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BEFORE THE PATENT TRIAL AND APPEAL BOARD

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*Ex parte* JOERG SABCZYNSDI and GEERT STREEKSTRA

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Appeal 2010-009770  
Application 11/574,748  
Technology Center 2600

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Before KRISTEN L. DROESCH, GEORGIANNA W. BRADEN and  
MIRIAM L. QUINN, *Administrative Patent Judges*.

QUINN, *Administrative Patent Judge*.

#### DECISION ON APPEAL

Appellants<sup>1</sup> appeal under 35 U.S.C. § 134(a) (2002) from a final rejection of claims 1-10. We have jurisdiction under 35 U.S.C. § 6(b).

We AFFIRM.

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<sup>1</sup> The Real Party in Interest is Koninklijke Philips Electronics, N.V.

STATEMENT OF THE CASE

*Appellants' Invention*

According to Appellants, the invention relates to a system and a method for the generation of three-dimensional images of a joint in different phases of its motion. (Spec. 1, ll. 2-3.)

*Representative Claim*

Independent claim 1 is representative and reads as follows:

1. System for the generation of dynamic 3D images of a joint in different phases of its motion, comprising:
  - a) a rotational X ray device adapted to generate a series of 2D projections of the joint in real time from different directions and having a preset acquisition frequency  $f_{x\text{-ray}}$  while the joint is moving in a cyclic manner with a frequency  $f_{\text{obj}}$  through the different phases of its motion, wherein a total number of 2D projections in the series is an integer multiple of the total number of phases within one cycle of the joint motion;
  - b) a monitoring device adapted to provide information on a current motion phase of the joint during its movement for respective 2D projections of the series; and
  - c) an image processing device for subdividing said series of 2D projections into classes corresponding to different motion phases of the joint and for reconstructing corresponding dynamic 3D images from the respective 2D projections of each class.

*References*

The prior art relied upon by the Examiner in rejecting the claims on appeal is:

Shah	US 5,154,178	Oct. 13, 1992
Latypov	US 6,005,548	Dec. 21, 1999
Heuscher	US 2003/0007593 A1	Jan. 9, 2003

Byoung-moon You, Pepe Siy, William Anderst, and Scott Tashman, *In Vivo Measurement of 3-D Skeletal Kinematics from Sequences of Biplane Radiographs: Application to Knee Kinematics*, IEEE Transactions on Medical Imaging, Vol. 20, No. 6 (June 2001) (hereinafter “YOU”)

*Rejections*

Claims 1-2, 4, 7-8, and 10 stand rejected under 35 U.S.C. § 103(a) as being unpatentable over YOU in view of Heuscher. (Ans. 4-8.)

Claim 3 stands rejected under 35 U.S.C. § 103(a) as being unpatentable over YOU in view of Heuscher and in further view of Latypov. (Ans. 8-9.)

Claims 5-6 and 9 stand rejected under 35 U.S.C. § 103(a) as being unpatentable over YOU in view of Heuscher and in further view of Shah. (Ans. 9-10.)

ISSUES

- (1) Did the Examiner err in rejecting independent claim 1 for obviousness over YOU and Heuscher because YOU teaches away from using the claimed “rotational X ray device,” rendering non-obvious the combination of YOU’s system with the CT scanner of Heuscher? (App. Br. 9.)

- (2) Did the Examiner err in rejecting independent claims 1, 8, and 10, and dependent claims 6 and 9 under 35 U.S.C. § 103(a), because neither YOU nor Heuscher teaches or suggests generating a series of 2D projections:
  - a. At a preset acquisition frequency;
  - b. While the joint is moving in a cyclic manner; and
  - c. In synchronization with the joint movement? (App. Br. 9-10, 14-16, and 18-19.)
- (3) Did the Examiner err in rejecting independent claims 1, 8, and 10 under 35 U.S.C. § 103(a), because neither YOU nor Heuscher teaches or suggests providing or determining “a current motion phase of the joint . . . for respective 2D projections”? (App. Br. 10, 16-17, and 19-20.)
- (4) Did the Examiner err in rejecting independent claims 1, 8, and 10 under 35 U.S.C. § 103(a), because neither YOU nor Heuscher teaches or suggests sub-dividing or classifying the series of 2D projections “into classes”? (App. Br. 11, 17, and 20.)
- (5) Did the Examiner err in rejecting independent claims 1, 8, and 10, and dependent claim 7, under 35 U.S.C. § 103(a), because neither YOU nor Heuscher teaches or suggests “reconstructing . . . dynamic 3D images from the respective 2D projections” and “displaying” the reconstructed 3D images “as a film sequence”? (App. Br. 11-12, 15, 17, and 20.)
- (6) Did the Examiner err in rejecting dependent claim 2 under 35 U.S.C. § 103(a), because YOU fails to teach or suggest the use of

“at least two markers on different segments of the joint”? (App. Br. 12.)

- (7) Did the Examiner err in rejecting dependent claim 3 under 35 U.S.C. § 103(a) because the combination of YOU, Heuscher and Latypov fails to teach or suggest the claimed use of a “goniometer”? (App. Br. 13.)
- (8) Did the Examiner err in rejecting dependent claim 4 and independent claim 10 under 35 U.S.C. § 103(a), because neither YOU nor Heuscher teaches or suggests deriving a motion phase of the joint from generated images? (App. Br. 13-14, 18.)
- (9) Did the Examiner err in rejecting dependent claims 5 and 6 under 35 U.S.C. § 103(a) over YOU, Heuscher, and Shah, because there is no teaching or motivation to combine the device in Shah with the system in YOU? (App. Br. 14-15.)
- (10) Did the Examiner err in rejecting independent claims 8 and 10 under 35 U.S.C. § 103(a), because YOU fails to teach or suggest the limitations of “movement from different directions” and “total number of 2D projections in the series is an integer multiple”? (App. Br. 16 and 19.)

#### ANALYSIS

We have reviewed the Examiner’s rejections in light of Appellants’ contentions that the Examiner has erred. Further, we have reviewed the Examiner’s response to Appellants’ arguments. Before delving into the specific issues, we note that Appellants’ Reply includes many new

arguments and explanations couched as corrections of the Appellants' understanding of YOU. (Reply 2-3.) Appellants are hereby on notice that "[a]ny bases for asserting error, whether factual or legal, that are not raised in the principal brief are waived." *Ex parte Borden*, 93 USPQ2d 1473, 1474 (BPAI 2010) (informative). *See also Optivus Tech., Inc. v. Ion Beam Appl'ns. S.A.*, 469 F.3d 978, 989 (Fed. Cir. 2006) ("[A]n issue not raised by an appellant in its opening brief . . . is waived.") (citations and quotation marks omitted). Furthermore, we find unpersuasive any allegation that corrective statements as to the "stronger understanding" of YOU were necessitated to respond to the Examiner's Answer. (Reply 2-3.) Appellants have known the YOU reference since, at least, the date of filing of the instant application as indicated by Appellants' Specification. (Spec. 1 (citing and describing YOU in the Background of the Invention).) And Appellants have not identified any specific statement by the Examiner that allegedly misinterprets YOU such that Appellants are entitled to raise new arguments and factual representations in the Reply Brief. *See e.g.* Reply 16-17 (arguing for the first time, and without good cause, that the combination of Heuscher and YOU operates in different ways to achieve different results for a different purpose.) Accordingly, as identified in this decision, we treat as waived such new arguments and allegedly corrective statements that could have been raised in Appellants' Appeal Brief, but were instead raised for the first time in the Reply Brief.

1. “Rotational X Ray Device” Issue – Claim 1

Appellants contend that claim 1 calls for a rotational X-ray device. (App. Br. 9.) In Appellants’ view, YOU teaches away from using that device, and, therefore, the Examiner’s rejection over the combination of YOU and Heuscher, which discloses a rotational X-ray device, is in error. (*Id.*) In support for this contention, Appellants argue that page 514, third paragraph, of YOU teaches against the use of a CT scanner, which is the rotational X-ray device taught in Heuscher. (*Id.*) YOU states that “CT/MRI are not yet capable of achieving high frame rates required for estimating dynamic function. In addition, the restrictions imposed by the imaging environment (typically a small-diameter cylindrical space) prevent full-motion kinematics measurement.” YOU at 514.

The Examiner responds that YOU suggests future computed tomography (CT) technology would be capable of achieving frame rates suitable for kinematics measurements. (Ans. 11.) Appellants take issue with the Examiner’s finding by stating that it gives a “false impression” that Heuscher discloses a more modern CT scanner capable of higher speed than that described in YOU. (Reply 4.) Appellants set forth additional arguments that question the Examiner’s findings and conclusions, such as the alleged failure to show *how* YOU would be modified to become a rotational X-ray device that could generate the data taught in Heuscher. We are not persuaded by Appellants’ arguments and disagree with Appellants’ conclusions.

“A reference may be said to teach away when a person of ordinary skill, upon reading the reference, would be discouraged from following the

path set out in the reference, or would be led in a direction divergent from the path that was taken by the applicant.” *In re Gurley*, 27 F.3d 551, 553 (Fed. Cir. 1994). Moreover, “obviousness must be determined in light of all the facts, and there is no rule that a single reference that teaches away will mandate a finding of nonobviousness. Likewise, a given course of action often has simultaneous advantages and disadvantages, and this does not necessarily obviate motivation to combine.” *Medichem v. Rolabo*, 437 F.3d 1157, 1165 (Fed. Cir. 2006) (citing *Winner Int’l Royalty Corp. v. Wang*, 202 F.3d 1340, 1349 n. 8 (Fed. Cir. 2000) (“The fact that the motivating benefit comes at the expense of another benefit, however, should not nullify its use as a basis to modify the disclosure of one reference with the teachings of another. Instead, the benefits, both lost and gained, should be weighed against one another.”).)

Appellants’ arguments focus on one passage of YOU and ignores the remaining teachings. Although YOU mentions the disadvantage of using a CT scanner for reasons of speed or space, it does not discredit its known use as a device that generates imaging for assessing directly the joint movement. *See* YOU at 514 (stating that CT technology allows assessing movements of the underlying bone directly). We further note that YOU teaches the use of a CT scanner *in addition* to the proposed fluoroscopic imaging system to obtain accuracy. *See* YOU at 516 (stating that a CT scan using a GE Hi-speed Advantage is first obtained of the joint). Taking YOU as a whole, we are not persuaded that YOU’s described disadvantages of using a CT scan alone while also teaching the use of a CT scan in combination with the disclosed system, nullifies the value of YOU – CT scanners (i.e. rotational

X-ray scanners) are known for assessing directly movements of the joint. Additionally, the Examiner finds, and we agree, that YOU does not foreclose the future benefits and use of CT scanners. (Ans. 11.)

We are further unpersuaded by Appellants' arguments that Heuscher confirms the unusability of a CT scanner in combination with YOU, because that CT scanner is just as slow as those CT scanners of the prior art. (Reply 4-5.) As we understand Appellants' arguments regarding Heuscher, the disclosed CT scanner could not be modified to increase shutter speeds to match those of YOU. (*Id.*) For example, Appellants reason that Heuscher and YOU would need to be modified so that the rotation speed of the CT scanner in Heuscher is increased to the fast shutter speeds disclosed in YOU. (Reply 5.) However, the obviousness inquiry is "whether the claimed inventions are rendered obvious by the teachings of the prior art as a whole." *In re Etter*, 756 F.2d 852, 859 (Fed. Cir. 1985) (en banc); *see also In re Keller*, 642 F.2d 413, 425 (CCPA 1981) (stating "[t]he test for obviousness is not whether the features of a secondary reference may be bodily incorporated into the structure of the primary reference"). Furthermore, "it is not necessary that the inventions of the references be physically combinable to render obvious the invention under review." *In re Sneed*, 710 F.2d 1544, 1550 (Fed. Cir. 1983) (citing *Orthopedic Equip. Co. v. United States*, 702 F.2d 1005, 1013 (Fed. Cir. 1983); *In re Andersen*, 391 F.2d 953, 958 (CCPA 1968)); *see also In re Nievelt*, 482 F.2d 965, 968 (CCPA 1973) ("Combining the *teachings* of references does not involve an ability to combine their specific structures.").

Appellants' arguments focus on the bodily incorporation of Heuscher and YOU, and are, therefore, unpersuasive. Furthermore, as the Examiner points out, Heuscher teaches imaging of a heart over the various states of a cardiac cycle and it is unlikely the frequency of the motion phases of some joint on a treadmill would exceed the frequency of heartbeats. (Ans. 11-12.)

For the foregoing reasons, we agree with the Examiner that YOU in view of Heuscher teaches or suggests "a rotational x-ray device adapted to generate a series of 2D projections of the joint in real time," as recited in claim 1.

2. *"Generating a Series of 2D Projections" Issue – Claims 1, 6, 8, 9, and 10*

Appellants next contend that claim 1 calls for the generation of a *series* of 2D projections. (App. Br. 9.) In Appellants' Appeal Brief, Appellant takes the position that YOU generates only a single shot. (App. Br. 9.) In the Reply Brief, Appellants change their position and admit that YOU generates a series of 2D projection images. (Reply 2.) Accordingly, this particular fact is deemed admitted.

As for the additional limitations regarding projections, Appellants contend that because YOU generates a *single* pair of X-ray tube shots, YOU does not teach or suggest a "preset acquisition frequency" as required by claim 1. (App. Br. 10.) For the same reasons, Appellants also argue that YOU does not teach moving the joint in a "cyclic manner," as required by claim 1. (*Id.*) Appellants make similar arguments concerning these claim requirements commensurately recited in claims 8 and 10. (App. Br. 15-16,

18.) Again, because Appellants have changed their position regarding the fact that YOU does not generate only a single shot, the arguments presented in Appellants' Appeal Brief, for claims 8 and 10, relying on the "single shot" fact, are unpersuasive.

Appellants further contend that YOU does not disclose moving the joint cyclically, and that YOU teaches away from such motion because of YOU's technique of using the obtained 2D projections together with a 3D model of the joint. (App. Br. 15, 18.) Appellants' position of how the technique in YOU teaches away from cyclic motion of a joint is not clear. Notwithstanding, we are in agreement with the Examiner's finding that YOU teaches or suggests that the joint is moving in a cyclic manner during the generation of the series of 2D projections. For example, the Examiner finds that YOU discloses cyclic motion when the patient is on a treadmill and the subject repeatedly moves to walk in accordance with the pace set by the treadmill. (Ans. 12, 22, and 27.) We also agree with the Examiner's finding that Heuscher teaches or suggests acquiring X-ray projections while the heart moves from the different cardiac phases of the cardiac cycle. (Ans. 12, 22, and 27.)

Appellants' contrary view is expressed in the Reply Brief, in an argument that focuses on the treadmill movement not being forced, precluding, thus, the motion of person or animal under study from being at a predetermined fixed frequency. (Reply 5-6.) We are not persuaded by Appellants' arguments. The claim requires for the joint to move in a cyclic manner with a frequency  $f_{obj}$ . The broadest reasonable interpretation of the claim language does not require the motion of the joint be either forced or at

a predetermined fixed frequency. Nevertheless, we note Appellants' argument is contrary to the disclosure in YOU, which teaches that the treadmill pace is set at 1.5 m/s and that acquisition of the 2D projections occur at 250 frames/second, such that forty continuous frames of a gait sequence may be selected for further study. YOU at 521. Further, YOU teaches that the X-ray is *precisely* synchronized to the event of interest or a *specific phase of motion for study* (e.g. heelstrike during gait) and that studies are performed during walking, running, and jumping. YOU at 515-516. Therefore, YOU suggests that the treadmill moves the joint, forcibly even, at a specific rate or pace during walking (cyclic motion) and that 2D projections are generated at 250 frames/second (a preset acquisition frequency). As such, we are not persuaded that the Examiner erred in finding that the limitations of cyclic joint motion and acquisition at a preset frequency are met by YOU. Because we agree with the Examiner's finding that YOU teaches or suggests these limitations, we do not address whether Heuscher also teaches or suggests these limitations.

Finally, concerning dependent claims 6 and 9, Appellants contend that YOU fails to teach or suggest that the joint movement is synchronized with the generation of 2D projections, as required by claims 6 and 9. (App. Br. 14, 18.) In Appellants' view, because YOU takes a single bi-plane image pair, there is no need to synchronize the movement of the joint. We do not agree with Appellants' conclusions.

The Examiner finds that YOU teaches the use of an accelerometer, optical sensors, and electronic timer to select a motion phase for study. (Ans. 18.) In fact, YOU is more emphatic in teaching synchronization by

stating that for *in vivo* testing, a *specific* phase of motion is selected (e.g. heelstrike during gait), and that X-ray exposure (for generating the projections) is *precisely synchronized to the event of interest* (using accelerometers and/or optical sensors and an electronic timer). YOU at 515. We, therefore, agree with the Examiner that YOU teaches the limitations of dependent claims 6 and 9. As for Appellants' additional contentions concerning Heuscher and Shah, we are not persuaded by Appellants' arguments in support thereof. We agree, instead, with the Examiner's findings and conclusions and adopt them as our own.

3. *The "Current Motion Phase" Issue – Claims 1, 8, and 10*

Appellants contend that YOU fails to teach or suggest any structure or device that provides information on the current motion phase, as required by claims 1, 8, and 10. (App. Br. 10, 16-17, and 19-20.) Appellants argue that YOU generates video images at regular time intervals – not based on a motion phase, as required by the claims. (*Id.*)

The Examiner responds that YOU meets the disputed claim limitation because YOU discloses a selection of a *specific phase of motion for study*, such as heelstrike during gait, and that YOU synchronizes the X-ray device to the selected event of interest or motion phase. (Ans. 13, 23, and 29.) The Examiner finds that YOU teaches the use of a monitoring device in the form of accelerometers and/or optical sensors and an electronic timer during *in vivo* testing, and in the form of skin-mounted or bone-implanted markers for measuring skeletal kinematics. (*Id.*) In response to the Examiner's answer, Appellants assert that no device in YOU monitors the markers to determine

when data acquisition should be triggered and that YOU triggers the X-ray tubes based on reaching the beginning of the selected motion range. (Reply 6-7.)

We agree with the Examiner that YOU teaches providing or determining “a current motion phase of the joint . . . for respective 2D projections,” as recited in claims 1, 8, and 10. YOU provides that for *in vitro* testing “[f]our tantalum spheres . . . were implanted in the bone to enable marker-based tracking.” YOU at 520. Three different motion sequences were studied, translation, rotation, and a combination of translation and rotation with specific motions of interest. YOU at 520 (describing the controlled motion and positions of the joint for the three sequences). For each sequence, a series of 124 radiographic images were acquired from which the bone movement was tracked from frame to frame. YOU at 520. YOU further provides that for *in vivo* testing, using accelerometers and/or optical sensors and an electronic timer, the X-ray exposure was “precisely” synchronized to the event of interest, which is a “specific phase of motion for study.” YOU at 515. Therefore, and contrary to Appellants’ assertions, YOU teaches that markers are monitored during imaging. Additionally, YOU uses markers or accelerometer/optical sensor devices, during movement of the joint, to provide information on the current motion phase for respective 2D projections of the series, as required by claims 1, 8, and 10.

Accordingly, we are not persuaded by Appellants’ arguments that the Examiner erred in finding that YOU teaches this limitation. Because we agree with the Examiner’s finding that YOU teaches or suggests this

limitation, we do not address whether Heuscher also teaches or suggests this limitation.

4. *Issue Concerning Sub-dividing and Classifying – Claims 1, 8, and 10*

Claim 1 calls for an image processing device for sub-dividing the series of 2D projections into classes corresponding to different motion phases of the joint. (App. Br. 11.) Claims 8 and 10 call for classifying the 2D projections of the series into classes. (App. Br. 17 and 20.) Appellants contend that YOU fails to teach this limitation because the YOU images are generated with no motion phase information, and, therefore, there is no information with which to subdivide or classify the images into classes corresponding to different motion phases of the joint. (App. Br. 11.) Appellants also contend that YOU's images and 3D model are in "undetermined joint motion phases." (App. Br. 17 and 20.) As for Heuscher, Appellants argue that Heuscher does not teach this limitation, because all data in Heuscher corresponds to the same cardiac phase, and, thus, there are no motion phases among which to divide the data. (App. Br. 11.)

The Examiner responds that YOU teaches subdividing the projections into classes corresponding to the different motion phases, because YOU discloses the use of accelerometers and/or optical sensors and an electronic timer, as well as markers, for synchronizing the acquisition of data to correspond with a particular motion phase. (Ans. 14.) According to the Examiner, it follows that X-ray projections are classified into a corresponding motion phase. (*Id.*) Notwithstanding the YOU disclosure,

the Examiner states that Heuscher teaches the classification of projections for particular phases of motion by disclosing that CT scan projection data is stored and classified into an associated cardiac phase or motion phase. (Ans. 14, 23-24, and 29-30.)

In the Reply Brief, Appellants raise new arguments. First, Appellants argue that each bi-planar image in YOU is taken in a different motion phase such that the X-ray projections are not classified. (Reply 7.) Appellants further argue that the Examiner failed to describe how either Heuscher or YOU would be modified to meet this limitation. (*Id.*) Specifically, Appellants argue that there is no teaching of *how* this principle could be applied to YOU because in YOU the various frames are not marked or indexed by motion phase. (*Id.*)

We have considered all of Appellants' arguments, even those raised in the Reply, which were untimely. However, we are not persuaded that the Examiner erred in finding that both YOU and Heuscher teach this limitation. As the Examiner finds, YOU suggests subdividing or classifying the projections according to the phase of motion. Again, YOU discloses taking a series of radiographic images of the joint during a gait sequence (YOU at 521), which is a motion phase from other motion phases involved in walking. The Examiner also finds that the use of the various monitoring devices suggests providing information for classifying the phases of motion, as was done for the gait sequence motion. (Ans. 14.) Further, Heuscher discloses "synchronizing the CT data with cardiac phase after data acquisition." Heuscher ¶ 60; Ans. 14. Heuscher also teaches that it analyzes more than one cardiac phase (Heuscher ¶ 48). Finally, Appellants' argument

– that the specific embodiments of YOU and Heuscher cannot be operatively combined – is not persuasive. *See In re Keller*, 642 F.2d at 425 (stating “[t]he test for obviousness is not whether the features of a secondary reference may be bodily incorporated into the structure of the primary reference”).

We, therefore, concur with the Examiner that YOU and Heuscher teach or suggest this limitation.

5. *Issues Concerning Reconstructing and Displaying Dynamic 3D Images – Claims 1, 7, 8, and 10*

Appellants contend that neither YOU nor Heuscher teaches reconstructing corresponding dynamic 3D images from the respective 2D projections for each class. (App. Br. 11, 17, and 20.) Specifically, Appellants argue that the bi-plane image pairs are not themselves reconstructed into a 3D image. (*Id.*) Appellants further admit that Heuscher “reconstructs CT data collected over a plurality of rotations of the CT gantry,” but that Heuscher and YOU are so different that YOU teaches away from the Heuscher reconstruction. (App. Br. 17 and 20.)

The Examiner responds that YOU discloses digitally reconstructed radiographs (“DDRs”) that correspond to the 3D images. (Ans. 14.) The Examiner points to Heuscher as also disclosing reconstruction of 3D images of the cardiac phases using the X-ray projections generated by the CT scanner. (Ans. 14-15, 24-25, and 30.) The Examiner also responds that Heuscher’s reconstruction may be combined with YOU, because Heuscher is analogous art dealing with dynamic volumetric imaging, and because it

discloses the advantages of providing improved quality and synchronization of images. (Ans. 24-25 and 30-31.) The Examiner finds that Heuscher teaches modern high speed rotational CT scanners for dynamic imaging and that it is unlikely that the frequency of the motion phases of a joint (as on a treadmill) would exceed the frequency of heart beats. (*Id.*) As such, the Examiner concludes that the Heuscher reconstruction is applicable to YOU's study of joint kinematics. (*Id.*)

In the Reply Brief, Appellants raise new arguments. First, Appellants argue that a digital camera does not output a 3D image, much like modern television sets receive digital video signals, but do not generate 3D images. (Reply 7.) Appellants next argue that the 2D projections of YOU cannot be combined to generate a 3D image. In particular, Appellant takes the position that Heuscher's reconstruction cannot be used with YOU, because the bi-plane image projections in YOU are "insufficient" to reconstruct a 3D image. (*Id.*)

We have considered all of Appellants' arguments, and we are not persuaded that the Examiner has erred. First, the claim language states "reconstructing corresponding dynamic 3D image from the respective 2D projections." Giving the claim language the broadest reasonable interpretation, we conclude that the limitation-at-issue does not exclude YOU's digital reconstructed radiographs or DDRs, even if in the process of reconstructing the 3D image, other data – in addition to the 2D projections – is used. As such, we are not persuaded by Appellants' arguments that YOU does not teach reconstruction of dynamic 3D images as claimed.

As for Appellants' arguments concerning Heuscher, we note that Appellants raise the inoperability of the combination of Heuscher and YOU in support of those arguments. However, factual assertions of inoperability of the prior art, as argued by counsel without a supporting declaration, have no probative value. *Meitzner v. Mindick*, 549 F.2d 775, 782 (CCPA 1977); *see also* MPEP § 716.01(c). In any event, we do not decide the merits of whether the Heuscher combination with YOU is proper since we agree with the Examiner that YOU teaches reconstruction as claimed.

With regard to the limitation recited in claim 7 concerning "displaying" the reconstructed 3D images "as a film sequence," we are unpersuaded by Appellants' arguments (App. Br. 15) that the Examiner erred. The Examiner finds that YOU discloses generated images are displayed as a series of frames to form a film sequence. (Ans. 20 (citing YOU at pages 523-524, fig.11).) As such, we agree with, and adopt as our own, the Examiner's findings and conclusions that YOU meets the limitations recited in claim 7.

6. *Issue Concerning "Markers" – Claim 2*

Appellants contend that neither YOU nor Heuscher teaches or suggests a "position measuring system adapted to determine the spatial position and/or orientation of at least two markers on different segments of the joint," as recited in claim 2. (App. Br. 12.) Specifically, Appellants argue that, although YOU discusses the use of markers, YOU teaches against the use of markers because YOU chooses not to use markers despite their known use. (*Id.*)

In response, the Examiner finds YOU teaches that results from the use of markers still produce acceptable data. (Ans. 15.) The Examiner concludes that the use of markers is well-known in the art and is a design choice whether to use the markers as monitoring device. (*Id.*) In reply, Appellants argue that no measuring system in YOU determines position of these markers. (Reply 8.)

We concur with the Examiner that YOU teaches this limitation. As the Examiner correctly states, YOU teaches the use of markers is well-known. (Ans. 15.) In fact, YOU utilizes markers in the *in vitro* testing specifically to track the position of the joint: “[f]our tantalum spheres . . . were implanted in the bone to enable marker-based tracking.” YOU at 520. Accordingly, we are not persuaded that the Examiner erred in finding that YOU teaches this limitation.

#### 7. *Goniometer Issue – Claim 3*

Claim 3 recites a monitoring device comprising “a goniometer adapted to be attached to the joint.” The Examiner rejects claim 3 for obviousness over a combination with Latypov. (Ans. 8.) Appellants admit that Latypov shows that goniometers are known in the art and that Appellants do not claim to have invented the goniometer, *per se*. (App. Br. 13.) However, Appellants argue that it is not obvious to add to YOU the use of a goniometer to supply information, because in Appellants’ view YOU does not disclose a monitoring device that provides information on motion phase. (*Id.*)

The Examiner acknowledges Appellants' admissions and responds that the use of a goniometer as a form of a monitoring device is a matter of design choice. (Ans. 16.) The Examiner also reasons that a person of ordinary skill in the art would incorporate a goniometer as a substitute or supplement to the monitoring device of YOU. (*Id.*) Finally, the Examiner states that Appellants' admissions concerning the known use of a goniometer render claim 3 unpatentable.

In their Reply, Appellants raise new arguments. First, Appellants argue that the Examiner fails to describe *how* or *why* one would be motivated to instrument a patient undergoing examination in YOU with a goniometer. (Reply 8.) Next, Appellants argue that incorporating the goniometers in YOU would create distortions in YOU's 2D projection images (Reply 8-9), essentially arguing that YOU's operation would be compromised.

We have considered all of Appellants' arguments, even those raised for the first time in the Reply, and we are not persuaded that the Examiner has erred. The Examiner correctly finds, and Appellants admit that, the use of a goniometer for tracking body parts is well-known. And, as stated *supra*, we agree with the Examiner's finding, that YOU teaches a monitoring device adapted to provide information on a current motion phase. Therefore, Appellants' arguments – that YOU lacks a monitoring device and that, therefore, YOU could not use a goniometer as that device – are unpersuasive.

We are further unpersuaded by Appellants' arguments that the Examiner failed to provide a rationale for the use of a goniometer with the

system of YOU. The Examiner provided a reasonable rationale for the combination in the Final Rejection at page 10 and in the Answer at page 16. And to the extent Appellants argue that the bodily incorporation of a goniometer of Latypov cannot be incorporated in either the YOU or Heuscher system, we are also unpersuaded. *See In re Keller*, 642 F.2d at 425 (stating “[t]he test for obviousness is not whether the features of a secondary reference may be bodily incorporated into the structure of the primary reference”).

Finally, Appellants raise the inoperability of the combination of YOU and Latypov in support of the argument that the references could not be combined. First, that argument was raised for the first time in the Reply brief, and is, therefore, untimely. Furthermore, factual assertions of inoperability of the prior art, as argued by counsel without a supporting declaration, have no probative value. *Meitzner v. Mindick*, 549 F.2d 775, 782 (CCPA 1977); *see also* MPEP § 716.01(c).

Accordingly, we are not persuaded that the Examiner erred in finding that the combination of YOU in view of Heuscher, and in further view of Latypov teaches this limitation.

8. *Issue Concerning Deriving a Motion Phase from Images – Claims 4 and 10*

Appellants contend that claim 4 calls for the monitoring device to comprise an imaging device and an evaluation unit for deriving the motion phase from images, and that in YOU, it is a human viewer, i.e. a diagnostician, who determines the motion phase from the display of the 3D

model. (App. Br. 13.) Appellants also repeat the arguments made with respect to claim 1, that YOU has no need to determine a current motion phase as it involves a single shot and no repetitively cyclic motion of the joint. (*Id.*) Appellants further argue that Heuscher does not disclose a device or technique by which current cardiac phase can be determined from the images themselves. (App. Br. 14.) Specifically, Heuscher collects all the data over the heart cycles using an electrocardiogram unit to measure the motion phase, which fails to disclose “deriving the motion phase from images,” as recited by claim 4. (*Id.*)

The Examiner responds to Appellants’ arguments regarding Heuscher by finding that Heuscher discloses “a window processor for extracting a cardiac state or motion phase where the cardiac state can be extracted from the CT images themselves through iterative reconstruction (Heuscher at page 4/par. 48-49.)” (Ans. 16-17.) We note that this finding was made known to Appellants in the Final Rejection, which rejected claim 4 on the basis of specific findings in Heuscher, not YOU. (Final Rej. 8-9.)

In their Reply, and for the first time, Appellants raise new arguments that were not necessitated by the Examiner’s Answer. First, without a supporting declaration or affidavit, Appellants argue the faults of the iterative reconstruction in Heuscher. (Reply 9.) However, factual assertions of inoperability of the prior art, as argued by counsel without a supporting declaration, have no probative value. *Meitzner v. Mindick*, 549 F.2d 775, 782 (CCPA 1977); *see also* MPEP § 716.01(c).

Next, Appellants argue that Heuscher does not teach a motivation to modify YOU to incorporate the iterative reconstruction of the 3D images

taught in Heuscher. (*Id.*) We note that Appellants argument deals with the alleged lack of teaching in the reference itself to provide an explicit motivation to combine. However, “[t]he obviousness analysis cannot be confined by a formalistic conception of the words teaching, suggestion, and motivation, or by overemphasis on the importance of published articles and the explicit content of issued patents. The diversity of inventive pursuits and of modern technology counsels against limiting the analysis in this way.” *KSR Int’l v. Teleflex Inc.*, 550 US 398, 419 (2007). A reason to combine teachings from the prior art “may be found in explicit or implicit teachings within the references themselves, from the ordinary knowledge of those skilled in the art, or from the nature of the problem to be solved.” *WMS Gaming Inc. v. Int’l Game Tech.*, 184 F.3d 1339, 1355 (Fed. Cir. 1999) (citing *In re Rouffet*, 149 F.3d 1350, 1357 (Fed. Cir. 1998)). Nevertheless, because this is a new argument raised on the Reply Brief, and not necessitated by the Examiner’s Answer, we decline to address it on the merits.

Accordingly, we are not persuaded that the Examiner erred in finding that the combination of YOU in view of Heuscher teaches this limitation.

9. *Issue Concerning the Combination of Shah and YOU – Claims 5-6*

Claim 5 requires that the monitoring device of claim 1 comprise “an apparatus for forcing an externally prescribed movement of the joint.” The Examiner rejects claim 5 over a combination of YOU in view of Heuscher, and in further view of Shah. (Ans. 9.) “Shah discloses a support means attached near a joint for oscillating a patient’s joint along a predetermined

path such that magnetic resonance images may be taken of the moving joint.” (Ans. 9.) Claim 6 requires synchronization of the joint movement with the generation of the 2D projections by the X-ray device. (*See* App. Br. Claims Appendix 23.) The Examiner rejects claim 6 over the same combination of YOU in view of Heuscher, and in further view of Shah. (Ans. 9-10.)

Appellants contend that the Examiner’s rejection of dependent claim 5 is in error because there is no teaching or motivation to add the cyclic movement device disclosed in Shah with the device in YOU. (App. Br. 14.) Specifically, Appellants argue that because YOU does not disclose a joint moving repeatedly through prescribed motion phases, adding an apparatus that forces the cyclic movement of a joint would not correct the deficiency in YOU. (*Id.*) Appellants offer similar arguments concerning the improper combination of Shah with YOU or Heuscher with reference to claim 6.<sup>2</sup> (App. Br. 14-15.)

The Examiner responds that YOU discloses a treadmill so that the patient or subject may repeatedly move its joints to walk in accordance with the pace set by the treadmill. (Ans. 17.) The Examiner finds that a treadmill acts as an external force for dictating the movement of a joint as the patient or subject must repeatedly move its joints to walk along the conveyor belt of the treadmill to stay on the treadmill. (*Id.*) The Examiner further points out that Appellants admit Shah teaches a device attached near a joint for

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<sup>2</sup> Appellants do not argue the combination with Shah with reference to claim 9, and, therefore, we do not address that claim with regard to this issue. (App. Br. 18.)

oscillating a patient's joint along a predetermined path such that images may be taken of the moving joint. (Ans. 18.) As for motivation, the Examiner reasons that Shah's system is advantageous for obtaining dynamic information resulting from induced voluntary motion of the patient for proper diagnosis. (*Id.*) Further, a person of ordinary skill in the art would modify the cyclic movement of a joint in YOU with the teachings of Shah to include a device to include voluntary motion of a patient for imaging. (Ans. 18.)

Appellants respond to the Examiner's Answer by arguing that a treadmill does not dictate the movement of a joint since a patient can move in many different ways. (Reply 9.) Further, Appellants argue that the motion of the joint in YOU cannot be constrained because such motion is not natural and would not yield results based on normal motion patterns. (Reply 9-10.) In Appellants' view, YOU would have no need to fix the motion of the joint as taught by Shah, because YOU has the 3D model to which the fixed motion can be applied, saving the patient from irradiation. (Reply 10.)

We concur with the Examiner that the combination with Shah is proper. It is undisputed that Shah teaches a device that forces an externally prescribed movement of the joint. Also, as the Examiner correctly notes, YOU teaches cyclical movement by setting a pace of a patient walking on a treadmill. Such a pace puts the joint in cyclical motion. *See supra*, section 2. Thus, Appellants' argument that a combination of Shah and YOU fails because YOU does not teach the cyclical motion of a joint is unpersuasive. We also find unpersuasive the argument that constrained motion would be

unnatural and therefore not of interest to YOU's study. Such arguments directly contradict YOU's disclosure of tests performed on a tibia "held fixed in a vice attached to a computer-controlled stepper motor driven positioning system capable of two-axis linear movement and single-axis rotation." YOU at 520. Finally, any subject of YOU's tests, whether in fixed or free motion, would be exposed to the irradiation disclosed in YOU for obtaining the 2D projections on which to base the study. Manipulation of the 3D model in YOU, without the benefit of the 2D projections of the joint in motion, defeats the purpose of and is contrary to YOU's teachings. Therefore, Appellants' argument that YOU would have no need to fix the motion as taught by Shah because of the hypothetical manipulation of the 3D model alone is unpersuasive.

Accordingly, we are not persuaded that the Examiner erred in combining YOU with Heuscher and Shah to teach the limitation of claim 5. Although we have dealt, in a separate section *supra*, with the merits of Appellants' arguments concerning claim 6, to the extent Appellants argue that the Examiner's reasons to combine Shah and YOU are improper with regard to claim 6, we find those arguments unpersuasive for the same reasons stated here with respect to claim 5.

*10. Issues Concerning Movement From Different Directions and "Total Number of 2D Projections in the Series is an Integer Multiple" – Claims 8 and 10*

Appellants contend that claims 8 and 10 call for movement to be from "different directions." (App. Br. 16, 19.) Specifically, Appellants argue that the 2D images in YOU are generated as the joint moves in a single direction.

(*Id.*) With respect to Heuscher, Appellants argue that the heart in Heuscher does not move back and forth in different directions, which fails to meet the alleged limitation of “movement from different directions.” (*Id.*).

The Examiner responds that claims 8 and 10 do not call for the movement of the joint to be from different directions, but that the “different directions” limitation refers to taking the projections from different directions. (Ans. 22, 28.) The Examiner finds that Heuscher discloses a CT scanner with a rotational X-ray device to take 2D X-ray projections of a heart or non-stationary object from different directions. (Ans. 22.)

In their Reply Brief, Appellants change their initial position and argue that the limitation of claim 8 refers to directions from which transmission data must be collected. (Reply 12.) Specifically, Appellants contend that the Examiner fails to explain how Heuscher’s disclosure of a rotating gantry CT scanner would teach one to modify YOU to rotate and do so while maintaining an imaging diameter large enough for full-motion kinematics. (*Id.*)

First, Appellants’ opening remarks are moot in light of the change in argument presented in the Reply; so we consider the opening arguments moot. Furthermore, we note that Appellants’ argument in the Reply is in the same vein as the arguments presented with respect to the rotational X-ray limitation of claim 1. As such, we rely on our conclusions and findings stated with respect to claim 1 to find no Error in the Examiner’s combination of YOU and Heuscher as teaching that 2D projections are generated from different directions. We further note that claims 8 and 10 do not recite the limitation of a rotational X-ray device, and therefore, the rotating CT

scanner of Heuscher is not necessary for the rejection of claims 8 and 10. Indeed, we find that YOU teaches generating 2D projections from different directions as it discloses two X-ray sources and corresponding cameras for obtaining 2D projections from two different directions. YOU fig.1; *see also* Final Rej. 5-6 (stating that YOU discloses a radiograph system containing two X-ray generators configured in a custom gantry for generating biplane X-ray projections of a joint from different directions while the joint of a patient is moving on a treadmill at the center of the system).

Lastly, Appellants raise the argument that claims 8 and 10 call for the total number of 2D projections in the series to be an integer multiple of the number of phases within one cycle of the joint motion. (App. Br. 16, 19.) Appellants did not raise this argument with respect to claim 1, so we do not consider these arguments with respect to that claim.

In Appellants' view, YOU does not meet this claim limitation because there is no cyclic motion. (App. Br. 16, 19.) And in Heuscher, Appellants assert, data is only acquired in a single cardiac phase, failing, thus, to teach that the total number of projections is an integer multiple of the total number of phases within one cycle of joint motion. (App. Br. 16, 19.)

The Examiner did not respond to these particular arguments in the Answer. However, we note that Appellants' arguments are supported by disputed facts the Examiner addressed with respect to claims 8 and 10. For example, the Examiner finds that YOU teaches the movement of a joint in a cyclic manner and the study of different motion phases (Ans. 21-22, 27-28), contrary to Appellants' argument. And the Examiner finds that Heuscher teaches dynamic imaging of a heart over the various cardiac states of a

cardiac cycle, and not a single cardiac phase as Appellants argue. (Ans. 25, 31.) As such, Appellants' arguments concerning the deficiencies in YOU and Heuscher with reference to the limitation-at-issue – total number of 2D projections in the series is an integer multiple – are unpersuasive.

In the Reply Brief, Appellants raised new factual arguments concerning the alleged failure of YOU and Heuscher to disclose the limitation-at-issue. We fail to see how the Examiner's Answer necessitated any of these new arguments. As such, we consider them waived. *Ex parte Borden*, 93 USPQ2d at 1474. Likewise, although unrelated to the limitation-at-issue, we consider waived the arguments appended to the end of the Reply Brief at pages 16-17, in which Appellants argue for the first time, and without good cause, that the combination of Heuscher and YOU operates in different ways to achieve different results for a different purpose.

### CONCLUSIONS

We conclude that the Examiner did not err in rejecting claims 1-2, 4, 7-8, and 10 under 35 U.S.C. § 103(a) as being unpatentable over YOU in view of Heuscher.

Further, we conclude that the Examiner did not err in rejecting claim 3 under 35 U.S.C. § 103(a) as being unpatentable over YOU in view of Heuscher, and in further view of Latypov.

Finally, we conclude that the Examiner did not err in rejecting claims 5-6 and 9 under 35 U.S.C. § 103(a) as being unpatentable over YOU in view of Heuscher, and in further view of Shah.

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**DECISION**

The Examiner's decision to reject claims 1-10 as being unpatentable under 35 U.S.C. § 103(a) is affirmed.

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

**AFFIRMED**

msc