

UNITED STATES PATENT AND TRADEMARK OFFICE

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BEFORE THE PATENT TRIAL AND APPEAL BOARD

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TETRA TECH CANADA INC.,  
Petitioner

v.

GEORGETOWN RAIL EQUIPMENT COMPANY,  
Patent Owner

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

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**PETITIONER'S REPLY**

The Board correctly instituted review of the challenged claims. In its Patent Owner Response, GREX contends that Petitioner failed to establish that Choros is prior art. But the date declaration and related evidence demonstrate that Choros was publicly accessible at the relevant time. For the unpatentability grounds, GREX's arguments are incorrect and unsupported, improperly apply the legal standards for obviousness, and mischaracterize and ignore record evidence. The Board should thus cancel each challenged claim.

### **I. Choros Is Prior Art**

GREX does not dispute Choros is prior art. Instead, GREX erroneously asserts that Petitioner "fails to show that Choros...is prior art." Response, 1. But the Petition refers to each reference as "issued, published, and/or...filed before June 23, 2009, the earliest proposed priority date," and cites to Choros (Ex-1007) and Rachel Watters' supporting date declaration (Ex-1007, 1-3). Petition, 6-7. Choros' public accessibility is also supported by conventional markers of public accessibility (Ex-1007, 5-7, 14) discussed in Ms. Watters' declaration (*id.*, 1-2).

In response to this record evidence, GREX argues that Petitioner improperly incorporates by reference Ms. Watters' declaration. Response, 2. That is incorrect. The Petition's reference to a few paragraphs of Ms. Watters' supporting declaration testimony to support a distinct point about Choros' public accessibility does not rise to the level of improper incorporation by reference.

GREX's alternative contention that "the cited pages fail to prove that Choros was publicly accessible" (Response, 2) also fails. The Federal Circuit has consistently found librarian date declarations, like Ms. Watters', sufficient to establish indexing, cataloging, and public accessibility of a contested reference. *See, e.g., In re Hall*, 781 F.2d 897, 899 (Fed. Cir. 1986) (finding librarian's affidavit supporting "general library procedure as to indexing, cataloging, and shelving" as "persuasive evidence" of accessibility before the critical date).

It is undisputed that Ms. Watters' statements concerning library procedures are based on her personal experience and knowledge as a University of Wisconsin-Madison librarian and that Ms. Watters is "well informed about the operations of the University of Wisconsin library system, which follows standard library practices." Ex-1007, 1. Instead, GREX argues that Ms. Watters' declaration purportedly "does not indicate how a POSITA would be able to locate Choros by exercising reasonable diligence." Response, 3. That is incorrect.

Ms. Watters testified that the University of Wisconsin-Madison Libraries have "owned" the publication including Choros and had it "cataloged in the system as of July 11, 2007," and made it publicly available to "[m]embers of the interested public," based on at least a "stamp on the verso page," a "cataloging system record" (Ex-1007, 2, 12), and the "[s]tandard operating procedures for materials at the University of Wisconsin-Madison Libraries" (*id.*, 1). Further, Ms. Watters explained

that “[m]embers of the interested public” could have located the publication, including Choros, after July 11, 2007, by “locating it on the library’s shelves or requesting it from WTS,” and “searching the public library catalog or requesting a search through WTS.” *Id.*, 2 (explaining that the “search could be done by title, author, and/or subject words.”). General library procedures for indexing, cataloging, and shelving, like those in Ms. Watters’ declaration, are “persuasive evidence” of accessibility. *Hall*, 781 F.2d at 899. GREX provides no evidence purporting to show that a “[m]ember[] of the interested public”—including a POSITA—would have been unable to locate Choros with a reasonable search.

GREX also complains that Ms. Watters’ declaration at most demonstrates how an interested person could search the Libraries’ catalog to find the conference publication, but not Choros, an excerpt from that publication. Response, 4. But Ms. Watters’ declaration specifically “relates to the dates of receipt and availability” of Choros in the conference publication. Ex-1007, 1; *see also id.*, 1-2 (Ms. Watters identifying the document following her declaration as a “true and accurate copy of the front matter of the *ASME/IEEE 2007 Joint Rail Conference and Internal Combustion Engine Division Spring Technical Conference* (2007) publication,” including “an excerpt of pages 173 to 181 of that volume” showing Choros).

Choros’ public accessibility is further bolstered by conventional markers of public accessibility, including, e.g., copyright date, ISBN number, library date stamp

(*id.*, 6), conference publication date (March 13-16, 2007, *id.*, 7), cataloging system record, (*id.*, 14), and an established publisher (*id.*, 6). These conventional markers, together with Ms. Watters' declaration, demonstrate by a preponderance of evidence that a POSITA could have accessed Choros. GREX provides no credible evidence suggesting otherwise. Choros is therefore prior art.

## **II. Ground 1: Claims 1-2, 5-7, 10-13, and 16-17 of the '320 Patent Are Unpatentable Over Villar, Choros, Casagrande, and Szwilski**

### **A. Claim 1 is Unpatentable**

It is undisputed that automated track inspection machine vision systems, like Villar's, were known before the relevant date. Nor is it disputed that Villar's system generates and analyzes crosstie image data to determine whether crossties have defects. Instead, GREX argues that implementing Villar's system to determine rail seat abrasion ("RSA") pursuant to Choros' RSA method (measuring the vertical distance between rail base and crosstie top surface heights) would not have been obvious because, allegedly, a POSITA "would not have combined a manual method with a machine vision system." Response, 4. That is not so. GREX provides no evidence other than conclusory and unsupported opinions from its expert, Dr. Bovik. *Ericsson Inc. v. Intellectual Ventures I, LLC*, 890 F.3d 1336, 1346 (Fed. Cir. 2018) ("To contradict a reference, an unsupported opinion is not substantial evidence."). Moreover, GREX improperly applies legal standards for obviousness while mischaracterizing and ignoring record evidence.

**1. It Would Have Been Obvious to Implement Villar's Automated Track Inspection System with Choros' RSA Measurement Method**

**a. One Would Have Been Motivated to Make the Combination, Despite GREX's Conclusory Arguments to the Contrary**

As explained in the Petition, Dr. Papanikolopoulos' declaration, and as evidenced by Villar and Choros, a POSITA would have found it obvious to implement Villar's automated track inspection system to determine the presence of RSA by measuring the vertical distance between the rail base and crosstie top surface heights, as taught by Choros. Petition, 25-31, 38-39 (citing Ex-1004, ¶¶41-49, 65-66). A POSITA would have been motivated to make the combination to provide important, reliable, and objective measures of crosstie health, to address and correct (or renew) crossties. Ex-1004, ¶42. Automation through Villar's machine vision would allow for more frequent and accurate measurement of critical track parameters while avoiding time, accuracy, and safety issues associated with human inspectors. Ex-1026, 545-546; Ex-1035, 4; Ex-1036, 1:8-16; Ex-1037, 1:38-55; Ex-1038, 1:14-3:28; Ex-1004, ¶¶42, 44.

In its Response, GREX first contends, relying solely on Dr. Bovik's declaration, that "the references do not teach or suggest" claim 1[e]'s "determining whether rail seat abrasion is present along the railroad track," because Choros "does not disclose a processor that determines or measures rail seat abrasion." Response,

8 (citing Ex-2001, ¶50). By attacking Choros individually and ignoring its combination with Villar, GREX and its expert misapply the legal standards for obviousness when based on a combination of references. *In re Merck & Co., Inc.*, 800 F.2d 1091 (Fed. Cir. 1986). The Petition relies on Villar, not Choros, for claim 1[c]’s processor recitation, and on the combination of Villar and Choros for claim 1[e]’s “determining whether rail seat abrasion is present along the railroad track.”

Again relying solely on Dr. Bovik’s unsubstantiated declaration, GREX next purports that “[i]t is not trivial or obvious to write an algorithm to implement a manual method because,” allegedly, “implementing even the simplest concept into machine vision is very difficult and time-consuming.” Response, 9 (citing Ex-2001, ¶52). That is incorrect and contrary to the record evidence.

GREX provides no legally sufficient reason explaining why implementing Villar’s automated track inspection system to determine RSA by measuring the vertical distance between rail base and crosstie top surface heights, as taught by Choros, would be difficult, time-consuming, or require a special amount of invention and creativity beyond that which a POSITA would find obvious. Moreover, Dr. Bovik’s conclusory statements are contradicted by record evidence demonstrating that automating manual inspection tasks were well-known and targeted for extensive research efforts in railroad and other inspection industries before 2009 to increase inspection rates and reliability, and obviate time, accuracy, and safety issues

associated with manual inspection. Ex-1026, 545-546; Ex-1035, 4; Ex-1036, 1:8-16; Ex-1037, 1:38-55; Ex-1038, 1:14-3:28; Ex-1004, ¶¶42, 44. In fact, Villar—GREX’s own patent—automates manual railroad track inspection tasks including crosstie defects, and contemplates using other known suitable image processing tools and software, including algorithms to determine or detect “other measurable aspects of railroad track.” Villar, ¶43, *see also id.*, ¶¶8, 23, 47, 50, 52.

What’s more, Villar automates misaligned tie plates and sunken tie plate detection (or tie plate cut) (*id.*, ¶55), which GREX’s CEO and technical advisor testified involve “the same, similar type of [measurement] analysis [as RSA].” Ex-1043, 85:16-22 (“We just refer to the one measurement as plate cutting because there’s a tie plate there, and then the other measurement we refer to as rail seat abrasion. There’s no tie plate. But it’s the same, similar type of analysis.”) (emphasis added); Ex-1044, 29:11-12 (“[R]ail seat abrasion is similar to plate cut.”) (emphasis added), 23:17-19. Accordingly, the combination would predictably result in Villar’s system automatically determining the presence of another railroad track defect, RSA, in furtherance of increasing railroad safety. Ex-1004, ¶47.

A POSITA would have also found it obvious to implement Villar’s automated track inspection system to determine RSA in response to the Federal Railroad Administration’s (“FRA”) initiatives to automate RSA detection following two high profile derailments in 2005 and 2006. Petition, 19-20, 26-27 (citing Ex-1016, 1-2;



Ex-1040; Ex-1041, 2-6; Ex-1021, 19; Ex-1020, 81; Ex-1004, ¶43). GREX focuses on the FRA's final rules (Response, 14-15), but ignores the initiatives and proposals promulgated by the FRA's Railroad Safety Advisory Committee ("RSAC") following the derailments, making RSA detection a priority (Ex-1019, 18; Ex-1018, 1, 12, Ex-1020, 81-83). Indeed, GREX ignores evidence from October 27, 2007, discussing formation of the Concrete Crosstie Task Force ("CCTF") and its objective developing manual and automated methods to detect rail seat failure on concrete ties. Ex-1020, 83. GREX also ignores the December 10, 2008, evidence demonstrating the RSAC's approval of a "concrete tie rule" proposing use of automated inspection systems to determine RSA. Ex-1021, 19; Ex-1020, 83; Ex-1016, 1-2; Ex-1040, Ex-1041, 2-6. Worse, GREX's argument contradicts testimony from its CEO regarding the derailments and subsequent industry push to automate RSA detection. Ex-1043, 39:24-40:2 ("[S]omewhere around 2006, 2007, there were a couple of derailments related to that failure mode, and it became a significant industry push to identify areas that had [RSA]."), 40:23-41:1.

GREX also argues that the FRA rules would not have motivated RSA automation because the FRA "clarified that its rules require only the use of automated equipment to 'indicate' areas of... '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." Response, 15. But GREX

misses the point. The 2005 and 2006 derailments and subsequent FRA initiatives and committee actions in 2007 and 2008<sup>1</sup> directed to “develop[ing] manual and automated methods to detect rail seat failure on concrete ties” (Ex-1020, 83) would have provided further motivation to implement an automated track inspection system, like Villar’s, to determine whether RSA is present—regardless of whether the rule later focused on “identifying,” not “measuring” RSA.

**b. Villar Does Not Teach Away from Automating RSA**

GREX provides no legally sufficient explanation why a POSITA would have been discouraged or dissuaded from implementing Villar’s automated track inspection system to determine RSA. *See In re Gurley*, 27 F.3d 551, 553 (Fed. Cir. 1994) (“teaching away” requires a POSITA to be discouraged from pursuing the solution in question). Because Villar does not discourage automating RSA—but rather encourages it—GREX’s teaching away argument plainly fails.

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<sup>1</sup> Contrary to GREX’s parallel argument (Response, 15 n.1), the discussed FRA initiatives and committee actions took place before the relevant date. *See* Ex-1018, 14 (adopted Oct. 18, 2006); Ex-1016 (Nov. 21, 2008); Ex-1040 (Dec. 10, 2008); Ex-1041, 1 (Dec. 10, 2008); Ex-1021, 1 (Dec. 10, 2008); Ex-1020, 81-83 (referring to the events and actions of the RSAC and CCTF in 2006-2008).

GREX and its expert essentially argue that, because Villar discloses that grading crosstie condition visually is “quite time consuming,” Villar “expressly teaches away from the manual measurement and visual inspection disclosed in Choros.” Response, 10-11. GREX’s contention is misguided. The Petition does not propose bodily incorporating Choros’ visual manual inspection of crossties into Villar. Instead, as the Petition presents, the combined teachings of Villar and Choros would have suggested to a POSITA to implement Villar’s automated track inspection system to determine whether RSA is present by measuring the vertical distance between rail base and crosstie top surface heights, as taught by Choros, not the physical or bodily incorporation of Choro’s systems and processes. Petition, 38-45; Ex-1004, ¶¶41-49, 65-76.

Moreover, Villar appreciates the need to regularly inspect track components, including crossties, for deterioration. Villar, ¶¶3-7. Recognizing that manual inspection of crosstie and other railroad track components is time-consuming, Villar concedes that automating manual inspection tasks, including identifying crosstie defects, were well-known and that its systems and methods are not “intended to be limited to the measurable aspects and particular techniques described herein.” *Id.*, ¶43; *see also id.*, ¶¶23, 47, 50, 52, 55. Thus, implementing Villar’s automated system to determine the presence of RSA would simply be an extension of Villar’s own automated track inspection teachings in furtherance of increasing railroad safety.

What's more, Choros discusses using automatic inspection methods, including collecting data on geometry cars as an alternative to manually identifying RSA locations, as well as adjusting parameters based on new field data values "[a]s measurement methodologies improve, either from automated inspection vehicles or hand held devices." Choros, 13 (emphasis added); *see also id.*, 7, 11. GREX contends that, "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." Response, 13. But GREX is wrong because Choros only contemplates using inspectors (and, only in addition to geometry cars) because of the lack of "availability of existing geometry cars." Choros, 11; Ex-1004, ¶45.

**2. Villar, Choros, Casagrande, and Szwilski Render Obvious Claim 1[f]**

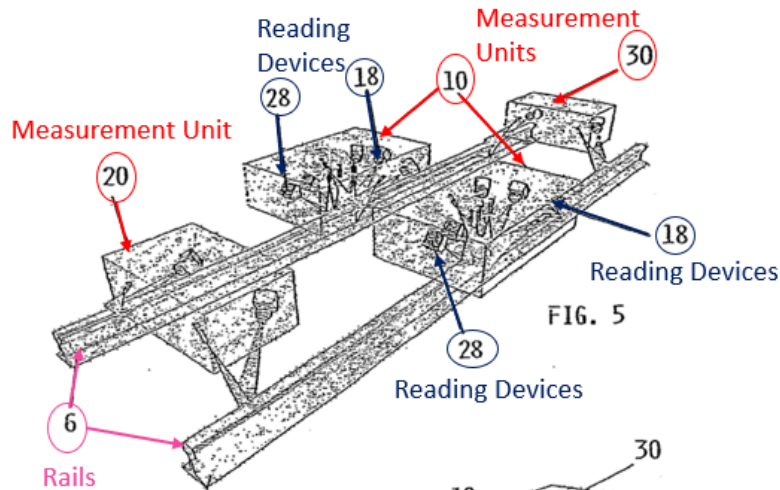
GREX argues that Villar, Choros, Casagrande, and Szwilski "do not disclose or suggest" claim 1[f]'s "wherein, when determining whether rail seat abrasion is present, the at least one processor compensat[ing] for a tilt of the railroad track." Response, 17. But GREX's arguments are incorrect and unsupported, improperly apply the legal standards for obviousness, and mischaracterize and ignore record evidence.

**a. GREX's Individual Attacks on Casagrande Fail**

GREX contends that Casagrande does not disclose claim 1[f]'s "determining whether rail seat abrasion is present," because Casagrande "fails to mention [RSA]." Response, 18. By attacking Casagrande individually, however, GREX misapplies the legal standards for obviousness based on a combination of references. *Merck*, 800 F.2d at 1091. The Petition relies on Casagrande's tilt compensation teachings—not to "determine[e] whether [RSA] is present." As the Petition explains, it would have been obvious to implement Villar and Choros' automated RSA track inspection system with Casagrande's tilt compensation software to automatically compensate imaged railroad component position data (and parameters of the track geometry based the imaged profile data) for railway or tramway carriage vertical alignment (or tilt) errors, when determining the presence of a defect, such as RSA. Petition, 46-50 (citing Casagrande, ¶¶9-12, 30-36; Ex-1004, ¶¶82-84).

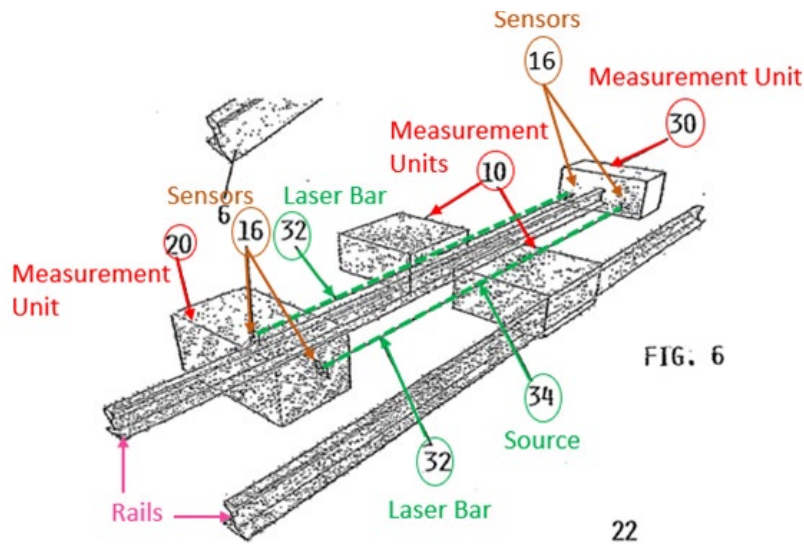
GREX's next contention that Casagrande does not "compensate[] for a tilt of the railroad track," as claim 1[f] requires, also misses the mark. Response, 20. As explained in the Petition, Casagrande's apparatus automatically compensates measured rail profile position data for vertical alignment measurement errors due to "elastic deformation of the railway or tramway carriage." Casagrande, ¶¶9-12, 30-36. As shown below in annotated FIG. 5, Casagrande's apparatus includes a central measurement unit 10 (red), reading devices 18, 28 (navy), and front and rear-end

units 20, 30 (red) with triangulation reading devices for imaging and measuring rail profile position data. Casagrande, ¶¶30-35.



Casagrande, FIG. 5 (annotated).

As shown below in annotated FIG. 6, laser bars 32 (green dashed line) emitted by sources 34 (green) in the central measurement units 10 (red) monitor the position (height) of each triangulation reading device in the end measurement units 20 and 30 (red). *Id.*, ¶36. Sensors 16 (orange) positioned in the end measurement units 20, 30, receive laser bars 32 and can “constitute a precise alignment of the points of measurement.” *Id.* According to Casagrande, any “[l]ack of alignment results in a signal which by means of suitable software is able to automatically compensate the resultant measurement errors.” *Id.*



Casagrande, FIG. 6 (annotated).

GREX argues that Casagrande does not compensate imaged component measurements for tilt, but instead “only for measurement errors caused by ‘oscillations’ or ‘elastic deformation’ of the ‘vehicle,’ ‘railway carriage,’ or ‘tramway carriage.’” Response, 21. That is incorrect. First, GREX ignores Casagrande’s disclosure of automatically compensating imaged position data for vertical alignment measurement errors due to “elastic deformation of the railway or tramway carriage.” Casagrande, ¶36 (emphasis added). GREX also ignores Dr. Papanikolopoulos’ testimony explaining that because Casagrande’s apparatus measures any lack of alignment of “the position in height of each triangulation reading device located in the two end measurement units 20 and 30,” the system detects a vertical alignment error between each triangulation reading device caused by, e.g., a vertical deviation of the railway and/or tramway carriage. Ex-1004, ¶81

(citing Casagrande, ¶36). And Casagrande’s system would detect this vertical deviation regardless of whether the elastic deformation (including vertical deviation, or tilt) to the “railway or tramway carriage,” was intentional (such as from being associated with a track curve) or unintentional (such as from excessive wear).

GREX’s next contention that Casagrande “is incapable of measuring or compensating for ‘tilt of the railroad track’ as element [f] requires,” because allegedly, when Casagrande’s vehicle travels on a tilted track, “the entire vehicle or carriage tilts” “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,” also misses the mark. Response, 21-22. Nothing in Casagrande suggests that railway deformation, including vertical deviation, must occur for each rail concurrently and at an angle causing tilt of an entire vehicle. To the contrary, vertical deviation of a single rail relative to normal (and the opposite rail) may simply lead to the side of a vehicle on the deviated rail to tilt relative to normal—not the entire vehicle. And it is this exemplary vertical deviation of the railway and vehicle that would cause a disturbance in the height alignment between the reading devices (as monitored by the laser bar and sensors), leading Casagrande’s system to detect a vertical alignment error. Ex-1004, ¶81; *see also* ’320 patent, 13:2-10 (explaining that an angular tilt L4 of a crosstie 10 associated with a curved track may tilt “slightly to the left” such that the height of the right rail 12 is slightly taller than left rail 12).



**b. GREX’s Individual Attacks on Szwilski Also Fail**

GREX next turns to Szwilski and contends—like with Casagrande—that the Petition’s combination fails because “Szwilski does not disclose the requirements of [claim 1[f].]” Response, 24. Specifically, GREX complains that Szwilski does not disclose “‘at least one processor’ as part of ‘analyzing the at least one image’ ‘of a profile of at least a portion of the railroad track,’ as recited by elements [b], [c], and [d].” Response, 25. But, like with Casagrande, GREX attacks Szwilski individually and ignores its combination with the other references. *Merck*, 800 F.2d at 1091. The Petition relies on Villar—not Szwilski—for “the at least one processor” recitation of claim 1[f], as well as claim 1[b], 1[c], and 1[d]’s recitations.

Instead, the Petition relies on Szwilski for its teachings of accounting for vertical track errors to accurately represent imaged railroad component position data when determining rail defects. Petition, 50. Szwilski’s automated track inspection platform obtains imaged railroad track component position data. Szwilski (Ex-1009), title, 1, 11, 12. To accurately represent the rail position being surveyed, as Szwilski’s platform travels along inspecting rails 120, it determines and accounts for any “track inclination perpendicular to the track 120a,b (also know[n] as Cross-level inclination).” *Id.*, 16. Otherwise, as Szwilski further explains, the “[p]osition data of the rail [being surveyed] will not be accurate.” *Id.* And, Szwilski recognizes that tilt

corrections “include, but are not limited to, determining rail displacement 234 or other rail 120a,b defects.” *Id.*, 20 (emphasis added).

GREX attacks Szwilski’s role in the combination because, allegedly, “Szwilski’s measurements are unrelated to the position of the rail seats, and thus cannot be used to obtain element [f].” Response, 26. But GREX misses the point. The Petition does not rely upon or propose bodily incorporating Szwilski’s specific systems and processes to determine RSA. Nor is the test whether Szwilski’s features may be physically or bodily incorporated into the references. Instead, the appropriate test is what the combined teachings would have suggested to a POSITA. *In re Keller*, 642 F.2d 413, 425 (CCPA 1981). And Szwilski’s teachings regarding vertical tilt compensation corrections and extending those corrections to “other rail [] defects,” would have suggested to a POSITA 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. Petition, 51-52 (citing Ex-1004, ¶87).

GREX’s further contention 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” (Response, 27), similarly fails because the Petition is not relying on Szwilski to determine RSA, but instead

for its imaged rail defect tilt compensation teachings. And GREX does not dispute that Szwilski's tilt compensation method is accurate.

Villar in combination with Choros, Casagrande, and Szwilski also render obvious claim 1's "at least one processor compensat[ing] for a tilt of the railroad track," to the extent it requires determining the railroad track tilt from the image representative of a profile of the scanned track. Petition, 52-54 (citing Casagrande ¶¶30, 34. Ex-1004, ¶¶88, 90-92). GREX does not dispute that it would have been obvious to implement Villar and Choros' automated RSA track inspection system to determine the vertical tilt of the track from the image representative of a profile of the scanned railroad track, as taught by Casagrande. Nor does GREX dispute why a POSITA would have implemented Villar and Choros with Casagrande's and Szwilski's tilt compensating teachings. Instead, GREX asserts that "even if a POSITA had sufficient reason to combine the references, the combination lacks element [f]'s features," because, allegedly, "neither Casagrande nor Szwilski disclose or suggest any capability for making measurements relating to the rail seats, and thus both are incapable of compensation for a tilt in the railroad track in making that determination." Response, 31. But again, the Petition relies upon Casagrande and Szwilski's teachings compensating imaged rail defect measurements for railway or vehicle tilt—not the RSA determination. The teachings of the combination render obvious claim 1[f].

**B. Claim 2 is Unpatentable**

GREX's only additional argument for claim 2 is that "[n]one 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." Response, 32. Specifically, GREX argues that "neither Casagrande nor Szwilski" "use those terms or any similar term, or disclose or suggest the application of any similar concept." *Id.* That is incorrect. When addressing claim 2[c]'s "tilt correction factor," the Petition cites to claim 1[f]'s analysis and further relies on Dr. Papanikolopoulos' unrebutted testimony that a POSITA "would have [] understood that the value used to compensate the RSA measurement for any vertical alignment or tilt error would constitute the claimed 'tilt correction factor.'" Petition, 55. Also, when addressing claim 2[d]'s "actual delta," the Petition cites to claim 1[e]'s analysis, and further relies on Dr. Papanikolopoulos' unrebutted testimony (Ex-1004, ¶97), explaining that because Villar and Choros' RSA railroad inspection vision system determines the distance between the rail base and crosstie heights for both sides, Villar's system determines an "actual delta" for the right and left rail bases (Petition, 56).

**C. Claim 5-7, 10-13, and 16-17 Are Unpatentable**

GREX does not separately argue the patentability of independent claims 7 and 12 (which recite features similar to claims 1 and 2), or the patentability of claims 5-

6, 10-11, 13, and 16-17 (which depend from one of claims 1, 2, 7, and 12). Therefore, these claims are unpatentable for the reasons provided above and in the Petition.

### **III. Ground 2: Claims 3, 8, and 14 Are Unpatentable Over Choros, Casagrande, Szwilski, and Khattak**

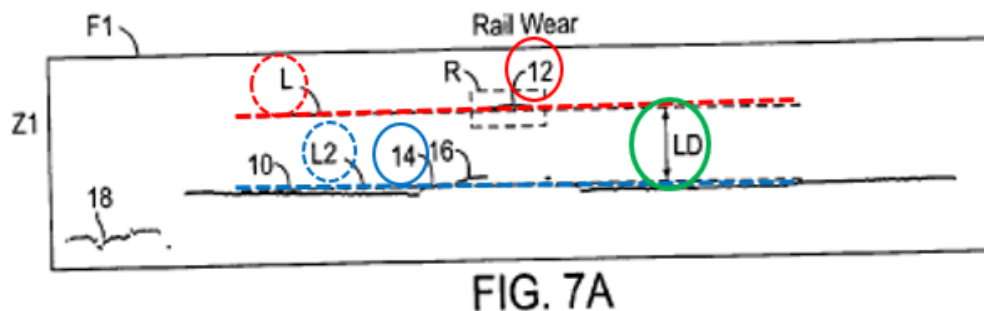
#### **A. Claim 3 is Unpatentable**

GREX alleges that the cited references do not disclose or suggest claim 3 because, allegedly, “Villar does not disclose determining vertical pixel counts for determining any height measurement.” Response, 36. That is incorrect. As presented in the Petition, Villar’s automated track inspection system generates images representative of a profile of a portion of a railroad track. Petition, 22, 35 (citing Villar, ¶35). Each image includes pixels “given X-Y coordinates,” showing the height contour of the imaged components along the track. Petition, 22, 35 (citing Villar, ¶¶24-25, 27, 31-32, 35). To identify track components, Villar analyzes the images for pixels indicating presence of a railroad track component. Petition, 64-65 (citing Villar, ¶¶35, 46, 49; Ex-1004, ¶119). Villar’s system then assesses the imaged components for potential defects through, e.g., contour line-fitting and orientation comparison algorithms, including for certain defects, comparing height contours of the imaged components. Petition, 40-44, 65-66 (citing Villar, ¶¶43, 47, 50, 52, 53, 55, FIGS. 7A, 8; Ex-1004, ¶¶69-74, 119-122.).

GREX argues that Villar does not disclose determining vertical pixel counts because ¶¶47, 50, 52, and 55 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.” Response, 36-37. That is not so.

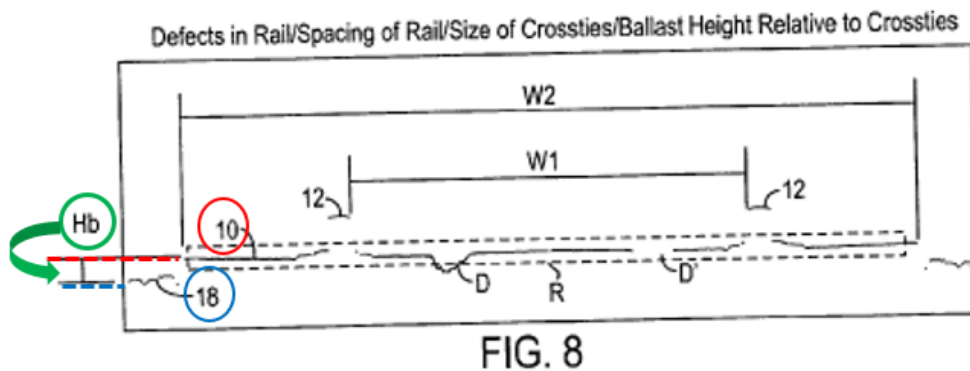
Although paragraphs ¶¶47, 50, 52, 55 of Villar do not recite “pixel,” Villar uses this term when explaining that the image “includes a plurality of pixels given X-Y coordinates” (Villar, ¶35; *see also id.*, pp. 15-16 (claims 11, 33, 55), FIGS. 3-10) and when analyzing the generated images for pixels indicating presence of a railroad track component (*id.*, ¶¶46, 49). Moreover, the cited paragraphs of Villar relate to orientation comparison algorithms, including measuring distances between railroad track components from the image data. In one example, shown below in annotated FIG. 7A, Villar discloses identifying rail wear by determining a “measurable distance,” LD (green) between level L (red dashed line) and reference level L2 (blue dashed line)—levels representing the respective height contours of the imaged pixel coordinates of the rail and tie plate in frame F1. *Id.*, ¶50.



Villar, FIG. 7A (annotated).

In another example, shown below in annotated Fig. 8, Villar discloses determining height of ballast 18 (blue dashed line) relative to crosstie 10 (red dashed

line) by determining the height  $H_b$  (green) of the imaged ballast height contour relative to the crosstie height contour. *Id.*, ¶53; *see also id.*, ¶43 (Villar explaining that “other measurable aspects of the railroad track can be determined or detected from the image data of the track bed.”) (emphasis added). As Dr. Papanikolopoulos testified, a POSITA would have understood that these disclosures of Villar regarding determining the measurable distance, LD, and height,  $H_b$ , and other “measurable aspects” between the height contours of imaged railroad track components “from the image data” would have included the step of determining vertical pixel counts. Ex-1004, ¶¶69-74, 119-122.



Villar, FIG. 8 (annotated).

GREX and its expert provide no legally sufficient reason explaining why Villar’s disclosures of determining distance, height, and other measurable aspects of the railroad track “from the image data of the track bed”—“includ[ing] a plurality of pixels given X-Y coordinates”—are not determined based on vertical pixel counts, as testified by Dr. Papanikolopoulos. *See id.* GREX contends that “algorithms using

the various techniques Villar discloses—curve fitting, edge detecting, and line fitting—do not necessarily include determining vertical pixel counts.” Response, 37. But GREX ignores Dr. Papanikolopoulos’ testimony concerning Villar’s orientation comparison algorithms, discussed above. Nor does GREX or its expert purport to describe any alternative method Villar uses to determine these measurable aspects from the pixels of the imaged railroad components.

GREX and its expert’s conclusory statements are further contradicted by record evidence confirming Villar’s pixel measurement technique. *See, e.g.*, Khattak, 6:36-37 (“the apparatus 10 is designed with an approximate 0.1 of an inch/pixel resolution”), 10:45-48, 57-11:16, 13:54-14:43 (determining length, width, and size of imaged surface distress features via frame pixel data), FIGS. 9, 14C; Ex. 1026, 553 (determining  $\Delta H$  (FIG. 7(a)), and defect parameters  $S_h$ ,  $S_l$ ,  $S_b$ , and broken length,  $W$  by “counting” pixels), 554, FIG. 8 ( $S_h$ ,  $S_l$ ,  $S_b$ , and  $W$ ), 558, FIG. 14 (showing distributions of parameters  $S_h$ ,  $S_l$  and  $S_b$  determined via pixel count); Ex-1029, 133-134 (using imaged pixel positions and “COUNT” functions to determine true object positions and other geometrical features); Ex-1024, 151-152, 226-230 (using “COUNT” functions to determine object position and other parameters from imaged pixel data), FIGS. 5.12, 12.1. Even GREX’s expert has recognized the well-known pixel measurement technique in 2008. Ex-1045, 130 (determining the length and width of imaged lesions by “computing the pixel distance” and further



explaining that “[s]ince the resolution of the images is known, the pixel measurement can be converted into physically meaningful quantities (e.g., mm)”).

**B. Claims 8 and 14 Are Unpatentable**

GREX does not separately argue the patentability of claims 8 and 14, which recite features similar to claim 3. Therefore, these claims are unpatentable for the reasons provided above and in the Petition.

**IV. Ground 3: Claims 4, 9, and 15 are Unpatentable Over Choros, Casagrande, Szwilski, and Andersson**

**A. Claim 4 is Unpatentable**

Contrary to GREX’s argument, nothing in the intrinsic record requires the standard tilt correction factor of claim 4 to be a distinct value from the tilt correction value of claim 2—nor be limited to “variations in vehicle suspension” and “rail height placement standards,” among other “factors unrelated to rail seat abrasion.” Response, 40. Instead, GREX drafted claim 4 broadly to only require “a standard tilt correction factor.” Ex-1001, 16:6-9. Nothing in the claim’s plain language precludes the standard tilt correction factor from being a sub-category of claim 1’s tilt correction factor, such as one developed to pre-emptively compensate imaged measurements for known vertical alignment tilt errors associated with upcoming track geometries. Petition, 74-75.

The ’320 specification, including at 12:63-13:17, likewise provides no disclaimer or definition mandating GREX’s interpretation. Instead, the cited portion

simply refers to an “exemplary embodiment” (*id.*, 12:63-13:20) describing a tilt correction factor incorporated into algorithms to adjust for tilt caused by variations in vehicle suspension, rail height placement stands, and other factors unrelated to rail seat abrasion; it does not provide any definition or disclaimer requiring importation into the claim. Indeed, “it is improper to read limitations from a preferred embodiment described in the specification—even if it is the only embodiment—into the claims absent a clear indication in the intrinsic record that the patentee intended the claims to be so limited.” *Liebel-Flarsheim Co. v. Medrad, Inc.*, 358 F.3d 898, 913 (Fed. Cir. 2004). The Board should reject GREX’s attempt to improperly convert the specification description into an express definition of “standard tilt correction factor.”

GREX’s next argument that Andersson does not disclose “a standard tilt correction factor, but a stored tilt correction factor that varies for each individual curve,” (Response, 41-42) similarly falls flat because neither the claim’s plain language nor the specification require applying the same standard tilt correction factor along each section of the track, as GREX suggests. That the specification provides a single-value tilt correction factor that was “[a]ccordingly” determined following the “example” of a single curve within a track does not require GREX’s interpretation to be read into the claim. ‘320 patent, 12:66-13:11.

GREX's final argument that a POSITA would not have looked to Andersson to further modify the references because the "additional use of the compensation employed by Andersson" would "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" (Response, 43) also is misplaced. As presented in the Petition, it would have been obvious to a POSITA to have implemented a standard tilt correction factor, as taught by Andersson, to pre-emptively compensate imaged measurements for known vertical alignment tilt errors associated with an upcoming track geometry. Petition, 75 (citing Ex-1004, ¶136). Thus, contrary to GREX's assertions, this modification would operate to pre-empt—not overcompensate—for known tilt errors associated with upcoming track geometries.

#### **B. Claims 9 and 15 Are Unpatentable**

GREX does not separately argue the patentability of claims 9 and 15, which recite features similar to claim 4. Therefore, these claims are unpatentable for the reasons provided above and in the Petition.

**V. CONCLUSION**

For the reasons set forth above and in the Petition, the challenged claims are unpatentable and should be canceled.

Respectfully submitted,

Dated: August 12, 2020

By: /Aaron L. Parker/  
Aaron L. Parker, Lead Counsel  
Reg. No. 50,785

**CERTIFICATE OF COMPLIANCE**

The undersigned hereby certifies that the foregoing **PETITIONER’S  
REPLY** contains 5,593 words, excluding those portions identified in 37 C.F.R. §  
42.24(c)(1), as measured by the word-processing system used to prepare this paper.

Respectfully submitted,

Dated: August 12, 2020

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**CERTIFICATE OF SERVICE**

The undersigned hereby certifies that a copy of the foregoing **PETITIONER'S REPLY**, was served on August 12, 2020, via email directed to counsel of record for the Patent Owner at the following:

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