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Paper 10
Entered: November 4, 2014

UNITED STATES PATENT AND TRADEMARK OFFICE

BEFORE THE PATENT TRIAL AND APPEAL BOARD

BRAINLAB, AG AND VARIAN MEDICAL SYSTEMS, INC.,
Petitioner,

v.

SARIF BIOMEDICAL LLC,
Patent Owner.

Case IPR2014-00753
Patent 5,755,725

Before MICHELLE R. OSINSKI, SCOTT E. KAMHOLZ, and DAVID C. MCKONE, *Administrative Patent Judges.*

OSINSKI, *Administrative Patent Judge*.

DECISION

Institution of *Inter Partes* Review
37 C.F.R. § 42.108

I. INTRODUCTION

A. Background

Brainlab AG and Varian Medical Systems, Inc. ("Petitioner") filed a Petition (Paper 1, "Pet.") requesting an *inter partes* review of claims 1–11 of U.S. Patent No. 5,755,725 (Ex. 1001, "the '725 patent"). Sarif Biomedical LLC ("Patent Owner") filed a Preliminary Response (Paper 9, "Prelim. Resp."). We have jurisdiction under 35 U.S.C. § 314, which provides that an *inter partes* review may not be instituted "unless . . . there is a reasonable likelihood that the petitioner would prevail with respect to at least 1 of the claims challenged in the petition." 35 U.S.C. § 314(a).

Upon consideration of the Petition and Preliminary Response, we determine that there is a reasonable likelihood that Petitioner would prevail with respect to claims 10 and 11 of the '725 patent, but not with respect to claims 1–9. Accordingly, we institute an *inter partes* review of claims 10 and 11 of the '725 patent.

B. Related Proceedings

The parties represent that the '725 patent is the subject of the following district court proceedings: (1) *Sarif Biomedical LLC v. Brainlab Inc.*, Case No. 1:13-cv-00846-LPS (D. Del.); (2) *Sarif Biomedical LLC v. Siemens Medical Solutions USA Inc.*, Case No. 1:13-cv-00847-LPS (D. Del.); and (3) *Sarif Biomedical LLC v. Accuray, Inc.*, Case No. 1:13-cv-00151-LPS (D. Del.). Pet. 2; Patent Owner's Mandatory Notices, Paper 8, 2.

C. The '725 Patent

The '725 patent relates to computer-assisted microsurgery equipment or methods for controlling same. Ex. 1001, Abstr.; 10:62–12:65 (claims 1–11). Figures 1a–1d of the '725 patent are reproduced below.

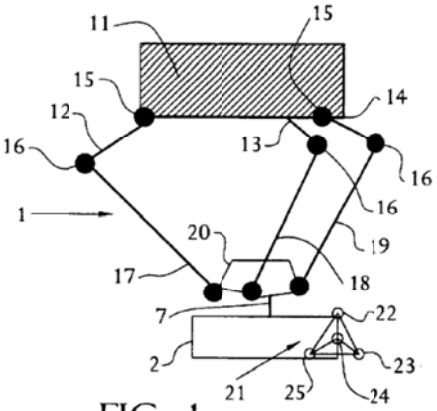

FIG. 1a

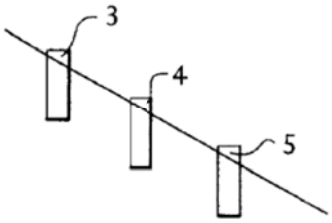

FIG. 1b

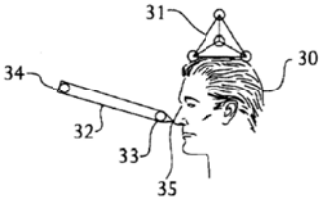

FIG. 1c

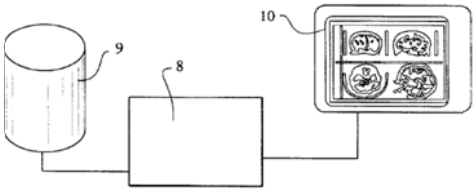

FIG. 1d

Figures 1a–1d depict schematic views of computer-assisted microsurgery equipment. *Id.* at 3:59–60. As illustrated in Fig. 1a, the equipment includes articulated tool support 1, one end of which (i.e., base 11) is integral with fixed reference frame R_c (e.g., the ceiling of the operating room). *Id.* at 4:5–7. Articulated tool support 1 comprises trihedron 21 made up of an assembly of four light points (e.g., electroluminescent diodes) 22–25. *Id.* at 4:23–26.

As illustrated in Fig. 1b, cameras 3, 4, 5 are integral with fixed reference system R_c and output an electrical signal enabling the calculation

at any moment of the position of the center of gravity of trihedron 21 and its orientation in fixed reference system R_c. *Id.* at 4:5–7. As illustrated in Fig. 1c, patient 30 carries trihedron 31 that allows cameras 3, 4, 5 to output an electrical signal enabling calculation at any moment of the position of the center of gravity of trihedron 31 and its orientation in fixed reference system R_c. *Id.* at 4:37–41.

As illustrated in Fig. 1d, the equipment further includes device 9 for storing digitized images. *Id*. at 4:3. The images may originate from an imaging system in image reference system R_i. *Id*. at 2:67–3:2. Images may be acquired by MRI, angiography, radiography, tomodensitometry, etc. *Id.* at 5:28–30. The '725 patent describes that the equipment "enables the implementation of correspondence between the images acquired and linked to the patient, with the tool. The localization should be possible no matter the position of the tool and the patient." *Id.* at 5:56–59.

D. Illustrative Claims

Claims 1 and 10 are illustrative of the claimed subject matter and are reproduced below.

> 1. A computer-assisted microsurgery installation, comprising:
>
> (a) an articulated tool support. one end of which is integral with a fixed reference frame R_c;
>
> (b) an image data base comprising images in an image reference frame R_i;
>
> (c) at least two sensors, integral with the fixed reference frame R_c, supplying a signal that is a function of the position of a reference frame R_p of a patient in the fixed reference frame R_c;
>
> (d) a computer adapted to:
>
> (1) determine correspondence of a reference frame R_o of the tool with the patient reference frame R_p and the

image reference frame R_i as a function of the signal from the at least two sensors;

(2) output a display signal for visualization of position of the tool in the image reference frame R_i on a control screen; and

(3) control position and displacements of the tool as a function of control signals originating from a control unit wherein the fixed reference frame R_c is independent of the patient reference frame R_p and of the image reference frame R_i; and

(e) means for determining coordinates of the tool in the fixed reference system R_c based on data from the image data base.

10. A method for performing microsurgery using a microsurgery tool, comprising the steps of:

(a) determining the position of the tool in a reference frame R_c of a camera by a transformation ${}^{m1}T_c$, giving the relation between a reference frame R_o of the tool and a fixed reference frame R_{ml}, and a transformation ${}^{o}T_{m1(t)}$, giving the relation between the camera reference frame R_c and the fixed reference frame R_{m1} determined in real time by optical measurement;

(b) determining a transformation T_{m2} giving the relation between an image reference frame R_i and a fixed reference frame R_{m2};

(c) determining the position of the fixed reference frame R_{m2} in relation to the camera reference frame R_c by a transformation ${}^{m2}T_{c(t)}$ determined in real time by optical measurement;

(d) calculating a transformation ${}^{i}T_{o(t)} = {}^{i}T_{m2}\ {}^{m2}T_{o(t)}\ {}^{o}T_{m1(t)}\ {}^{m1}T_o$, giving the relation between the image reference frame R_i and the tool reference frame R_o to display in real time a section corresponding to a point of interest indicating the position of the tool in relation to a prerecorded image; and

(e) performing the microsurgery based on the real-time display of the section.

E. The Asserted Grounds of Unpatentability

Petitioner contends that claims 1–11 of the '725 patent are unpatentable based on the following specific grounds.

Claims challenged	Basis	References
1	§ 102(b)	Allen[1]
1	§ 103(a)	Allen
2 and 5	§ 103(a)	Allen and Heilbrun[2]
8	§ 103(a)	Allen and Schulz[3]
1 and 8	§ 103(a)	Schulz and Taylor[4]
2 and 5	§ 103(a)	Schulz, Taylor, and Heilbrun
3, 4, 6, and 7	§ 103(a)	Schulz, Taylor, Heilbrun, and Henrion[5]
9	§ 103(a)	Schulz, Taylor, Heilbrun, Henrion, and Allen
10	§ 103(a)	Schulz and Heilbrun
11	§ 103(a)	Schulz, Heilbrun, and Glassman[6]

[1] Allen, US 4,991,579 (issued Feb. 12, 1991) ("Allen," Ex. 1005).
[2] Heilbrun et al., US 5,389,101 (issued Feb. 14, 1995) ("Heilbrun," Ex. 1002).
[3] Schulz, US 5,622,170 (issued Apr. 22, 1997) ("Schulz," Ex. 1004).
[4] Taylor, US 5,445,166 (issued Aug. 29, 1995) ("Taylor," Ex. 1006).
[5] Henrion et al., US 5,868,675 (issued Feb. 9, 1999) ("Henrion," Ex. 1011).
[6] Glassman et al., US 5,086,401 (issued Feb. 4, 1992) ("Glassman," Ex. 1008).

II. DISCUSSION

A. Claim Construction

In an *inter partes* review, the Board interprets claim terms in an unexpired patent[7] using the broadest reasonable construction. 37 C.F.R. § 42.100(b); Office Patent Trial Practice Guide, 77 Fed. Reg. 48,756, 48,766 (Aug. 14, 2012). Claim terms generally are given their ordinary and customary meaning, as would be understood by one of ordinary skill in the art in the context of the entire disclosure. *In re Translogic Tech., Inc.*, 504 F.3d 1249, 1257 (Fed. Cir. 2007). Although Petitioner submits constructions for five terms, we determine that only the term "means for determining coordinates of the tool in the fixed reference frame R_c based on data from the image data base" as recited in claim 1 requires construction for our determination of whether to institute trial.

"An element in a claim for a combination may be expressed as a means . . . for performing a specified function without the recital of structure, material, or acts in support thereof, and such claim shall be construed to cover the corresponding structure, material, or acts described in the specification and equivalents thereof." 35 U.S.C. § 112 ¶ 6.[8] A

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[7] We note that the '725 patent will expire on May 26, 2015, and that "the Board's review of the claims of an expired patent is similar to that of a district court's review." *In re Rambus, Inc.*, 694 F.3d 42, 46 (Fed. Cir. 2012).

[8] Section 4(c) of the Leahy-Smith America Invents Act (AIA) re-designated 35 U.S.C. § 112 ¶ 6, as 35 U.S.C. § 112(f). Because the '725 patent has a filing date before September 16, 2012 (effective date of the statute), we will refer to the pre-AIA version of 35 U.S.C. § 112.

limitation using the term "means for" creates a rebuttable presumption that the drafter intended to invoke 35 U.S.C. § 112 ¶ 6. When construing a means-plus-function limitation under 35 U.S.C. § 112 ¶ 6, we must first identify the claimed function, and then we look to the specification to identify the corresponding structure that performs the claimed function. *Medical Instrumentation & Diagnostics Corp. v. Elekta AB*, 344 F.3d 1205, 1210 (Fed. Cir. 2003); *Cardiac Pacemakers, Inc. v. St. Jude Med., Inc.*, 296 F.3d 1106, 1119 (Fed. Cir. 2002). With respect to the second step, "structure disclosed in the specification is 'corresponding' structure only if the specification or prosecution history clearly links or associates that structure to the function recited in the claim." *Golight, Inc. v. Wal-Mart Stores Inc.*, 355 F.3d 1327, 1334 (Fed. Cir. 2004) (citations and quotation marks omitted).

Petitioner and Patent Owner agree that the "means for determining coordinates" clause of claim 1 should be construed in accordance with 35 U.S.C. § 112 ¶ 6. Pet. 22; Prelim. Resp. 2. Petitioner submits that there is no disclosure in the specification of "how the position of the tool could be found in the camera coordinate system R_c 'based on data from the image data base'" as the specification describes that determining coordinates of the tool in fixed reference frame R_c is accomplished with the use of cameras, not data from the image data base. Pet. 23–24 (citing Ex. 1014 ¶ 38; Ex. 1001, 3:39–43, 4:27–33, 10:34–37). Petitioner asserts that the "means-plus-function clause . . . cannot be construed because structural support is lacking in the specification," but proceed to construe the phrase for purposes of *inter partes* review as "a computer that determines the coordinates of the tool in the fixed reference frame R_c based on images obtained by the 'at least two

sensors'" under the assumption that Patent Owner would urge such a construction. Pet. 22, 24.

We do not adopt Petitioner's proposed construction of the means-plus-function limitations. Petitioner urges a construction that improperly adopts a function different from that recited in the claim. Petitioner proposes a construction that recites the function as determining the coordinates of the tool in the fixed reference frame based on images from at least two sensors, rather than the image data base. "[A] court may not construe a means-plus-function limitation 'by adopting a function different from that explicitly recited in the claim.'" *JVW Enters., Inc. v. Interact Accessories, Inc.*, 424 F.3d 1324, 1331 (Fed. Cir. 2005) (quoting *Micro Chem., Inc. v. Great Plains Chem. Co.*, 194 F.3d 1250, 1258 (Fed. Cir. 1999) (determining that the district court impermissibly added unclaimed functional limitations of "unlocking" and "releasing" to the means-plus-function limitation of "means for lockably receiving a video game controller")). Moreover, Petitioner improperly imports the functions of a working embodiment into the claims, rather than looking at the claim language itself. *See JVW Enters., Inc.*, 424 F.3d at 1331 (quoting *Rodime PLC v. Seagate Tech., Inc.*, 174 F.3d 1294, 1303 (Fed. Cir. 1999) ("[A] court errs 'by importing the functions of a working device into the[] specific claims, rather than reading the claims for their meaning independent of any working embodiment.'")).

Patent Owner, on the other hand, construes the means-plus-function limitation as "an algorithm or software running on a computer system that 'obtains the transformation ${}^{o}T_{i(t)}$, inverse of ${}^{i}T_{o(t)}$, making it possible to automatically control the tool in real time in relation to a target defined in

the image data base.'" Prelim. Resp. 1–2 (citing Ex. 1001, 10:52–55). Patent Owner asserts that a relationship between a reference frame of a tool and the image reference frame is determined "by knowing the position of the tool in the fixed reference frame, determining the correlation between the fixed reference frame and the image reference frame, and computing the transformation ${}^{i}T_{o(t)}$." Prelim. Resp. 3 (citing Ex. 1001, 10:34–51). Patent Owner also asserts that the converse is given by the inverse transformation ${}^{o}T_{i(t)}$. *Id*. Patent Owner further asserts that all of the steps of the algorithm required to compute the inverse transformation ${}^{o}T_{i(t)}$ are provided in the specification both in mathematical formulae and prose. *Id*. at 3–4.

We must determine, looking at the disclosure of the '725 patent, whether one of skill in the art would have understood the disclosure to encompass an algorithm or software for determining the coordinates of the tool in the fixed reference system based on data from the image data base, "not simply whether one of skill in the art would have been able to write such a software program." *Medical Instrumentation & Diagnostics Corp.*, 344 F.3d at 1212 (citing *Amtel Corp. v. Info. Storage Devices, Inc.*, 198 F.3d 1374, 1380 (Fed. Cir. 1999)). Although the specification of the '725 patent refers to "[i]mplementation of concordance between the image reference frame and the tool reference frame," "obtain[ing] the transformation ${}^{o}T_{i(t)}$, inverse of ${}^{i}T_{o(t),}$" and "making it possible to automatically control the tool in real time in relation to a target defined in the image data base," there is insufficient indication that one of skill in the art would have understood the disclosure to refer to algorithms or software for determining the coordinates of the tool in the fixed reference system based on data from the image data base. Ex. 1001, 10:28–32, 52–55. In other words, algorithms disclosed in

the ’725 patent are not clearly linked to the claimed function. Because there is nothing in the specification that clearly links or associates an algorithm or software with determining the coordinates of the tool in the fixed reference frame based on data from the image data base, there is no disclosed corresponding structure for the “means for determining coordinates of the tool in the fixed reference system R_c based on data from the image data base” as recited in claim 1. For these reasons, we determine that the recitation “means for determining coordinates of the tool in the fixed reference frame R_c based on data from the image data base” cannot be construed. *See In re Aoyama*, 656 F.3d 1293, 1298 (Fed. Cir. 2011) (quoting *Enzo Biochem, Inc. v. Applera Corp.*, 599 F.3d 1325, 1332 (Fed. Cir. 2010) (“If a claim is indefinite, the claim, by definition, cannot be construed.”)).

B. Challenges Against Independent Claim 1 and its Dependent Claims 2–9

As indicated in the claim construction section, *supra*, we are unable to arrive at an interpretation of the “means for determining coordinates of the tool in the fixed reference system R_c based on data from the image data base” as recited in claim 1 due to the lack of disclosed structure clearly linked or associated with the claimed function of determining the coordinates of the tool in the fixed reference frame based on data from the

image data base. Consequently, claim 1 is not amenable to construction, and, therefore, we do not institute *inter partes* review.[9]

Petitioner applies additional prior art, i.e., Heilbrun and Henrion, in addition to Allen, Schulz, and Taylor, against dependent claims 2–9 which depend from independent claim 1. Pet. 42–48. For the same reasons as set forth in connection with the challenge of independent claim 1, we do not institute an *inter partes* review of dependent claims 2–9.

C. Obviousness of Claim 10 Over Schulz and Heilbrun

1. Overview of Schulz

Schulz discloses an image-guided surgical system for performing microsurgery on a patient. Ex. 1004, 5:4–8, Figs. 1B–2. Images of a patient can be taken by computed tomography (CT) or magnetic resonance imaging (MRI), and the images are stored in database 40. *Id*. at 6:17–26. Three light sensors 20, 22, 24 track the position of probe 12 and cranium 11 of a patient. *Id*. at 5:42–49, 13:44–49. Computer 36 displays an image of the patient from the database that corresponds to the position of the tip of probe 12. *Id*.

[9] Even if the means-plus-function limitation of independent claim 1 were amenable to construction, Petitioner's challenges are premised on Petitioner's erroneous claim construction in which the coordinates of the tools in the fixed reference system are determined based on sensors, not data from the image data base. Pet. 32–33, 41 (citing Ex. 1004, 6:26–45; Ex. 1005, 14:52–56). Consequently, Petitioner does not explain in the Petition how Allen or the combination of Schulz and Taylor discloses or teaches means for determining coordinates of the tool in the fixed reference system *based on data from the image data base* as recited in independent claim 1.

at 14:4–11. A surgeon can perform surgery guided by the displayed image. *Id*. at 5:4–8, Fig. 2.

2. Overview of Heilbrun

Heilbrun discloses a pair of video cameras "positioned for making a pair of images along respective sightlines 204, 206, of a medical workspace 208 which includes a patient's body region." Ex. 1002, 5:6–17, Fig. 2. Heilbrun further discloses that "[t]he apparatus develops a calibrated 3 dimensional framework of the workspace from a pair of 2D images made from different fixed locations, and aligns the workspace framework with a 3D scan framework defined by a volume scan. A pair of video cameras is the present preferred imaging means for obtaining the 2D image pairs." *Id*. at 3:10–15.

3. Obviousness of Claim 10

Petitioner alleges that independent claim 10 would have been obvious over Schulz and Heilbrun. Pet. 48–53. Petitioner relies on Schulz for every element of independent claim 10 except for the recitation of cameras. *Id*. at 48. Petitioner argues that Heilbrun "recite[s] cameras and uses them for the same purpose as Schulz . . . uses light sensors: to optically track surgical instruments." Pet. 51 (citing Ex. 1002, 3:10–15, 7:56–68). Petitioner argues that a person having ordinary skill in the art "would appreciate that cameras . . . could be substituted for the light sensors disclosed in Schulz." Pet. 51 (citing Ex. 1014 ¶ 67).

With respect to the remaining elements of claim 10, Petitioner argues that Schulz inherently practices the mathematical transformations that correlate the three-dimensional coordinate system of the preoperative images to the position of the surgical tool in the fixed coordinate system. Pet. 48

(citing Ex. 1018 ¶¶ 13–14). More particularly, Petitioner argues that Schulz discloses determining the position of the tool in reference frame R_c of a camera by, firstly, a transformation ${}^{m1}T_o$, giving the relation between reference frame R_o of the tool and fixed reference frame R_{m1}. Pet. 49. In support of this argument, Petitioner contends that (i) probe 12 includes light emitters 14, 16 forming a fixed reference frame equivalent to fixed reference frame R_{m1} (Pet. 50; Ex. 1018 ¶ 16); (ii) tip 18 of probe 12 is equivalent to reference frame R_o of the tool (Pet. 50; Ex. 1018 ¶ 16); and (iii) because the relationship between light emitters 14, 16 and tip 18 of probe 12 is known, the transformation ${}^{m1}T_o$ is known (Pet. 50; Ex. 1018 ¶ 16).

Petitioner further argues that Schulz discloses determining the position of the tool in reference frame R_c of a camera by, secondly, a transformation ${}^{c}T_{m1(t)}$, giving the relation between camera reference frame R_c and fixed reference frame R_{m1} determined in real time by optical measurement. Pet. 49–50. In support of this argument, Petitioner explains that (i) light sensors 20, 22, 24 are located at known positions and orientations with respect to predetermined reference coordinate system 80 equivalent to camera coordinate system R_c (Pet. 50; Ex. 1018 ¶ 15); (ii) sensors 20, 22, 24 determine the three-dimensional location of emitters 14, 16 and compute their coordinates in predetermined coordinate system 80 (Pet. 50; Ex. 1018 ¶ 17); and (iii) this calculation is expressed mathematically as the transformation ${}^{c}T_{m1(t)}$ (Pet. 50; Ex. 1018 ¶ 17).

Petitioner also argues that Schulz discloses determining a transformation ${}^{i}T_{m2}$ giving the relation between image reference frame R_i and fixed reference frame R_{m2} of the patient. Pet. 51–52. In support of this argument, Petitioner explains that (i) reference points 71, 73, 75 are

measured and recorded relative to the coordinate system of the imaging device equivalent to image reference frame R_i (Pet. 51; Ex. 1018 ¶ 18); (ii) reference emitters 70, 72, 74 are attached to the patient and define fixed reference frame R_{m2} (Pet. 51; Ex. 1018 ¶ 18); and (iii) correlation between the reference system of the image and the emitters on the patient is expressed mathematically as the transformation ${}^{i}T_{m2}$ (Pet. 51–52; Ex. 1018 ¶ 18).

Petitioner also argues that Schulz discloses determining the position of fixed reference frame R_{m2} of the patient in relation to camera reference frame R_c by a transformation ${}^{m2}T_{c(t)}$ determined in real time by optical measurement. Pet. 52; Ex. 1018 ¶ 19. In support of this argument, Petitioner explains that (i) locations of reference emitters 70, 72, 74 on patient reference frame R_{m2} are tracked by sensors 20, 22, 24 in camera reference frame R_c; and (ii) this correlation is expressed mathematically as ${}^{m2}T_{c(t)}$. Pet. 52; Ex. 1018 ¶ 19.

Petitioner also argues that Schulz discloses calculating a transformation ${}^{i}T_{o(t)} = {}^{i}T_{m2}\ {}^{m2}T_{o(t)}\ {}^{o}T_{m1(t)}\ {}^{m1}T_{o}$, giving the relation between image reference frame R_i and tool reference frame R_o, to display in real time a section corresponding to a point of interest indicating the position of the tool in relation to a prerecorded image. Pet. 52–53; Ex. 1018 ¶ 20. In support of this argument, Petitioner explains that (i) the transformation is the mathematical expression that describes the results of the above-referenced steps to yield the coordinates in the image data base that correspond to the position of the tool tip (Pet. 53; Ex. 1018 ¶ 20); and (ii) "[t]he image displayed is 'at the current position of the probe tip,' and thus the display is in real time" (Pet. 53 (citing Ex. 1004, 14:11–13)).

Petitioner also argues that Schulz discloses performing the microsurgery based on the real-time display of the section. Pet. 53. Petitioner explains that Figure 2 "illustrates 'a surgeon performing intracranial surgery on a patient, and showing a cursor on the display screen that marks the corresponding position of the invasive tip of the probe within the image of previously obtained model data.'" Pet. 53 (citing Ex. 1004, 5:4–8).

Based on the present record, Petitioner has shown sufficiently that the mathematical transformations recited in independent claim 10 necessarily flow from the teachings of Schulz. We also determine that, on the present record, Petitioner has shown sufficiently that the combination of Schulz and Heilbrun teaches all of the limitations of claim 10, and have provided articulated reasoning with rational underpinning for combining the references. In view of the foregoing, we determine Petitioner has established a reasonable likelihood that they would prevail on their assertion that independent claim 10 would have been obvious over Schulz and Heilbrun under 35 U.S.C. § 103(a).

D. Obviousness of Claim 11 over Schulz, Heilbrun, and Glassman

1. Overview of Glassman

Glassman discloses robotic surgical system 10 including robot 12 having manipulator arm 14 with surgical tool 22. Ex. 1008, Abstr., 3:8–10. Glassman discloses making preoperative image scans of a patient taken with alignment pins 46 in the patient to determine a set of bone reference coordinates. *Id*. at 8:36–47. A surgeon selects an appropriate implant shape from an implant shape library and positions the implant model relative to the image scan. *Id*. at 8:47–54. The coordinates, implant identification, and the

surgeon-specified implant location are provided to robot controller 24 for planning the surgery. *Id*. at 8:68–9:6. The surgeon guides the robot to locate alignment pins 46 in the patient. *Id*. at 9:35–68. "[R]obot 12 . . . mills out the correct shape to receive the implant. The surgeon monitors the progress of the operation both by direct visual observation and through observation of the online display 48 where CT derived images and selected cross-sections of the implant model are superimposed." *Id*. at 10:4–9.

2. Obviousness of Claim 11

Petitioner relies on the analysis relating to claim 10 for elements (a) through (d) of claim 11. Pet. 54. With respect to additional element (e), namely, calculating a transformation ${}^{o}T_{i(t)}$, which is an inverse of the transformation ${}^{i}T_{o(t)}$, Petitioner points out that "Schulz discusses using an inverse transform to switch between the tool coordinate systems and the 'model' or image coordinate system." Pet. 54 (citing Ex. 1004, 12:10–20); Ex. 1018 ¶¶ 21–22.

With respect to additional element (f), namely, automatically controlling the tool in real time in relation to a target defined in the image data base using the transformation ${}^{o}T_{i(t)}$, Petitioner argues that Glassman discloses automatically controlling a tool in connection with "image-directed robotic surgery" and that the robot is controlled in real time. Pet. 55 (citing Ex. 1008, 8:68–9:6) ("[T]he robot controller 24 is enabled through various 'part subroutines' to determine ***during surgery*** the sequence of effector motions required to form the implant-shaped cavity at the surgeon-specified location within the femur."). Petitioner asserts that "[i]t would be advantageous to add automatic tool control to Schulz's disclosure to prevent

mistakes and to allow the surgeon to focus on other things besides manipulating the tool." Pet. 56 (citing Ex. 1014 ¶¶ 70–71).

Again, based on the present record, Petitioner has shown sufficiently that the mathematical transformations recited in independent claim 11 necessarily flow from the teachings of Schulz. We also determine that, on the present record, Petitioner has shown sufficiently that the combination of Schulz, Heilbrun, and Glassman teaches all of the limitations of claim 11, and have provided articulated reasoning with rational underpinning for combining the references. In view of the foregoing, we determine Petitioner has established a reasonable likelihood that it would prevail on its assertion that independent claim 11 would have been obvious over Schulz, Heilbrun, and Glassman under 35 U.S.C. § 103(a).

III. CONCLUSION

For the foregoing reasons, based on the present record, we determine that Petitioner has demonstrated that there is a reasonable likelihood that Petitioner would prevail in showing that claims 10 and 11 of the '725 patent are unpatentable. At this stage of the proceeding, the Board has not made a final determination with respect to the patentability of the challenged claims or any underlying factual and legal issues.

IV. ORDER

For the reasons given, it is

ORDERED that, pursuant to 35 U.S.C. § 314(a), *inter partes* review is instituted as to claims 10 and 11 based on the following grounds of unpatentability:

A. Claim 10 under 35 U.S.C. § 103(a) as obvious over Schulz and Heilbrun; and

B. Claim 11 under 35 U.S.C. § 103(a) as obvious over Schulz, Heilbrun, and Glassman.

FURTHER ORDERED that *inter partes* review is commenced on the entry date of this Order, and pursuant to 35 U.S.C. § 314(c) and 37 C.F.R. § 42.4, notice is hereby given of the institution of a trial; and

FURTHER ORDERED that the trial is limited to the grounds of unpatentability listed above, and no other grounds of unpatentability are authorized for *inter partes* review.

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