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UNITED STATES PATENT AND TRADEMARK OFFICE

BEFORE THE PATENT TRIAL AND APPEAL BOARD

Ex parte MAYA ELLA BARLEY, ADRIEN EMMANUEL DESJARDINS, RAYMOND CHAN, and GERT WIM 'THOOFT

Appeal 2019-002586
Application 14/000,415
Technology Center 3700

Before EDWARD A. BROWN, CHARLES N. GREENHUT, and WILLIAM A. CAPP, *Administrative Patent Judges.*

GREENHUT, *Administrative Patent Judge.*

DECISION ON APPEAL

STATEMENT OF THE CASE

Pursuant to 35 U.S.C. § 134(a), Appellant[1] appeals from the Examiner's decision to reject claims 1–24. *See* Final Act. 1. We have jurisdiction under 35 U.S.C. § 6(b).

We AFFIRM.

[1] We use the word Appellant to refer to "applicant" as defined in 37 C.F.R. § 1.42. Appellant identifies the real party in interest as KONINKUJKE PHILIPS N.V. Appeal Br. 1.

CLAIMED SUBJECT MATTER

The claims are directed to a non-rigid-body morphing of vessel image using intravascular device shape. Claim 1, reproduced below, is illustrative of the claimed subject matter:

> 1. A medical system, comprising:
>
> a medical imaging system configured to generate real-time images of an interventional procedure;
>
> an overlay generator configured to generate an overlay image which includes an image of an anatomical structure on the images of the interventional procedure, said overlay image being a separate image from the real-time images of the interventional procedure generated by the medical imaging system; and
>
> an interventional device tracking system configured to dynamically track a three dimensional (3D) position, orientation and shape of an interventional device during the procedure, said interventional device tracking system including a fiber-optic shape sensing system configured to obtain shape information for the interventional device;
>
> wherein the overlay image including the image of the anatomical structure is dynamically updated in response to deformations caused to the anatomical structure by the interventional device during the procedure based on position, orientation and shape information from the interventional device tracking system.

REFERENCES

The prior art relied upon by the Examiner is:

Name	Reference	Date
Graumann	US 6,317,621 B1	Nov. 13, 2001
Glossop	US 2005/0182319 A1	Aug. 18, 2005
Teber	Augmented Reality: A New Tool To Improve Surgical Accuracy during Laparoscopic Partial Nephrectomy? Preliminary In Vitro and In Vivo Results	European urology 56.2 (2009): 332–338
Szekely	Segmentation of 2-D and 3-D objects from MRI volume data using constrained elastic deformations of flexible Fourier contour and surface models	Medical Image Analysis 1.1 (1996): 19–34

REJECTIONS

Claims 1–13 and 15–18 are rejected under 35 U.S.C. § 103(a) as being unpatentable over Glossop in view of Teber.

Claim 14 is rejected under 35 U.S.C. § 103(a) as being unpatentable over Glossop, Teber, and Szekely.

Claims 19–24 are rejected under 35 U.S.C. § 103(a) as being unpatentable over Glossop, Teber, and Graumann.

OPINION

Appellant presents substantive arguments regarding the rejection of claims 1–9. Appeal Br. 9–15. Claim 1 is representative of this claim grouping under 37 C.F.R. § 41.37(c)(1)(iv). Arguments for the remaining claims rely on those arguments presented with regard to claims 1–9. Appeal Br. 15–21.

In rejecting claim 1 the Examiner relied on Glossop as disclosing the basic medical system, including, inter alia:

> an interventional device tracking system configured to dynamically track a three dimensional (3D) position, orientation and shape of an interventional device during the procedure, said interventional device tracking system including a fiber-optic shape sensing system configured to obtain shape information for the interventional device.

Final Act. 3. This brings us to Appellant's first point of contention:

> Glossop fails to teach or suggest that the image space positions that are overlaid may be specifically based on shape sensing or that the image space positions may be updated in response to deformations caused to the anatomical structure by the interventional device during the procedure based on information including position, orientation and shape information from the interventional device tracking system wherein the shape information is obtained by a fiber-optic shape sensing system.

Appeal Br. 11.

As the Examiner initially points out, Appellant's arguments do not accurately reflect the actual claim language. Ans. 3. Limitations not appearing in the claims cannot be relied upon for patentability. *In re Self*, 671 F.2d 1344, 1348 (CCPA 1982). There does not appear to be any dispute that Glossop's tracking system is configured to track the recited interventional device "position" and "orientation" based on Glossop's express disclosure that "location, position, orientation, and/or coordinates relative to a tracking device determined and recorded." Final Act. 3 (citing Glossop para. 91). With respect to the limitation we believe to be challenged by Appellant, claim 1 calls for the device tracking system to also be "configured to [] track [a] shape of an interventional device." The Examiner reasonably determined:

> The position of multiple position indicating elements placed along the length of a flexible interventional tool would convey the shape of the tool (see the position elements shown in figures 4 and 7C - knowing the position of each position indicating element relative to the others would convey the shape of the device). In particular, if Shape Tape is used as the position indicating element(s) the shape would be indicated by knowledge of the relative positions of the portions of the device with the Shape Tape attached.

Ans. 4. We are unable to find any arguments by Appellant specifically rebutting the Examiner's position that a tracking system configured to track the *relative positions of multiple points* along an interventional device reasonably amounts to tracking the shape of that interventional device. Specifically, Glossop discloses:

> The location of the one or more position indicating elements within the anatomical region may then be imaged using an imaging device such as, for example an x-ray device or other imaging device.

Glossop para. 43. More specifically, Glossop discloses:

> Registration device 101 may contain one or more detectable elements 105a-105n. In one embodiment, detectable elements

> 105a-105n may be placed on or adjacent to position indicating element 103, such that the location of detectable elements 105a-105n may be correlated to the location and/or orientation of position indicating element 103 as disclosed in U.S. Pat. No. 6,785,571, which is incorporated herein by reference in its entirety. Detectable elements 105a-105n may include radio-opaque elements or elements that are otherwise detectable to certain imaging modalities such as, for example, x-ray, ultrasound, fluoroscopy, computerized tomography (C1) scans, positron emission tomography (PE1) scans, magnetic resonance imaging (MRI), or other imaging devices.

Glossop para. 94.

The phrase "configured to" in claim 1 is a broad term that does not impose any particular method or level of accuracy needed for the shape tracking. The shape of an object is ultimately known, and thus "track[ed]" by determining and recording positional information for multiple positions of that object. The *accuracy* of that shape may be determined by the number of discrete data points and the ability to accurately interpolate between them. Indeed, this is exactly what Appellant describes in their own Specification regarding shape tracking:

> Electromagnetic (EM) localization where single-point EM sensors can be used to accurately localize points at intervals along an interventional device. By interpolating between these points, the 3D device shape can be determined.

Spec. 2:6–8.

> a 3D shape of the interventional device is determined, for example, by EM localization of *one or more points* along the interventional device, optical shape sensing (using optical interrogation of fiber strains and 3D reconstruction of strain fields to track the continuous device shape in three dimensions)

> or x-ray-based 3D device shape sensing (e.g., using 3D markers at intervals along the device).

Spec. 9:23–10:2 (emphasis added).

By mentioning, albeit somewhat questionably, that "one or more points" can be used for shape determination there would not seem to be any particular lower limit imposed regarding the specific *number* of points that must be tracked so as to be configured for shape determination according to claim 1. If there is any distinction between the shape-determining technique disclosed in Appellant's Specification and the multiple positions tracked via multiple elements 105a–105n in Glossop it appears to involve only interpolation or connecting of the tracked points. Appellant does not rebut the Examiner's analysis with any explanation as to why "shape," in a general sense, cannot be indicated by a collection of points, with or without connecting those points. As Appellant chose to omit from claim 1 any disclosure used in the Specification pertaining to specific shape-tracking techniques, such as interpolation, it is only reasonable to conclude, reading claim 1 in light of the Specification, that claim 1 also does not require such a specific process for a device to be "configured to" track a shape. Our reviewing court has repeatedly cautioned against reading limitations into a claim from the preferred embodiment, even if it is the only embodiment described in the Specification. *In re American Academy of Science Tech Center*, 367 F.3d 1359, 1369 (Fed. Cir. 2004). Furthermore, where, as here, apparatuses or processes are substantially the same, they are not distinguished simply by employing different terminology to describe them. *In re Neugebauer*, 330 F.2d 353, 356 n. 4 (CCPA 1964) ("In the construction of words, not the mere words, but the thing and the meaning, are to be inquired after.") Thus, it was reasonable for the Examiner to conclude that "[t]he position of multiple position indicating elements placed along the length of a flexible interventional tool would convey the shape of the tool." Ans. 4.

Claim 1 does recite more specific language regarding shape tracking, requiring:

> a fiber-optic shape sensing system configured to obtain shape information for the interventional device;

This appears to be exactly what would be provided by implementing Glossop's suggestion to use "a fiber-optic tracking device (e.g., Shape-Tape, MEasurand, Inc.[])" for the position indicating element 103. Final Act. 3; Ans. 4 (both citing Glossop para. 91). According to the publication cited by the Examiner (Final Act. 3[2] *citing* www.electronicproducts.com), Shape-Tape is itself comprised of multiple sensors spaced along its length, much like the detectable elements 105a–105n described in Glossop. Appellant's only remark with regard to ShapeTape is:

> Glossop is completely silent with respect to utilizing the Shape-tape to determine the shape of the position indicating elements.

Appeal Br. 6. Shape tracking appears to be the very purpose of ShapeTape. Although the product appears to have been superseded by the manufacturer, it can be easily verified that ShapeTape, as of Glossop's filing date, was known as a "fiber optic based 3D bend and twist sensor," that "measures and tracks: Shape[,] Movement[,] Position[, and] Orientation"

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[2] *Citing* https://www.electronicproducts.com/Optoelectronics/Distributed-measurement_tape_knows_its_exact_position.aspx (last accessed Oct. 24, 2019).

based on information from an "array of fiber optic sensors along its length."[3] Thus, the Examiner reasonably determined that by inclusion of ShapeTape in Glossop's tracking system that system is reasonably regarded as "configured to [] track [a] shape of an interventional device" and "configured to obtain shape information for the interventional device" via "a fiber-optic shape sensing system" as required by claim 1. Ans. 4.

Appellant further argues:

> Glossop fails to teach or suggest that the overlay of the image space positions may be dynamically updated based on the determined spatial relationships of the position indicating elements. Instead, Glossop solely discloses that a model of an anatomical region, such as a rigid body model may be formed by the spatial relationships of the position indicating elements (Glossop ¶ 136). A model of an anatomical region is completely different than an overlay image of an anatomical region.

Appeal Br. 12. This argument continues:

> there is no teaching or suggestion that the modification of a <u>coordinate</u> for the position indicating elements based on the motion model results in the image itself being updated, such as to change the overlaid image of an anatomical structure in response to deformations caused to the anatomical structure by the interventional device.
>
> . . .
>
> Glossop is completely silent with respect to updating the image that is overlaid, such as the shape of the object in the overlay, based on a determined shape of an interventional device by a tracking system.

Appeal Br. 13.

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[3]*See* https://web.archive.org/web/20030214005117/http://www.measurand.com/products/shapetape.html.

The Examiner first, correctly points out that Appellant's reading of Glossop is incorrect. Ans. 5. Glossop clearly describes the use of a deformable model of an anatomical region. Glossop para. 56. A model and an image may not *be* the same thing as Appellant argues. Appeal Br. 13. However, at least paragraph 56 Glossop clearly implies that that described model is used to display real-time images regarding the anatomical region:

> In some embodiments, the one or more software modules may enable the processor to create a *dynamic, deformable model* of the anatomical region of the patient, and *display real time images regarding the anatomical region*.

Glossop para. 56 (cited at Final Act. 3) (emphasis added). This is stated in the context of describing an overlay image of the anatomical region:

> This combination may produce an "overlay image" or "composite image" where the image space positions of the one or more position indicating elements are calculated and displayed on the previously acquired image (or other image) of the anatomical region.

Glossop para. 41 (cited at Final Act. 3). More Specifically, Glossop states:

> In an operation 307, the position of the one or more position indicating elements may be sampled by a tracking device. This position information may be combined with the registration of operation 303. This combination may produce an "overlay image" or "composite image" where the image space positions of the one or more position indicating elements are calculated and displayed on the image acquired in operation 301.

Glossop para. 113 (cited at Final Act. 3). The above paragraphs of Glossop, taken together, clearly teach, contrary to Appellant's argument that Glossop produces a deformable model, represented in an image overlay that is updated in real time. Indeed, this real-time (or "dynamic[] update[ing]" according to claim 1) is done, for among other things, one of the very same reasons Appellant updates the overlay—"in response to deformations caused to the anatomical structure by the interventional device during the procedure:"

> Any movement affecting the conduit within the anatomical region of interest may be detected via its effect on the one or more position indicating elements. This motion may include any motion that affects the contents of the anatomical region of interest such as, for example, . . . *movement of the soft or deformable organs or tissues within the anatomical region due to intervention by a medical professional or instrument*
> . . .
> Operation 509 may produce a dynamic model of the anatomical region that models any motion affecting the anatomical region in real time.

Glossop paras. 137–38 (cited at Final Act. 3).

The Examiner next correctly points out that, to the extent Glossop's disclosure regarding updating the anatomical *model* and/or *coordinates of the interventional device* based on movement or deformation in the anatomical region of interest does not *expressly* teach updating the displayed image of that anatomical region, Teber was relied upon by the Examiner for that teaching. Final Act. 3; Ans. 5–6.

Appellant appears to recognize that Teber, being concerned with the problem of using a rigid anatomical model that did not account for tissue shifts or deformation (Teber p. 333, para. 1 (cited at Final Act. 3)), created a anatomical image that is overlaid to augment an image during a procedure. Appeal Br. 14. Appellant also acknowledges that Teber teaches that "[i]n the case of organ motion during manipulation, the augmented picture with the detected navigation aids could automatically follow the videoendoscopic picture using the navigation aids as landmarks; in this way, shifts were easily compensated." Appeal Br. 14–15; Reply. Br. 9. Appellant does not appear to dispute the Examiner's assertion that Teber teaches updating the display augmented with an overlay of an anatomical region in the case of organ or tissue motion or deformation. Rather, Appellant's arguments concerning Teber only seem to assert that Teber lacks certain subject matter for which the Examiner relied on Glossop. Appeal Br. 14–15 ("Teber fails to disclose that the system is configured to perform shape sensing"). Arguments must address the Examiner's action. 37 C.F.R. § 41.37(c)(1)(iv) ("The arguments shall explain why the examiner erred as to each ground of rejection contested by appellant"). "Non-obviousness cannot be shown by attacking references individually when the rejection is predicated upon the teachings of a combination of references." *See In re Merck & Co. Inc.*, 800 F.2d 1091, 1097 (Fed. Cir. 1986)(citation omitted); Ans. 6.

For the foregoing reasons, we sustain the Examiner's rejections.

CONCLUSION

The Examiner's rejections are affirmed.

DECISION SUMMARY

Claims Rejected	**35 U.S.C. §**	**Basis**	**Affirmed**	**Reversed**
1–13, 15–18	103(a)	Glossop, Teber	1–13, 15–18	
14	103(a)	Glossop, Teber, Szekely	14	
19–24	103(a)	Glossop, Teber, Graumann	19–24	
Overall Outcome:			1–24	

TIME PERIOD FOR RESPONSE

No time period for taking any subsequent action in connection with this appeal may be extended under 37 C.F.R. § 1.136(a). *See* 37 C.F.R. § 1.136(a)(1)(iv).

AFFIRMED

Notice of References Cited	Application/Control No. 14/000,415	Applicant(s)/Patent Under Patent Appeal No. 2019-002586	
	Examiner	Art Unit 3793	Page 1 of 1

U.S. PATENT DOCUMENTS

*		Document Number Country Code-Number-Kind Code	Date MM-YYYY	Name	CPC Classification	US Classification
	A	US-				
	B	US-				
	C	US-				
	D	US-				
	E	US-				
	F	US-				
	G	US-				
	H	US-				
	I	US-				
	J	US-				
	K	US-				
	L	US-				
	M	US-				

FOREIGN PATENT DOCUMENTS

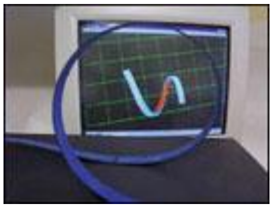
*		Document Number Country Code-Number-Kind Code	Date MM-YYYY	Country	Name	CPC Classification
	N					
	O					
	P					
	Q					
	R					
	S					
	T					

NON-PATENT DOCUMENTS

*		Include as applicable: Author, Title Date, Publisher, Edition or Volume, Pertinent Pages)
	U	3D Flexible Strips Measure Shape, Position, Orientation Statically and Dynamically, (accessed Oct. 24, 2019) https://www.electronicproducts.com/Optoelectronics/Distributed measurement_tape_knows_its_exact_position.aspx.
	V	
	W	
	X	

*A copy of this reference is not being furnished with this Office action. (See MPEP § 707.05(a).)
Dates in MM-YYYY format are publication dates. Classifications may be US or foreign.

3D flexible strips measure shape, position, orientation statically and dynamically



ShapeTape measures and tracks:
Shape
Movement
Position
Orientation

ShapeTape is a fiber optic based 3D bend and twist sensor, that knows where it is continuously along its length, providing accurate position and orientation information, even when in partial or variable contact with an object or person. ShapeTape can be used on its own, built into or attached to a structure, or attached to person to form real-time 3D computer images and collect data corresponding to complex shapes. A high-speed (10kHz), non-multiplexed version is available for rapid data acquisition.

ShapeTape Details and Specs

S1280CS ShapeTape™ and S1680 High-Speed ShapeTape™

A light weight, wearable, flexible ribbon that uses its own software, ShapeWare to create a 3D computer image and data set of its shape in real time, based on bend and twist information from an array of fiber optic sensors along its length. It follows human arm, leg, back, and neck movements for motion capture, virtual reality, biomedical, gaming, and robotic control applications. It is also used for crash testing, computer-aided design, and automotive interior design.

The S1280CS ShapeTape operates through the serial port of a Windows PC. ShapeWare software allows viewing a real-time image of the ShapeTape and collecting data from the entire tape at up to 110Hz.

The S1680 ShapeTape is a high speed, non multiplexed version of our S1280CS multiplexed ShapeTape , for use with a separate data acquisition system (not included). 3D dynamic shape information can be acquired from the length of the tape at a bandwidth of 10kHz.
Both the S1280CS and the S1680 ShapeTape can be supplied with different lengths, widths, sensor spacing and locations. Bend only and armored versions are also available.

3D ShapeTape Characteristics
These typical characteristics are approximate and subject to change without notice

Characteristics, S1280CS multiplexed ShapeTape™
(Specifications will vary for other lengths, number of sensors, etc.)

Dimensions of tape: 1.3 x 13 x 1800 mm nominal
Dimensions of interface box: 16 x 54 x 168 mm nominal
Operating temperature: -20 to 50 deg c
Sensitive zone: outboard 480 mm contains 16 sensors arranged in 8 pairs
Sensor length: each sensor integrates curvature over a 60 mm portion of the sensitive zone
Sensor pair: each pair resolves bend and twist, using calibration constants
Calibration: Circle, twist, & flat poses yield stored calibration constants
Data: x,y,z and orientation at 16 or more points along sensitive zone, relative to inboard reference end
Calibrated Range of each sensor: ± 40 mm radius bend; ±22.8 deg twist
Safe Bending radius: ± 20 mm radius
Spatial sampling limits: each monotonic (single polarity) curve requires two sensor lengths
Operating range for end of 'U' shape: two elliptical volumes, 160 x 250 mm each.
Endpoint accuracy within operating range and sampling limits: 5 mm rms, x,y,or z, without correction
Endpoint resolution: 0.3 mm rms, x,y,or z; 0.5 deg, roll, pitch, or yaw
Other locations on tape: errors reduce toward inboard reference end, within range and sampling limits
Maximum data acquisition speed: 110 Hz
Included: Wall mount power supply (60 Hz, 120VAC), serial cable, interface box, and tape

Options
We frequently vary the number of sensors, lead lengths, and other tape parameters to suit special needs. Up to 48 sensors can be handled by one interface box. Multiple tape systems and other software routines are available.

Characteristics, S1680 High-Speed ShapeTape™

Made to special order, these tapes have up to 40 analog output channels, each with a 10 kHz bandwidth. Add a high speed data acquisition system (not included) to acquire high speed crash or sport data. Interface box dimensions are similar to those of the S1280CS tapes. Tapes are available in different lengths, widths, and sensor configurations.

(ShapeTape is produced under license from the Canadian Space Agency).