

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.

Case IPR2019-01581
Patent No. 8,081,320

**PATENT OWNER'S RESPONSE TO
PETITION FOR *INTER PARTES* REVIEW
OF U.S. PATENT NO. 8,081,320**

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LIST OF EXHIBITS

Exhibit	Description
Ex-2001	Declaration of Alan Conrad Bovik, Ph.D.
Ex-2002	Curriculum Vitae of Professor Alan Conrad Bovik, Ph.D.

I. INTRODUCTION

Patent Owner Georgetown Rail Equipment Company submits this Response to Petition for *Inter Partes* Review of U.S. Patent No. 8,081,320 (“’320 patent”).

The Petition does not prove that claims 1-17 of the ’320 patent are unpatentable over the prior art cited in Grounds 1, 2, or 3.

II. LEVEL OF ORDINARY SKILL IN THE ART

For purposes of this response, Patent Owner does not contest Petitioner's asserted level of ordinary skill in the art. *See* Petition at 16-17.

III. CLAIM CONSTRUCTION

For purposes of this response, Patent Owner agrees with the Petitioner that the ’320 patent terms should be given their plain and ordinary meaning. *See* Petition at 17.

IV. PETITIONER FAILS TO SHOW THAT CHOROS IS PRIOR ART.

Petitioner fails to show that Choros, which is used as a reference for all of Petitioner's grounds of unpatentability, is prior art. At trial, Petitioner has the burden to prove that a reference is a prior art printed publication, as Petitioner bears the burden of proving unpatentability by a preponderance of the evidence. 35 U.S.C. § 316(e); *see also Activision Blizzard, Inc. v. Acceleration Bay, LLC*, Case IPR2015-01951 at 10 (PTAB March 23, 2017) (Paper 107). Petitioner also has the burden to show public accessibility at trial. *In re Lister*, 583 F.3d 1307, 1317 (Fed. Cir. 2009).

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The Petition fails to establish that Choros is a printed publication under the patent statute. Instead, the Petition merely states “each asserted reference is prior art under at least one of 35 U.S.C. §§ 102(a), (b), and/or (e).” Petition at 6. However, the Petition fails to include any evidence that Choros is actually prior art. Instead, the petitioner merely alleges that Choros was “published in 2007” citing to “Ex-1007, 1-3 (Declaration of Rachel J. Watters on Authentication of Publication)” without presenting any evidence in the Petition itself. Petition at 7. The Board's rules require a Petition to include “a detailed explanation of the significance of the evidence.” 37 § C.F.R. 42.22(a)(2). The Petition fails to explain anything about the Declaration of Rachel J. Watters on Authentication of Publication.

The Board's rules expressly prohibit incorporation by reference. 37 C.F.R. 42.6(a)(3). Incorporation by reference “amounts to a self-help increase in the length of the brief.” *DeSilva v. DiLeonardi*, 181 F.3d 865, 866-67 (7th Cir. 1999) (“A brief must make all arguments accessible to judges, rather than ask them to play archaeologist with the record.”) As such, the Board should not consider the substance of the Declaration of Rachel J Watters located on pages 1-3 of Ex-1007.

Even if the Board were to consider the content of the Watters' Declaration, the cited pages fail to prove that Choros was publicly accessible. It is well-established that public accessibility is the touchstone of establishing that a reference

is a printed publication under the patent statute. *See In re Cronyn*, 890 F.2d 1158, 1160 (Fed. Cir. 1998) (inquiry is whether reference is “sufficiently accessible to the public interested in the art.”). A reference is deemed “publicly accessible” upon proof that (1) the “document has been disseminated,” or (2) “otherwise made available to the extent that persons interested and ordinarily skilled in the subject matter or art exercising reasonable diligence, can locate it.” *Cordis Corp. v. Boston Scientific Corp.*, 561 F.3d 1319, 1333 (Fed. Cir. 2009); *see In re Wyler*, 655 F.2d 221, 227 (C.C.P.A. 1981).

The Watters' Declaration does not provide sufficient evidence in that regard. The declaration does not indicate how a POSITA could locate Choros prior to the critical date by exercising reasonable diligence. Instead, the declaration alleges that members of the interested public could instead locate the different publication titled, “ASME/IEEE 2007 Joint Rail Conference and Internal Combustion Engine Division Spring Technical Conference (2007),” excerpts of which are attached as Exhibit A to the Watters Declaration. Ex-1007 at 1-2 & Ex. A. Although the Choros article is a portion of that publication, the Watters declaration does not indicate how a POSITA would be able to locate Choros by exercising reasonable diligence. The declaration states that “the cataloging system record of the University of Wisconsin-Madison Libraries” “copy of the *Prevention of derailments due to concrete tie rail*

seat deterioration (2007) publication”—or, in other words, the purported catalog record of the Choros article—is “[a]ttached as Exhibit B.” *Id.* at 2. To the contrary, the catalog record attached as Exhibit B does not reference the Choros article, “Prevention of derailments due to concrete tie rail seat deterioration (2007).” Exhibit B instead refers to the “Proceedings of the ASME/IEEE Joint Rail Conference” from 2007. *Id.* at Ex. B. At most the declaration therefore demonstrates how an interested person could search the catalog to find the ASME/IEEE proceedings, but not that it was possible to search the catalog to locate Choros. The Watters declaration accordingly does not provide evidence on how a POSITA would be able to locate Choros by exercising reasonable diligence. Moreover, as discussed above, the Watters’ declaration should not even be considered because any evidence it allegedly provides is not presented in the Petition as required.

Choros is cited in each ground of unpatentability. See Petition at 8, 20, 23-76. Consequently, the Board should find each claim patentable.

V. CLAIMS 1-17 ARE PATENTABLE OVER THE PRIOR ART CITED IN GROUNDS 1-3 BECAUSE A POSITA WOULD NOT HAVE COMBINED A MANUAL METHOD WITH A MACHINE VISION SYSTEM.

Petitioner’s Grounds 1-3 of unpatentability each rely on combining Choros’ manual method with Villar’s far more complex machine vision system. The

disclosure in those references, along with the evidence provided by Patent Owner's expert, Dr. Alan Bovik, demonstrate that a POSITA would not have combined them.

The '320 patent claims 1-17 generally concern application of computer or machine vision to achieve a specific task in a specific way. Ex-2001, ¶37. As Dr. Bovik explains, "[c]omputer vision is an 'art,'" "not an area of technology that involves simple mechanics. Although computer vision has been a topic of study for decades," creating a "machine vision system with a specific feature, especially a new feature, is difficult and generally is not an obvious endeavor" "because implementing even the simplest concept into computer vision is a difficult and extremely time-consuming process." Ex-2001, ¶38.

Consequently, in Dr. Bovik's opinion, "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" or "a formula, an equation, or measurement technique (manual or otherwise)" disclosed in a prior art reference "with a prior art reference that discloses the use of machine vision, unless the vision system already performs that task or technique." Ex-2001, at ¶39. "The process of taking such a task, technique, formula, or equation and synthesizing it into one that operates in computer vision system is very burdensome." *Id.*

As Dr. Bovik explains, “[r]eferring to a prior art reference, like Choros, that performs the task of manually measuring rail seat abrasion, and then referencing prior art that implements computer or machine vision, like Villar, would not have made it obvious to implement the determination or measurement of rail seat abrasion in a computer vision system.” Ex-2001, ¶40. “The content of a prior art reference that utilizes computer vision simply would not have been helpful to a POSITA in implementing those tasks or techniques in computer vision,” and certainly no more helpful than “a computer vision textbook.” *Id.*

VI. CLAIMS 1-2, 5-7, 10-13, AND 16-17 ARE PATENTABLE OVER THE PRIOR ART CITED IN GROUND 1.

The Petition fails to show that claims 1-2, 5-7, 10-13, and 16-17 are unpatentable over the prior art cited in Ground 1.

A. Claim 1 is Patentable.

The prior art Petitioner cites does not disclose or suggest claim 1's elements. Thus, even if a POSITA would have combined the references, claim 1 remains patentable. In addition, based on the references' disclosures and the opinions of Patent Owner's expert, Dr. Alan Bovik, a POSITA would not have combined and/or modified the prior art to create claim 1. Ex-2001, ¶¶47-88.

1. **Claim 1[e]: “determining whether rail seat abrasion is present along the rail road track”**

Contrary to Petitioner's argument (Petition at 37-45, 20-32), Villar and Choros do not disclose or suggest element [e]. Ex-2001, ¶¶47-64. Element [e] is a step performed by “at least one processor” as part of “analyzing the at least one image” “of a profile of at least a portion of the rail road track” as recited in elements [b], [c], and [d].

Petitioner provides no adequate reason for combining Villar and Choros to achieve a claimed element, much less element [e]. Petitioner asserts that “[i]t would have been obvious” to combine “*Villar* and *Choros* to make and use an automated railroad track inspection vision system” having a litany of features. Petition at 25. Relating to element [e], Petitioner contends that the combined system would have “an image processor for analyzing the at least one image to determine whether rail seat abrasion is present along the railroad track by measuring a vertical distance between rail base and crosstie top surface heights.” *Id.*

Petitioner asserts that a POSITA “would have understood that *Choros* discloses measuring RSA [rail seat abrasion] at each of the left rail/tie ... and right rail/tie ... seats” by means of a human inspector using “an RSA measurement gauge device that fits between an abraded tie and the rail base to measure rail seat abrasion” “by determining the depth or vertical distance between” the rail base and the abraded

top surface of the tie. *Id.* at 37-38. Petitioner then incorrectly contends that “it would have been obvious” to a POSITA “to implement *Villar*’s automated railroad track inspection vision system with *Choros*’ method of measuring RSA (i.e., measuring a vertical distance between rail base and crosstie top surface heights) to automatically determine whether RSA is present along a railroad track.” *Id.* at 39. More specifically, Petitioner erroneously argues that “similar to how an inspector in *Choros* would manually measure the vertical distance or depth of RSA and associate the vertical distance with a known criterion by which to determine actionable RSA, so too would a programmer implement *Villar*’s automated vision system to determine the presence of RSA.” *Id.* at 45.

However, according to Dr. Bovik, the references “do not teach or suggest element [e].” Ex-2001, ¶50. *Villar* does not disclose or suggest determining whether rail seat abrasion is present or measuring it. *Id.* *Choros* does not disclose or suggest a processor (let alone an image processor), or a processor that analyzes a railroad track image to measure distances of any kind (let alone the vertical distance between the rail base and the crosstie top surface heights), or a processor that determines or measures rail seat abrasion. *Id.*

In addition, a POSITA would not have combined the references in any event. *Id.*, ¶51. Petitioner erroneously asserts that a POSITA “could have easily

implemented” the combination with “predictable results” because both references “describe a railroad track inspection device and method for identifying alignment defects of railroad track components.” Petition at 30-31. However, in Dr. Bovik’s opinion, “a POSITA would not have modified Villar with Choros because there is a vast chasm between Choros’ manual method and an automated method that uses machine vision, like Villar.” Ex-2001, ¶52. As he explains, “[i]t is not trivial or obvious to write an algorithm to implement a manual method because” “implementing even the simplest concept into machine vision is very difficult and time consuming. A special amount of invention and creativity is necessary to write and implement such an algorithm.” *Id.* “For that reason, combining the technique for measuring rail seat abrasion disclosed in Choros with a computer vision system, like that disclosed in Villar, to create a machine vision system that measures rail seat abrasion would not have been obvious.” *Id.*

Indeed, in Dr. Bovik’s opinion, “Villar is at best a starting point for the creation of another invention, not an obvious endeavor.” *Id.*, ¶53. “Even if a POSITA were motivated to add the feature of determining rail seat abrasion to Villar, a POSITA would need to create a model, create code for the model, and then experiment and test the resulting code and system to make certain that they work properly.” *Id.* “The disclosure in Choros is not helpful to that endeavor because

Choros does not contain a model, an algorithm, or code for determining rail seat abrasion.” *Id.*

Further, Dr. Bovik opines that “a POSITA would not have modified Villar with Choros because their techniques are diametrically opposed.” *Id.*, ¶54. In that regard, he explains that “Choros employs a simple technique using human visual inspection to locate the rail seat followed by manual placement of a gauge, ruler, or similar measurement tool in or near the rail seat to physically measure the distance between the rail seat and the abraded top surface of the crosstie.” *Id.* In contrast, “Villar employs a vastly more complicated technique that involves automated imaging of virtually every object inspected and all surrounding areas, recording an image of the height of each object’s entire visible surface and of the surrounding areas, to create multiple images, and analyzing those images to locate certain objects and measure various aspects of the railroad track and its components.” *Id.*

An additional reason why a POSITA would not have combined Villar and Choros is that, as Dr. Bovik explains, “Villar expressly teaches away from the manual measurement and visual inspection disclosed in Choros.” *Id.*, ¶55. Villar states that its disclosed “invention” for an automated vision railroad track bed inspection system “is directed to overcoming, or at least reducing the effects of, one or more of the problems set forth” in its background section. Ex-1005 at ¶[0007].

One of those problems is that “railroad inspectors attempt to grade the condition of crossties” and, in that procedure, the “grading is most often done with a visual inspection.” Ex-1005 at ¶[0004]. This method is problematic because “[t]he process of visual inspection is quite time consuming.” Ex-1005 at ¶[0004]. In fact, a crew of 3 or 4 inspectors may only be able to manually grade about 5 to 7 miles of railroad track a day. Ex-1005 at ¶[0004]. To overcome the problem of visual and manual inspection, Villar discloses a laser/camera line optical scanning and analysis system that can automatically determine certain measurable aspects of a railroad track, including condition and location of crossties, aspects of tie plates, fasteners, and insulators, size and height of ballast, and rail break or separation. Ex-1005 at ¶[0008]; Ex-2001, ¶55.

In contrast to Villar's teachings, Choros discloses a manual measurement and visual inspection method. Ex-2001, ¶56 (citing Ex-1007 at 11-13). Specifically, Choros discloses the use of a tool called “an abrasion measurement gauge” that is physically placed “between the abraded tie and the rail base” to “measure the void between the rail and tie” and thus “measure concrete tie abrasion” as compared to the unabraded crosstie surface. Ex-1007 at 11. Choros adds that “similar feeler gages or a ruler” can also be used the same way. *Id.*

Villar expressly teaches away from using this type of measurement system. Ex-2001, ¶57. A reference “teach[es] away” if a POSITA, “upon reading the reference, would be discouraged from following the path set out in the reference, or would be led in a direction divergent from” the claimed invention. *Polaris Indus., Inc. v. Arctic Cat, Inc.*, 882 F.3d 1056, 1069 (Fed. Cir. 2018). Even if a reference does not “teach away, its statements regarding preferences are relevant to a finding regarding whether a skilled artisan would be motivated to combine that reference with another.” *Id.*

Here, Choros discloses a manual technique in which a person visually locates the rail seat, and then physically determines or measures, and visually observes the amount of, rail seat abrasion, while Villar expressly teaches “overcoming” or “reducing” the “problems” of “visual inspection” by an “inspector walking along the track to inspect and record” the data. Ex-1005, ¶¶[0007], [0004]; Ex-2001 at ¶57. In Dr. Bovik’s opinion, “Villar thus explicitly criticizes, discredits, and discourages use of Choros’ type of system.” Ex-2001, ¶57. Thus, “a POSITA would not have been motivated to combine Choros with Villar for this additional reason.” *Id.*

In an attempt to support a motive for combining Villar and Choros, Petitioner erroneously contends that Choros discloses “both manual and automatic inspection methods” because Choros purportedly “describes using geometry cars to collect

pertinent data for identifying critical locations that have excessive rail seat abrasion and present a safety issue,” and thus “disclos[es] that data collected on geometry cars is considered as an alternative method for identifying critical locations of RSA.”

Petition at 31, 28; *see id.* at 37. To the contrary, Choros says only the following:

Methods to detect areas that have excessive rail seat abrasion and present a safety issue are under investigation by FRA [Federal Railroad Administration]. Data collected on geometry cars is considered as an alternative method for identifying critical locations. However, for these measurements to be reliable the required frequency of inspections may be too high based on the availability of existing geometry cars. A simpler method is being considered for field forces, either FRA or railroad inspectors, to evaluate a site once it has been detected by a geometry car or during a visual inspection by an inspector.

Ex-1007 at 11. This “simpler method” is the manual and visual measurement system discussed above. *Id.* Choros thus discloses that the automated geometry car systems can, at best, detect potential locations where RSA might exist, but to determine if there is RSA, and to measure RSA, requires that a track inspector must subsequently visit those locations to view and physically measure RSA at each rail seat on each crosstie. Ex-2001, ¶59. Accordingly, rather than suggesting automated determination of RSA, Choros instead emphasizes the importance of using visual inspection and manual measurement to determine the existence of RSA. *Id.*

Information from Petitioner's other exhibits are consistent with this conclusion. *Id.*, ¶60. Those exhibits state that geometry cars are capable of measuring "loaded track geometry data" only in the form of "rail cant," "rail profile," and "gage widening," and that such data can "indicate" "possible" or "potential" track locations where RSA might be present, such that the possible presence of RSA can, as a result, be further investigated and measured by "Manual/Visual Inspection" methods "on-the-ground" "by inspectors" "to verify whether [RSA] exists." *See* Ex-1019 at 3, 18; Ex-1015 at 2-3; Ex-1017 at 3-4.

Further, Petitioner otherwise provides an insufficient reason why a POSITA would have combined Villar and Choros. Ex-2001, ¶61. Petitioner relies on a motivation "to yield an 'automated'" "machine vision system" because "automating manual inspection tasks" "obviate[s] time, accuracy, and safety issues associated with a human inspector's RSA inspection and measurement," and would have been "further to and consistent with rules promulgated to the railroad industry by" the "Federal Railroad Administration ('FRA')." Petitioner at 25-27.

However, the FRA rules do not provide the motivation Petitioner describes. Ex-2001, ¶62. The FRA rules Petitioner references did not come into effect until November 8, 2011, over two years after the '320 patent's effective filing date. *See* Ex-1017 at 1. They thus provided no impetus to a POSITA in the relevant

timeframe. Also, the FRA expressly recognized that existing automated and manual technologies were sufficient to satisfy those rules. In that regard, the Association of American Railroads (“AAR”) petitioned the FRA to reconsider the proposed rule because “today’s automated inspection equipment cannot measure rail seat deterioration at all, let alone within 1/8 of an inch.” Ex-1017 at 3. The FRA agreed that the AAR’s position “is technically correct that automated equipment cannot currently *measure* rail seat deterioration,” and the FRA noted that, in contrast, “today’s automated equipment can [only] *indicate* locations of rail seat deterioration.” *Id.* (emphasis original). The FRA then clarified that its rules require only the use of automated equipment to “indicate” areas of the track where there is “possible rail seat deterioration,” and that “on-the-ground visual verification must be done by inspectors” to locate, determine, and measure actual rail seat deterioration. Ex-1017 at 3-4. Accordingly, for this additional reason, the FRA rules would not have motivated a POSITA to implement an automated system for rail seat abrasion measurement. Ex-2001, ¶62.¹

¹ Notably, as stated above, the rules and proposed rules, and the commentary all took place well after the ’320 patent’s effective filing date. *See* Ex-1017 at 1, 3-4. Thus, even the FRA’s discussion of the existing capability of geometry cars and other technologies cannot be used to determine the patentability of the ’320 patent claims at issue. Ex-2001, ¶63.

Finally, it should be noted that, in support of its argument, Petitioner includes a series of figures labeled “*Choros*, FIG. 8 (annotated)” (Petition at 39, 40, 44), but none of them are part of *Choros*. The illustrations are fake prior art. They are *Choros*' Figure 8, created by Petitioner, and “annotated” with extra imagined features from Villar, using element [e] as a blueprint. They thus cannot provide basis for a proper contention of unpatentability.

Indeed, along with these figures, Petitioner attempts to create the appearance of an algorithm like that in element [e] from a combination of Villar and *Choros*, even though no such algorithm exists in the references, while suggesting that it would have been obvious to implement such an apparent algorithm. Petition at 39-40, 43-44; see Ex-2001, ¶64. Although, as stated above, a POSITA would not have combined Villar and *Choros* in any event, implementing *Choros*' manual technique into Villar would not have been obvious because each step of the procedure Petitioner proposes raises a research problem that would need to be fully investigated and then, as discussed above, a model would need to be created, an algorithm and software code created based on the model, and then the resulting code and system tested to make certain that it works properly. Ex-2001, ¶64; see *id.*, ¶53.

2. **Claim 1[f]: “wherein, when determining whether rail seat abrasion is present, the at least one processor compensates for a tilt of the rail road track.”**

Contrary to Petitioner's contention (Petition at 46-54), Villar, Choros, Casagrande, and Szwilski do not disclose or suggest element [f]. Ex-2001, ¶¶65-88.

1. **Combination of Villar, Choros, and Casagrande**

Petitioner incorrectly asserts that it was “well-known at the relevant time to compensate for th[e] tilt of a railroad track when determining a railroad track component defect, as evidenced by, e.g., *Casagrande*.” Petition at 46. Petitioner erroneously concludes as a result that “[i]t would have been obvious” to a POSITA “to have implemented *Villar* and *Choros*' automated RSA railroad track inspection vision system with *Casagrande*'s tilt compensation software to automatically compensate measurements of imaged railroad track components for any vertical alignment errors associated with the deformation of the railway or vehicle-mounted vision system, as taught by *Casagrande*.” *Id.* at 49.

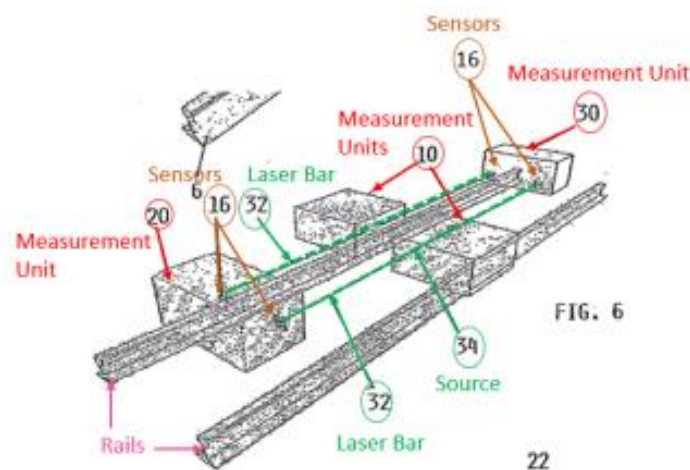
To the contrary, as Dr. Bovik explains, “Casagrande does not disclose or suggest the critical features of element [f].” Ex-2001, ¶68. Casagrande discloses using up to three measurement units that each have laser beams illuminating the rails, and cameras that capture the images, to obtain the rail profiles. Ex-1008, ¶¶[0001], [0004]-[0006], [0020]-[0025], [0029]-[0030]. If three such units are used,

the measurements obtained on the two rails enable the processor to calculate various track geometry coordinates, including rail wear, gauge, radius of curvature, horizontal alignment, vertical alignment, and skew. *Id.*, ¶¶[0025], [0029]-[0030], [0007], [0009], [0011].

However, Casagrande does not disclose or suggest “determining whether rail seat abrasion is present,” as the first part of element [f] requires. Ex-2001, ¶69. Although Casagrande discloses some rail related measurements that its system can make, it conspicuously fails to mention rail seat abrasion. *See id.* (citing Ex-1008, ¶¶[0007]-[0043]). Further, although broadly stating an objective of “measur[ing] all the parameters of a railway or tramway line,” and that the system can “calculate the various parameters of the track geometry” (Ex-1008, ¶¶[0008], [0030]), Casagrande is in fact incapable of measuring rail seat abrasion. Ex-2001, ¶69. Casagrande’s system measures points on, and obtains profiles of, the “two rails,” “each rail,” and “the top of the rail head,” not any other components, such as the crossties. *See* Ex-1008, ¶¶[0022]-[0030] & Figs. 1-5. Because Casagrande makes no mention of illuminating, capturing images of, or making any measurements relating to the crossties, Casagrande is incapable of determining or measuring the difference in height between the rail seat and the unabraded crosstie surface, and thus cannot determine the existence of, or measure, rail seat abrasion. Ex-2001, ¶69.

Accordingly, because Casagrande cannot determine whether rail seat abrasion is present, it then follows that Casagrande likewise cannot disclose or suggest “compensat[ing] for a tilt of the rail road track” when making such a determination, as the second part of element [f] requires. *Id.*

Petitioner incorrectly contends in the alternative that, “[t]o the extent *Casagrande* does not explicitly disclose compensating an RSA measurement for vertical tilt error, *Casagrande* describes compensating imaged rail profile and other measured geometric parameters (e.g., gauge, radius of curvature, horizontal and vertical alignment, and skew) for vertical alignment errors.” Petition at 49. Petitioner’s argument relies on the Casagrande embodiment shown in Figure 6. Petitioner’s annotated version of that figure is reproduced below:



Casagrande, FIG. 6 (annotated).

Petition at 48. In this embodiment, the “position in height of” the “two end measurement units 20 and 30 is monitored by a laser bar 32” emitted from the center unit and “received by a sensor 16” in the end units that provides “a precise alignment of the points of measurement.” Ex-1008, ¶[0036]. If the sensors are not aligned with the laser, the software uses the resulting signal “to automatically compensate the resultant measurement errors.” *Id.*

However, utilizing that feature, the processor in Casagrande does not “compensate[] for a tilt of the railroad track,” as element [f] requires. Ex-2001, ¶71. As Casagrande expressly acknowledges, its system’s objective “is to effect all the rail measurements with the measurement apparatus insensitive to oscillation and deformation of the vehicle on which it is mounted.” Ex-1008, ¶[0012]. Accordingly, unlike element [f], this feature of Casagrande instead provides only the ability to “compensat[e] for the errors due to elastic deformation of the railway or tramway carriage” so that each rail measurement “is insensitive to elastic deformation and oscillation of the railway carriage on which [the device] is mounted.” Ex-1008, ¶¶[0036], [0043]. In other words, this feature adjusts only for measurement errors caused by “oscillations” or “elastic deformation” of the “vehicle” or “carriage” (whether a “railway carriage” or a “tramway carriage”) on which the measurement units are mounted. It does not in any manner detect,

measure, or adjust for the “tilt” of the rails or the vertical displacement of one rail in regard to another rail. Ex-2001, ¶71.

Petitioner thus incorrectly labels this aspect of Casagrande as “tilt compensation software” that can “automatically compensate” “for any vertical alignment errors associated with the deformation of the railway or vehicle-mounted system.” Petition at 49. Directly contrary to Petitioner's characterization, Casagrande does not compensate for rail “tilt.” On its face, Casagrande never discusses tilt, nor does it disclose or suggest a way to compensate for tilt. Ex-2001, ¶72; Ex-1008, ¶¶[0007]-[0043]. As stated above, Casagrande compensates only for measurement errors caused by “oscillations” or “elastic deformation” of the “vehicle,” “railway carriage,” or “tramway carriage.” Also, to the extent that, by Petitioner's statement that Casagrande images “railroad track components,” Petitioner suggests that Casagrande images any component other than the two rails, the suggestion is meritless. Casagrande measures points on and obtains profiles of only the “two rails,” “each rail,” and “the top of the rail head,” not any other components. Ex-2001, ¶72; Ex-1008, ¶¶[0022]-[0030] & Figs. 1-5.

Moreover, as Dr. Bovik explains, Casagrande is incapable of measuring or compensating for “tilt of the railroad track” as element [f] requires. Ex-2001, ¶73. If, because of a curve or bend in the track, the track is tilted to one side, any vehicle

traveling on the tracks—including Casagrande's vehicle, railway carriage, or tramway carriage carrying the measurement units—will lean or tilt because it is riding on the track rails. *Id.* Because the entire vehicle or carriage tilts, each measurement unit mounted on the vehicle or carriage will likewise tilt the same as the vehicle, which means that such a tilt will not disturb the alignment between the front, middle, and back measurement units as monitored by the laser bar 32 and sensors 16. *Id.* Consequently, Casagrande's system will not even notice or register the existence of the railway tilt, nor will it be able to “compensate for” that “tilt” as element [f] requires. *Id.*

Finally, Petitioner claims that a POSITA “could have easily implemented” Casagrande in combination with Villar and Choros to obtain RSA “measurement for vertical tilt errors,” “and doing so would yield nothing more than predictable results.” Petition at 49; *see id.* at 46-49. To the contrary, for the reasons stated above, even if a POSITA had sufficient reason to combine the references, the claimed invention would not have been attained. Ex-2001, ¶74. Instead, as Dr. Bovik explains, “the only ‘predictable result’ of adding Casagrande to the combination of Villar and Choros would be a measurement system that compensates for oscillations and elastic deformation of the carriage on which the measurement device is mounted, and which is capable of measuring the gauge, radius of curvature,

horizontal and vertical alignment, and skew of the rails (as Casagrande discloses).”

Id. Petitioner refers to nothing in the references, or otherwise provides sufficient reason, demonstrating why a POSITA would have further modified the combined references to include element [f]’s requirements. *See* Petition at 46-49.

Moreover, a POSITA would not have sufficient reason to combine the references to achieve element [f]. Ex-2001, ¶75. As stated above, a POSITA would not have combined Villar with Choros because a POSITA would not have looked to a reference disclosing a primitive manual method of measurement, like that in Choros, to modify a sophisticated machine vision system, like that in Villar. *Id.*

2. Combination of Szwilski with Villar and Choros

Petitioner next relies on Szwilski as a potential source for element [f]’s requirements to contend that Szwilski’s combination with Villar and Choros renders that element obvious. Petition at 50-52. Petitioner characterizes Szwilski as “disclos[ing] a mobile track surveying and monitoring apparatus using image-capturing technology to obtain railroad track component position data” that also “[a]ccount[s] for vertical track inclination errors to accurately represent imaged railroad component position data when determining rails defects.” *Id.* at 50. Petitioner concludes that, “in light of Szwilski’s teachings extending vertical tilt compensation corrections to ‘other rail [] defects,’ ” “it would have been obvious ...

to implement *Villar* and *Choros*' automated RSA railroad track inspection system to account for vertical track inclination errors to accurately represent the imaged railroad component position data when determining whether a well-known 'rail [] defect[],' such as RSA, is present." *Id.* at 51-52.

To the contrary, in Dr. Bovik's opinion, "the combination of Szwilski with *Villar* and *Choros* cannot render element [f] unpatentable because, like *Casagrande*, Szwilski does not disclose the requirements of that element." Ex-2001, ¶77. Szwilski discloses using two GPS receivers on a mobile platform that travels on a railroad track, with one receiver mounted higher than the other, and both receivers vertically aligned over the same rail. Ex-1009 at 5-6, 10-12 & Fig. 3. Using a base station GPS receiver in conjunction with the two mobile receivers to create an overall "High Accuracy Differential Global Positioning System (HADGPS)," the position data received in each receiver allows for a calculation of the track inclination angle and the vertical and horizontal errors associated with that angle. *Id.* at 9, 5, 12, 16 & Fig. 3.

Petitioner effectively admits that Szwilski does not disclose the use of a tilt correction to determine if rail seat abrasion is present (as element [f] requires), but instead expressly discloses only correcting for the vertical and horizontal errors in measuring "rail displacement." Petition at 51. Petitioner relies instead on Szwilski's

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general statement that these error corrections could also apply to “other rail ... defects.” *Id.*; Ex-1009 at 20. The basis that Petitioner provides for applying that disclosure to obtain element [f] is its expert’s declaration stating only “it would have been obvious” to apply that correction mechanism to “RSA” because “[t]he combination would have yielded the claimed subject matter.” Petition at 51-52; Ex-1004, ¶87. However, the statement is unsubstantiated because it provides no technical analysis or explanation, and thus provides insufficient grounds to prove unpatentability. Ex-2001, ¶78. To prove unpatentability based on why a POSITA would have sufficient reason to combine references, Petitioner “must instead articulate specific reasoning, based on evidence of record.” *In re Mangum Oil Tools Int’l Ltd.*, 829 F.3d 1364, 1380 (Fed. Cir. 2016); *see KSR Int’l Co. v. Teleflex Inc.*, 550 U.S. 398, 418 (2007) (“there must be some articulated reasoning with some rational underpinning”).

In any event, even if Szwilski’s disclosure in this regard somehow suggests combining Szwilski with Villar and Choros, Szwilski nevertheless does not disclose element [f]. Ex-2001, ¶79. Element [f] is a step performed by “at least one processor” as part of “analyzing the at least one image” “of a profile of at least a portion of the rail road track” as recited in elements [b], [c], and [d]. Szwilski’s determination of track inclination is based on the positions of its GPS receivers and

calculations based on those positions, rather than based on any image, or profile in an image, of a railroad track. Ex-2001, ¶79. Petitioner effectively acknowledges Szwilski's deficiency in this regard. *See* Petition at 52.

More importantly, however, another reason why the purported combination falls short, as Dr. Bovik explains, is that "Szwilski's measurements are unrelated to the position of the rail seats, and thus cannot be used to obtain element [f]." Ex-2001, ¶80. Szwilski's mobile platform rides on top of the rails, and its GPS receivers are attached to that platform. Ex-1009 at 1, 5-6, 10-12, 16-17, Fig. 1, 3. As a result, Szwilski's measurements are based on the location of the rail tops because, as the position of the tops changes or undulates (such as from rail wear), the position of the platform and the GPS receivers likewise move to mimic those changes. *See, e.g.*, Ex-1009 at 10-11, 16-17, Fig. 3. However, element [f] concerns determining abrasion relating to the "rail seat" or the bottom of the rail, and thus the relative position of the rail "seat," not the rail's top surface. *See, e.g.*, Ex-1001 at 15:38-39, 50-55, 12:64-14:6, Fig. 17. A change in the rail top's position due to wear of the rail top will not translate to the rail seat because the rail seat abrades, and thus changes position, in its own distinct manner. Ex-2001, ¶80. Because Szwilski's vertical error and inclination measurements are based on the rail top rather than the rail seat, even if a POSITA would have combined Szwilski with Villar and Choros, element [f]

would not have been attained because Szwilski has no application to determining or measuring rail seat abrasion or compensating for a tilt in the track in making that determination or measurement. *Id.*

Moreover, Dr. Bovik further opines that a POSITA would not have looked to or implemented Szwilski to compensate for railroad track tilt in determining rail seat abrasion because Szwilski's system is far too inaccurate. Ex-2001, ¶81. Szwilski states that the GPS "position coordinate accuracies [that] can be achieved by [its] system" are "a vertical coordinate component of less than 2.5 cm" (less than 1 inch) and that the "average accuracies" include "2.2 cm (0.87 ins) vertical for platform velocities of 5, 10 and 15 mph." Ex-1009 at 6, 7. Szwilski further states that its "HADGPS coordinates" can only be "generated every 14.6 feet" if, for example, the mobile platform is moving "at 10 mph." *Id.* at 12.

As Dr. Bovik explains, "it is readily apparent from this disclosure that a POSITA would have viewed Szwilski's system as useless for determining the presence of, or measuring, rail seat abrasion, including for compensating for track tilt in making such a determination or measurement." Ex-2001, ¶82. Rail seat abrasion is a measure of the vertical distance or depth of abrasion into the top surface of a crosstie. Ex-1001 at Fig. 17; Ex-1007 at 9, 11-12, & Figs. 1, 3, 8); Ex-1012 at 7 (Fig. 4). The Federal Railroad Administration's rules mandate that crossties

cannot be “[d]eteriorated or abraded at any point under the rail seat to a depth of $\frac{1}{2}$ inch or more.” Petition at 20; Ex-1041 at 1-2; Ex-1021 at 17 (46 C.F.R. §213.109(e)(4)). Also, Choros provides a table of “maximum abrasion[s]” that, depending on the class of track and rail wear, range from “ $\frac{2}{16}$ ” to “ $\frac{11}{16}$ ” inches (0.125 to 0.6875 inches). Ex-1007 at 14 (Table 2).

Szwilski's vertical error (*i.e.*, vertical distance or depth) of “less than” one inch and an “average” of 0.87 inches is far too inaccurate to determine rail seat abrasion under these standards. Ex-2001, ¶83. The error is significantly larger than the FRA's maximum allowed abrasion of 0.5 inches. *Id.* It is also larger than all of Choros' disclosed “maximum abrasion[s]” of between 0.125 inches to 0.6875 inches. *Id.* Thus, a POSITA would have viewed Szwilski's system as useless for measuring RSA or determining if RSA is present, let alone to apply Szwilski to compensate for track tilt. *Id.*

In addition, cross-ties and the rail fasteners are spaced about 20 inches apart. Ex-2001, ¶84; Ex-1005, ¶[0004]. Because there is one rail seat between each rail and cross-tie, a useful system for determining RSA thus must be able to measure vertical distance or depth at least every 20 inches. Ex-2001, ¶84. Because Szwilski is able to determine its coordinates (vertical and horizontal) only about every “14.6 feet,” it obtains such coordinates and measures vertical error only once over a span

that includes roughly eight to nine cross ties. *Id.* The measurement thus takes place over about eight to nine rail seats on each rail or, in other words, a combined total of roughly sixteen to eighteen rail seats on both rails over the full track. *Id.* Consequently, instead of providing the precise location of any vertical distance (or depth) measurement, or the appropriate place to apply a tilt correction, over a specific rail seat, Szwilski would at best identify a large area of track containing between about sixteen to eighteen rail seats. *Id.* In Dr. Bovik's opinion, this is an additional reason why "a POSITA would have viewed Szwilski's system as useless to use for measuring RSA or determining if RSA is present, or for implementing Szwilski's system to compensate for track tilt as element [f] requires." *Id.*

Finally, another reason why a POSITA would not have looked to implement Szwilski with Villar and Choros is that, as stated above, its measurements are unrelated to the position of the rail seats. Ex-2001, ¶85. Because Szwilski's vertical measurements and inclination measurements are based on the rail top rather than the rail seat, a POSITA would not have combined Szwilski with Villar and Choros to obtain element [f] because Szwilski has no application to determining rail seat abrasion. *Id.* Finally, for the reasons stated above, a POSITA would not have combined Villar with Choros in the first instance, let alone add Szwilski to that combination. *Id.*

3. Combination of Villar, Choros, Casagrande, and Szwilski

Petitioner finally relies on combining Casagrande and Szwilski with Villar and Choros to supposedly render element [f] unpatentable. Petition at 52-54. Petitioner essentially repeats its arguments on the combination of Casagrande, Villar, and Choros but then briefly mentions Szwilski. Specifically, Petitioner incorrectly asserts that Casagrande calculates “the ‘vertical alignment’ or tilt of the track” and, when combined with “*Villar and Choros*’ automated RSA railroad track inspection system,” it “would simply provide another track component defect” “to automatically identify and correct” and thus the combination would have been obvious. *Id.* at 52-54. Petitioner then states only that, “[a]nd further to *Casagrande* and *Szwilski*’s teachings, when determining whether RSA is present,” “*Villar*’s system would compensate the RSA measurement for any vertical alignment error.” *Id.* at 54.

In support of its argument, Petitioner includes a figure labeled “*Choros*, FIG. 8 (annotated)” (Petition at 54), but that figure is not in Choros. The illustration is fake prior art. It is Choros’ Figure 8, created by Petitioner, and “annotated” with extra imagined features from Villar, Casagrande, and Szwilski, using element [f] as a blueprint. It thus provides no basis for a proper contention of unpatentability.

In any event, in Dr. Bovik's opinion, "even if a POSITA had sufficient reason to combine the references, the combination lacks element [f]'s features." Ex-2001, ¶88. As set forth above, neither Casagrande nor Szwilski disclose or suggest any capability for making measurements relating to the rail seats, and thus both are incapable of compensating for a tilt in the railroad track in making that determination, as element [f] requires. *Id.* As further described above, even putting aside their lack of ability to make RSA-related measurements, Casagrande is incapable of detecting, measuring, or adjusting for rail tilt for any railroad track measurement, and Szwilski's rail tilt measurement not only does not relate to and cannot be applied to rail seat measurements, but Szwilski's tilt measurement is also far too wildly inaccurate to apply to compensate for tilt in any rail seat measurement. *Id.* Accordingly, even if a POSITA had sufficient reason to combine the four references, the claimed invention would not have been achieved. *Id.* Petitioner refers to nothing in the references, or otherwise provides a sufficient reason, demonstrating why a POSITA would have further modified the combined references to include element [f]'s requirements. Further, a POSITA would not have combined Villar and/or Casagrande with Choros and/or Szwilski for the reasons stated above. *Id.*

B. Claim 2 is Patentable.

Claim 2 depends on claim 1. Because claim 1 is patentable for the reasons stated above, claim 2 is patentable. Further, Petitioner's argument that claim elements 2[a] through 2[e] are unpatentable relies on its reasoning why claim elements 1[e] and/or 1[f] are unpatentable. Petition at 54-56. As stated above, those arguments fail.

Further, contrary to Petitioner's argument (*id.*), Villar, Choros, Casagrande, and Szwilski do not disclose or suggest claim 2 for another reason. None of the references disclose or suggest the use of any "tilt correction factor" or an "actual delta" for the rail bases, as elements [c] and [d] of claim 2 require. Ex-2001, ¶91. In fact, the Petition does not allege any of the references disclose or suggest "determining a tilt correction factor." Petition at 55. Specifically, neither Casagrande nor Szwilski (the references on which Petitioner relies for tilt compensation) use those terms or any similar term, or disclose or suggest the application of any similar concept. *See* Ex-1008; Ex-1009. Accordingly, claim 2 would not have been obvious based on the combination of Villar, Choros, Casagrande, and Szwilski. Ex-2001, ¶91.

C. Claim 5 is Patentable.

Claim 5 depends on claim 2, which depends on claim 1. Because claims 1 and 2 are patentable for the reasons stated above, claim 5 is patentable.

Further, contrary to Petitioner's argument (Petition at 57-58), Villar, Choros, Casagrande, and Szwilski do not disclose or suggest claim 5 for an additional reason. Claim 5 requires that "the step of determining the actual delta is accomplished based upon the tilt correction factor." As stated above relating to claim 2, none of the references disclose or suggest the use of any "tilt correction factor" or an "actual delta" for the rail bases. Ex-2001, ¶94. They likewise do not disclose or suggest using the tilt correction factor to determine the actual delta or the application of any similar concept. *Id.* Accordingly, claim 5 would not have been obvious based on the combination of Villar, Choros, Casagrande, and Szwilski.

D. Claim 6 is Patentable.

Claim 6 depends on claim 2, which depends on claim 1. Because claims 1 and 2 are patentable for the reasons stated above, claim 6 is patentable. Further, Petitioner's argument that claim 6 is unpatentable relies on its reasoning why claim element 2[e] is unpatentable. Petition at 58. That reasoning fails for the reasons stated above.

E. Claim 7 is Patentable.

Contrary to Petitioner's argument (Petition at 59-60), the combination of Villar, Choros, Casagrande, and Szwilski do not disclose or suggest claim 7. Regarding all elements except element [b], Petitioner relies on its reasoning why those references purportedly disclose the elements of claims 1 and 2. *Id.* at 59. That reasoning fails for the reasons stated above.

F. Claims 10-11 are Patentable.

Claims 10-11 depend on claim 7. Because claim 7 is patentable as stated above, claims 10-11 are patentable. Further, Petitioner's argument that claims 10 and 11 are unpatentable relies on its reasoning why claim 5 and claims 1 and 5 are unpatentable, respectively. Petition at 60-61. As stated above, those arguments fail.

G. Claim 12 is Patentable.

Contrary to Petitioner's argument (Petition at 61-62), the combination of Villar, Choros, Casagrande, and Szwilski do not disclose or suggest claim 12. Regarding the preamble and elements [a]-[e] of claim 12, Petitioner relies on its reasoning why those references purportedly disclose the same elements of the preamble and elements [b], [e], and [f] of claim 1. *Id.* That reasoning fails for the reasons stated above.

H. Claims 13, 16, and 17 are Patentable.

Claim 13 depends on claim 12 and claims 16-17 depend on claim 13. Because claim 12 is patentable as stated above, claims 13, 16, and 17 are patentable. Further, Petitioner's argument that claims 13, 16, and 17 are unpatentable relies on its reasoning why claims 1-2, claim 5, and claim 6 are unpatentable, respectively. Petition at 62-63. As stated above, those arguments fail.

VII. CLAIMS 3, 8, AND 14 ARE PATENTABLE OVER THE PRIOR ART CITED IN GROUND 2.

The Petitioner fails to show that claims 2, 8, and 14 are unpatentable over the prior art cited in Ground 2.

A. Claim 3 is Patentable.

Claim 3 depends on claim 2. Because claim 2 is patentable for the reasons stated above, claim 3 is patentable. Further, Petitioner's argument that claim 3 is unpatentable relies on its reasoning why claim elements 1[f] and claim 2 are unpatentable. Petition at 64. As stated above, those arguments fail.

In addition, contrary to Petitioner's argument (Petition at 64-72), Villar, Choros, Casagrande, Szwilski, and Khattak do not disclose or suggest claim 3. Ex-2001, ¶109. Claim 3 recites, among other things, "determining vertical pixel counts for each of the heights of the left rail base, right rail base, left crosstie and right crosstie." Ex-1001 at 16:1-3. Petitioner incorrectly asserts that "it would have been

obvious” to a POSITA “to implement Villar’s system to identify and assess the rail base and crosstie top surface height contours via contour line-fitting and orientation comparison algorithms by determining the left and right rail base and crosstie heights by determining and comparing vertical pixel counts in the image for the left and right rail base heights” “and left and right crosstie heights.” Petition at 66-67.

To the contrary, as noted by Dr. Bovik, “Villar does not disclose determining the vertical pixel counts for determining any height measurement.” Ex-2001, ¶110. Rather, “[t]he only use of pixel summing disclosed in Villar is averaging or summing the value of pixels in an entire region of interest to determine the presence of a crosstie. The reason for that summing is that the contour of a crosstie is composed of dark pixels and a frame that includes a crosstie will have a greater average or sum of pixels than a frame that does not include a crosstie.” *Id.*; see Ex-1005 at ¶[0046]. This teaching dramatically differs from determining vertical pixel counts to determine a height as recited by claim 3. Ex-2001, ¶110.

As alleged support for its contention to the contrary, Petitioner cites paragraphs [0047], [0050], [0052], and [0055] of Villar. Petition at 64-67. Petitioner erroneously asserts that, in these paragraphs, “Villar discloses determining the distance in pixels” “between a contour of a rail” and “a tie plate” and “determining a height in pixels” “of ballast” “relative to [a] crosstie.” Petition at 65-66. However,

the cited paragraphs of Villar do not mention the term “pixel,” let alone the counting of pixels or using pixel counts for determining either these or other height measurements. Ex-1005 at ¶¶[0047], [0050], [0052], [0055]. Rather, these portions of Villar discuss using best fit or curve fitting techniques, edge detecting techniques, and line fitting techniques to determine the distances or heights involved. *Id.*; Ex-2001, ¶111.

Petitioner appears to recognize this shortcoming elsewhere in the Petition. Specifically, Petitioner alleges that claim 3 would have been obvious because Villar discloses “determining ... track heights of the left rail base, right rail base, left crosstie and right crosstie via well-known machine vision contour line-fitting and orientation comparison algorithms,” and then Petitioner adds that “[s]uch algorithms would necessarily include determining vertical pixel counts for each rail base and crosstie top surface heights.” Petition at 64; *see* Ex-1004, ¶119. Petitioner cites no support for this allegation other than the paragraphs from Villar discussed above, and that contain no such disclosure. Moreover, contrary to Petitioner’s allegations, algorithms using the various techniques Villar discloses—curve fitting, edge detecting, and line fitting—do not necessarily include determining vertical pixel counts. Ex-2001, ¶112. This is evidenced by the fact that the Petition fails to reference a single instance where Villar discloses determining vertical pixel counts

to determine a height. *See* Petition 64-67. Accordingly, claim 3 would not have been obvious based on the combination of Villar, Choros, Casagrande, Szwilski, and Khattak. Ex-2001, ¶112.

B. Claims 8 and 14 are Patentable.

Claim 8 depends on claim 7, while claim 14 depends on claim 13 (which depends on claim 12). Because claims 7, 12, and 13 are patentable for the reasons stated above, claims 8 and 14 are patentable. Further, Petitioner's argument that claims 8 and 14 are unpatentable relies on its reasoning why claim 3 is unpatentable. Petition at 72-73. As stated above, that argument fails.

VIII. CLAIMS 4, 9, AND 15 ARE PATENTABLE OVER THE PRIOR ART CITED IN GROUND 3.

The Petitioner fails to show that claims 4, 9, and 15 are unpatentable over the prior art cited in Ground 3.

A. Claim 4 is Patentable.

Claim 4 depends on claim 2. Because claim 2 is patentable for the reasons stated above, claim 4 is patentable. Further, Petitioner's argument that claim 4 is unpatentable relies on its reasoning why claim elements 1[d] and [e] and claim 2 are unpatentable. Petition at 73-74. As stated above, those arguments fail.

In addition, contrary to Petitioner's argument (Petition at 73-75), Villar, Choros, Casagrande, Szwilski, and Andersson do not disclose or suggest claim 4.

Ex-2001, ¶118. Claim 4 adds the requirement “wherein the step of determining the tilt correction factor is accomplished based upon the left and right rail base heights and a standard tilt correction factor.”

The “standard tilt correction factor” in claim 4 is a factor distinct from the “tilt correction factor” in claim 2. Ex-2001, ¶120. By using different wording to label each “factor,” the plain claim language demonstrates that fact. Also, the principle of claim differentiation further mandates that the terms have distinct meanings because, otherwise, claims 2 and 4 would have the same scope. *See Clearstream Wastewater Sys., Inc. v. Hydro-Action, Inc.*, 206 F.3d 1440, 1446 (Fed. Cir. 2000) (“Under the doctrine of claim differentiation, it is presumed that different words used in different claims result in a difference in meaning and scope for each of the claims.”).

The specification reinforces that conclusion. With reference to the embodiment in Figure 17, it states that “the tilt correction factor (TC)” is “based upon the” “equation: $TC = (H^{Lrail} - H^{Rrail})$.” Ex-1001 at 13:45-49. In other words, the tilt correction factor in that example is the difference measured between the left and right rail base heights due to a tilt in the railway. *See* Fig. 17. In stark contrast, regarding the “standard tilt correction factor,” the specification states:

[D]uring significant empirical and mathematical research for the present invention, a standard tilt correction factor of 0.12 was determined. This tilt correction factor is incorporated into algorithms of the present invention in order to adjust for tilt caused by variations in vehicle suspension, rail height placement standards, and other factors unrelated to rail seat abrasion.

Ex-1001 at 13:11-17.

Accordingly, unlike the “tilt correction factor,” the “standard tilt correction factor” is not merely based on the simple error in vertical height measurements based on tilt of the railway, but instead factors in “variations in vehicle suspension” and “rail height placement standards,” among other “factors unrelated to rail seat abrasion.” Ex-2001, ¶121. Accordingly, claim 4 at a minimum requires the use of another factor, one that is distinct from the “tilt correction factor” required by claim 2, and thus compensates for the tilting not caused by a tilt in the railway. *Id.* Also, because it is a “standard” factor, and stated to be a fixed number (“0.12”) in the specification, the factor is a fixed factor applied to all curves and other parts of the railway. *Id.*

Petitioner alleges that it “would have been obvious to one of ordinary skill in the art to implement a standard tilt correction factor to pre-emptively compensate imaged measurements for such vertical alignment tilt errors through use of a

standard tilt correction factor, as evidenced by, e.g., *Andersson*.” Petition at 74 (emphasis original); *see id.* at 75; Ex-1004, ¶¶134, 136. To the contrary, Andersson does not disclose a “standard tilt correction factor” as recited in claim 4. As Dr. Bovik explains, “Andersson does not disclose a standard tilt correction factor, let alone one distinct from a tilt correction factor. Andersson discloses measuring the tilt of a rail car body as it travels through curves along a portion of railroad track, storing the tilt measurements made on every pass through each curve, and using the individual stored measurements to compensate for the tilt of the rail car body in a subsequent pass through each of the individual measured curves.” Ex-2001, ¶122; *see* Ex-1011 at 3:45–6:18. Thus, “Andersson discloses a database of individual tilt corrections, one for each curve, along a section of track rather than a standard tilt correction factor that is applied to every curve.” Ex-2001, ¶122.

Even Petitioner recognizes that “*Andersson* discloses a control system that uses a stored tilt correction factor ***associated with a track curve*** to tilt a train car body in real-time when the train passes through the track curve.” Petition at 74 (emphasis added). Indeed, Andersson states that “[d]ata about the geometry of each curve track along a route are stored in the train computer in a database in the form of sampled values for the track curvature and the rail superelevation angle for each track curve.” Ex-1011 at 4:1-4. “If the system of Andersson used a standard tilt

correction factor, it would not need to store data about the geometry of each curve along a route in a database.” Ex-2001, ¶123; *see* Ex-1011 at 4:1-4.

Further, “Andersson teaches that it calculates an ‘angular value’ that is ‘multiplied’ ‘by a compensation factor which possibly may vary with the speed of the train through the curve.’” Ex-2001, ¶124; *see* Ex-1011 at 6:38-41. As Dr. Bovik explains, “[a]s is evident from the ’320 patent’s disclosure, the standard tilt correction factor is a fixed number, rather than a variable number that changes from curve to curve, because it adjusts for tilt caused, for example, by variations in vehicle suspension, rail height placement standards, and other factors unrelated to rail seat abrasion, rather than adjusting for the tilt of each individual curve.” Ex-2001, ¶124; *see* Ex-1001 at 13:11-17. Thus, Andersson does not disclose use of a standard tilt correction factor, but a stored tilt correction factor that varies for each individual curve. Accordingly, Andersson’s disclosure cannot render claim 4 unpatentable. Ex-2001, ¶124.

Finally, in Dr. Bovik’s opinion, “a POSITA would not look to Andersson to further modify the combination alleged by Petitioner of Villar, Choros, Casagrande, and Szwilski.” Ex-2001, ¶125. Claim 4 requires use of both the “tilt correction factor” recited in claim 2 and the separate “standard tilt correction factor” recited in claim 4. As Dr. Bovik explains, “[a]ssuming that, as Petitioner asserts, Casagrande

and/or Szwilski combined with Villar and Choros would detect the tilt of the railroad track and compensate for that measured tilt to more accurately determine rail seat abrasion, a POSITA would not add the feature disclosed in Andersson to that combination. Because Andersson measures and stores the tilt in each curve, that measured tilt, and any compensation based on that tilt, includes any tilting in the railway caused by uneven heights of the rails, rail seat abrasion, and other physical conditions in the railway that, based on Petitioner's contention, the systems used in Casagrande and/or Szwilski measure and/or use as compensation for tilt as well. The additional use of the compensation employed by Andersson would thus act to overcompensate for all these other overlapping factors that cause any tilting in the railway, such as those caused by uneven heights of the rails, rail seat abrasion, or other physical conditions in the railway." Ex-2001, ¶125. Claim 4 is patentable for at least these additional reasons.

B. Claims 9 and 15 are Patentable.

Claim 9 depends on claim 7, while claim 15 depends on claim 13 (which depends on claim 12). Because claims 7, 12, and 13 are patentable for the reasons stated above, claims 9 and 15 are patentable. Further, Petitioner's argument that claims 9 and 15 are unpatentable relies on its reasoning why claim 4 is unpatentable. Petition at 76. As stated above, that argument fails.

IX. CONCLUSION

Based on all the evidence, claims 1-17 are patentable over the prior art.

DATE: May 20, 2020

Respectfully submitted,

/C. Kevin Speirs/

C. Kevin Speirs

Registration No. 48,988

CERTIFICATE OF COMPLIANCE

Pursuant to 37 C.F.R. § 42.24(d), the undersigned certifies that above
**PATENT OWNER'S RESPONSE TO PETITION FOR INTER PARTES
REVIEW OF U.S. PATENT NO. 8,081,320**, exclusive of the parts exempted as
provided in 37 C.F.R. § 42.24(b), contains 9,610 words and therefore complies with
37 C.F.R. § 42.24(b)(1).

Dated: May 20, 2020

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CERTIFICATE OF SERVICE

In accord with 37 C.F.R. 42.6(e)(4), the undersigned certifies that a true and correct copy of the foregoing **PATENT OWNER'S RESPONSE TO PETITION FOR INTER PARTES REVIEW OF U.S. PATENT NO. 8,081,320** and **Exhibits 2001-2002** have been served on May 20, 2020 by filing this document through the PTAB's End to End system, with a courtesy copy of the RESPONSE electronically mailed, and the exhibits made available by FTP site, to the following counsel for Petitioner:

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