obvious over the combination of Holmes and Trosino. As we have stated,

‘just because better alternatives exist in the prior art does not mean that an inferior combination is inapt for obviousness purposes.’ *Mouttet*, 686 F.3d at 1334.” *See supra* Section II.E.1.[d].

Thus, Petitioner’s Motion to Exclude is dismissed as moot as to Exhibits 2006 and 2007.

Exhibit 2008 is the testimony of John Kainer. Petitioner alleges that at “least paragraphs ¶¶ 5 and 16 of Mr. Kainer’s testimony are improper lay testimony and/or expert testimony and thus should be excluded because he makes several uncorroborated, conclusory statements about features allegedly included in the Aurora system.” Mot. Excl. 5. Patent Owner responds that these paragraphs “contain proper lay testimony and/or expert testimony concerning certain hardware (laser, cameras, and an encoder) used in GREX’s Aurora system.” Opp. Mot. Excl. 8.

Exhibit 2020 includes the testimony of Lynn Turner. Petitioner argues that this testimony includes inadmissible hearsay under FRE 801 and 802 and should be excluded. Mot. Excl. 6–10. Patent Owner argues that the exception in FRE 807 applies. Opp. Mot. Excl. 10–14.

We need not consider the merits of Petitioner’s Motion to Exclude with respect to these exhibits, because even if the disputed evidence is considered, we have accorded it its proper weight and it nevertheless fails to persuade us that Patent Owner has prevailed in its secondary considerations arguments. Thus, Petitioner’s Motion to Exclude is dismissed as moot as to Exhibits 2008 and 2020.

IV. PETITIONER’S AND PATENT OWNER’S MOTIONS TO SEAL

Patent Owner and Petitioner each filed Motions to Seal certain papers and exhibits. Paper 15 (Patent Owner); Paper 24 (Petitioner).

In its Motion to Seal, Patent Owner seeks to seal the confidential version of the Patent Owner Response (Paper 16), as well as Exhibit 2008 (Declaration of John Kainer, filed in redacted and unredacted forms), Exhibit 2012 (Declaration of Gregory T. Grissom, filed in redacted and unredacted forms), and Exhibit 2013 (Schedule of Aurora Financial Data 2003–September 2019, filed in redacted and unredacted forms). Paper 15, 1–2. Patent Owner represents that the parties agreed to use the default protective order set forth in the July 2019 update to the Office Patent Trial Practice Guide, and submits a Proposed Stipulated Protective Order as Exhibit 2022. *Id.* at 3.

In its Motion to Seal, Petitioner seeks to seal the confidential version portions of Exhibit 1062 (Deposition Transcript of Gregory T. Grissom, filed in redacted and unredacted forms) as well as Exhibit 1063 (Deposition Transcript of John Kainer, filed in redacted and unredacted forms). Paper 24, 2. Petitioner states that the parties have agreed to use the default protective order set forth in the July 2019 update to the Office Patent Trial Practice Guide (Ex. 2022). *Id.*

“There is a strong public policy for making all information filed in a quasi-judicial administrative proceeding open to the public, especially in an *inter partes* review which determines the patentability of claims in an issued patent and therefore affects the rights of the public.” *Garmin Int’l v. Cuozzo Speed Techs., LLC*, IPR2012–00001, Paper 34 at 1–2 (PTAB Mar. 14, 2013). For this reason, except as otherwise ordered, the record of an *inter partes* review trial shall be made available to the public. *See* 35 U.S.C. § 316(a)(1); 37 C.F.R. § 42.14. The standard for granting a motion to seal is good cause. 37 C.F.R. § 42.54. That standard includes showing that the

information addressed in the motion to seal is truly confidential, and that such confidentiality outweighs the strong public interest in having the record open to the public. *See Garmin*, Paper 34 at 2–3.

After having considered the arguments, we determine that the parties establish good cause for sealing the documents identified in the respective Motions. Specifically, the parties demonstrate that the information they seek to seal consists of portions of papers, declarations, and deposition transcripts dealing with confidential technical and financial information about the parties' products, and exhibits having to do with confidential financial information. *See, e.g.*, Paper 15, 1–2; Paper 24, 1. The parties have also filed publicly available, redacted versions of the documents sought to be sealed. Accordingly, the Motions are *granted* and the Proposed Protective Order (Ex. 2022) is *entered*.

There is an expectation that information will be made public where the information is identified in a final written decision, and that confidential information that is subject to a protective order ordinarily would become public 45 days after final judgment in a trial, unless a motion to expunge is granted. 37 C.F.R. § 42.56; TPG, 77 Fed. Reg. at 48,761. A party dissatisfied with the Final Decision may appeal the Decision pursuant to 35 U.S.C. § 141(c), and has 63 days after the date of the Decision to file a notice of appeal. 37 C.F.R. § 90.3(a). Thus, it remains necessary to maintain the record, as is, until resolution of an appeal, if any. In view of the foregoing, the confidential documents filed in the instant proceeding will remain under seal, at least until the time period for filing a notice of appeal has expired or, if an appeal is taken, the appeal process has concluded. The record for the instant proceeding will be preserved in its entirety, and the

confidential documents will not be expunged or made public, pending appeal. Notwithstanding 37 C.F.R. § 42.56 and the Office Patent Trial Practice Guide, neither a motion to expunge confidential documents nor a motion to maintain these documents under seal is necessary or authorized at this time. *See* 37 C.F.R. § 42.5(b).

V. CONCLUSION

For the foregoing reasons, Petitioner has proven by a preponderance of the evidence that the challenged claims of the '329 patent are unpatentable, as summarized in the following table:

Claims	35 U.S.C. §	Reference(s)/ Basis	Claims Shown Unpatentable	Claims Not shown Unpatentable
16, 23, 38, 44, 46, 62, 68, 70	103	Davis, Kowalski, Bostrom, Trosino, Kanade		16, 23, 38, 44, 46, 62, 68, 70
16, 23, 38, 44, 46, 62, 68, 70	103	Holmes, Bostrom, Trosino, Kanade, Davis	16, 23, 38, 44, 46, 62, 68, 70	
Overall Outcome			16, 23, 38, 44, 46, 62, 68, 70	

VI. ORDER

In consideration of the foregoing, it is hereby:

ORDERED that claims 16, 23, 38, 44, 46, 62, 68, and 70 of the '329 patent have been proven to be *unpatentable*;

FURTHER ORDERED that Petitioner's Motion to Exclude (Paper 36) is *dismissed as moot*;

FURTHER ORDERED that Patent Owner's Motion to Seal (Paper 14) is *granted*; and

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

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