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UNITED STATES PATENT AND TRADEMARK OFFICE

BEFORE THE PATENT TRIAL AND APPEAL BOARD

Ex parte BERNARD CHALMOND, ALAIN TROUVE, YONG YU, JIAPING WANG, OLIVIER RENAUD, and SPENCER SHORTE

Appeal 2017-000538
Application 12/739,006[1]
Technology Center 3600

Before PHILIP J. HOFFMANN, BRUCE T. WIEDER, and KENNETH G. SCHOPFER, *Administrative Patent Judges*.

WIEDER, *Administrative Patent Judge*.

DECISION ON APPEAL

This is a decision on appeal under 35 U.S.C. § 134 from the Examiner's rejection of claims 1–30. We have jurisdiction under 35 U.S.C. § 6(b).

We REVERSE.

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[1] According to Appellants, the real party in interest is Centre National de la Recherche Scientifique Institut Pasteur. (Appeal Br. 2.)

CLAIMED SUBJECT MATTER

Appellants' claimed "invention relates to a method of reconstructing the volume of an object from a sequence of section images of said object, the positions of said sections relative to the object being known in uncertain manner." (Spec. 1, ll. 3–6.) "The invention applies in particular . . . to confocal microscopy." (*Id.* at 1, ll. 7–8.)

Claim 1 is illustrative of the claims on appeal. It recites:

> 1. A method of reconstructing the volume of an object from a sequence of section images of said object acquired by an observation instrument, said sections corresponding to different positions and/or orientations of an acquisition plane relative to the object, said positions and/or orientations being subject to random movements, the method being carried out using a data processor and comprising the following steps:
>
> a) selecting a finite base of functions representative of densities on which the volume for reconstruction can be decomposed, each spatial function being represented by a finite number of coefficients, and implementing the base in a data processor device;
>
> b) selecting and implementing in the data processor device a first quantification function for quantizing the difference between the real position and/or orientation of each section relative to said object and its nominal position and/or orientation, said difference being representative of said random movements;
>
> c) selecting and implementing in the data processor device a second quantification function for quantizing the spatial coherence of the reconstructed volume;
>
> d) selecting and implementing in the data processor device a third quantification function for quantizing the difference between the section images of the object and the corresponding sections of the reconstructed volume;
>
> e) selecting and implementing in the data processor device an overall cost function, of value that depends on the values of said first, second, and third quantizing functions;

f) jointly estimating by the data processor device the real positions and/or orientations of the sections, in combination with the coefficients for decomposing the volume of the object on said function base, by minimizing said overall cost function; and

g) using a reconstruction algorithm to generate and display the volume of the object from the estimated coefficients and the function base.

REJECTIONS

Claims 1–30 are rejected under 35 U.S.C. § 101 as claiming ineligible subject matter.

Claims 1–3, 7–15, 21, 23–26, and 29 are rejected under 35 U.S.C. § 103(a) as unpatentable in view of Edic (US 2003/0123718 A1, pub. July 3, 2003) and Kaufman (US 2003/0095693 A1, pub. May 22, 2003).

Claims 4 and 5 are rejected under 35 U.S.C. § 103(a) as unpatentable in view of Edic, Kaufman, and Horn (US 2004/0117403 A1, pub. June 17, 2004).

Claim 6 is rejected under 35 U.S.C. § 103(a) as unpatentable in view of Edic, Kaufman, and Reeves (US 2004/0252870 A1, pub. Dec. 16, 2004).

Claims 16, 17, and 22 are rejected under 35 U.S.C. § 103(a) as unpatentable in view of Edic and Krucinski (US 7,398,047 B2, iss. July 8, 2008).

Claims 18 and 19 are rejected under 35 U.S.C. § 103(a) as unpatentable in view of Edic, Krucinski, and Kenet (US 5,836,872, iss. Nov. 17, 1998).[2]

[2] Claim 16 recites, in part, "estimating the relative positions and orientations of the observation plane for each of the sections of said sequences by a

Claims 27, 28, and 30 are rejected under 35 U.S.C. § 103(a) as unpatentable in view of Edic, Kaufman, and Meyer (US 2008/0285827 A1, pub. Nov. 20, 2008).

ANALYSIS

The § 101 rejection of claims 1–30

"Whoever invents or discovers any new and useful process, machine, manufacture, or composition of matter, or any new and useful improvement thereof, may obtain a patent therefor, subject to the conditions and requirements of this title." 35 U.S.C. § 101. Section 101, however, "'contains an important implicit exception: Laws of nature, natural phenomena, and abstract ideas are not patentable.'" *Alice Corp. Pty. Ltd. v. CLS Bank Int'l*, 134 S. Ct. 2347, 2354 (2014) (quoting *Assoc. for Molecular Pathology v. Myriad Genetics, Inc.*, 569 U.S. 576, 589 (2013)).

Alice applies a two-step framework, earlier set out in *Mayo Collaborative Services v. Prometheus Laboratories, Inc.*, 566 U.S. 66 (2012), "for distinguishing patents that claim laws of nature, natural phenomena, and abstract ideas from those that claim patent-eligible applications of those concepts." *Alice*, 134 S. Ct. at 2355.

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method according to claim 1." Claims 17–19 depend from claim 16, and claim 22 recites "using a method according to claim 16." The Examiner does not indicate reliance on Krucinski or Kenet to address the deficiency in Edic for which the Examiner relies on Kaufman in rejecting claim 1. (*See* Final Action 5, 16–18.) Therefore, we treat the omission of Kaufman from the rejection of claims 16, 17, and 22, and from the rejection of claims 18 and 19, under § 103(a), as inadvertent.

Under the two-step framework, it must first be determined if "the claims at issue are directed to a patent-ineligible concept." *Id.* If the claims are determined to be directed to a patent-ineligible concept, then the second step of the framework is applied to determine if "the elements of the claim . . . contain[] an 'inventive concept' sufficient to 'transform' the claimed abstract idea into a patent-eligible application." *Id.* at 2357 (citing *Mayo*, 566 U.S. at 72–73, 79).

With regard to step one of the *Alice* framework, the Examiner determines that "[c]laims 1-30 are directed to [the] abstract idea of mathematical operation for processing image data which is considered to be an organizing human activities processing mathematical operation." (Final Action 2.) Additionally, the Examiner determines that this abstract idea "is analogous to the court-defined abstract idea in *Digitech* in that it organizes information (sequence of section images) through mathematical correlations (a finite base function, first, second and third quantification function, overall cost function, reconstruction algorithm etc.)." (Answer 8.)

Appellants disagree and argue that "the claims recite a specific invention having improved functionality for reconstructing the volume of an object from a sequence of section images of said object acquired by an observation instrument." (Supp. Appeal Br. 3.) Appellants analogize their claims to those in *McRO, Inc. v. Bandai Namco Games Am. Inc.*, 837 F.3d 1299 (Fed. Cir. 1016). (*Id.*) In particular, Appellants argue that

> the process here is [a] "process specifically designed to achieve an improved technological result in conventional industry practice," and therefore is not directed to an abstract idea. [*McRO*, 837 F.3d at 1316.]
>
> As such, the independent claims are not drawn merely to the idea of using various mathematical formulas for

> reconstructing the volume of an object from a plurality of section image sequence, but instead recite exactly how the volume of an object is reconstructed from a sequence of section images of said object acquired by an observation instrument, said sections corresponding to different positions and/or orientations of an acquisition plane relative to the object, said positions and/or orientations being subject to random movements.

(Supp. App. Br. 3, emphasis omitted.)

McRO involved "[a] method for automatically animating lip synchronization and facial expression of three-dimensional characters." *McRO*, 837 F.3d at 1307. The court determined that the relevant claim was "focused on a specific asserted improvement in computer animation, i.e., the automatic use of rules of a particular type." *Id.* at 1314. In particular, the process claimed in *McRO* "uses a combined order of specific rules that renders information into a specific format that is then used and applied to create desired results." *Id.* at 1315. Additionally, "[t]he limitations in claim 1 prevent preemption of all processes for achieving automated lip-synchronization of 3-D characters." *Id.* The court cautioned against oversimplifying the claims in carrying out the analysis under *Alice* and, in particular, cautioned against looking at the claims "generally and failing to account for the specific requirements of the claims." *Id.* at 1313.

Appellants' Specification describes several prior art techniques. The Specification discloses a prior art technique

> that enables an image to be obtained of a section of an object such as a cell, said section corresponding to the focal plane of the microscope. By successively shifting the focal plane, a series of two-dimensional images are acquired from which the volume of the object can be reconstructed in three dimensions.

(Spec. 2, ll. 4–10.) But, the Specification discloses, "[t]hat technique can be applied only to articles that are capable of being fixed to a substrate." (*Id.* at 2, ll. 11–12.)

The Specification discloses another prior art technique in which an object is placed in suspension in a container. (*Id.* at 2, ll. 16–19.) "The main limitation of that technique lies in the fact that the movement of the object in the container can be controlled in imperfect manner only." (*Id.* at 2, ll. 30–32.) But, the Specification discloses, attempts to take into account the movement uncertainties "do[] not provide a satisfactory estimate of the random movements in translation and/or rotation." (*Id.* at 3, ll. 12–14.)

The Specification describes the present invention as "provid[ing] methods enabling the volume of an object to be reconstructed on the basis of a section image sequence, these methods being applicable even when the positions and/or the orientations of the sections in the volume of said object are subject to uncertainty." (*Id.* at 3, ll. 16–21.) In other words, the Specification discloses an improved method for reconstructing the volume of an object.

Additionally, in determining to what claim 1 is directed, we note that claim 1 recites "[a] method of reconstructing the volume of an object from a sequence of section images of said object acquired by an observation instrument . . . comprising the following steps: a) selecting a finite base of functions representative of densities," "b) selecting and implementing . . . a first quantification function for quantizing the difference between the real position . . . of each section . . . and its nominal position," "c) selecting and implementing . . . a second quantification function for quantizing the spatial coherence of the reconstructed volume," "d) selecting and implementing . . .

a third quantification function for quantizing the difference between the section images . . . and the corresponding sections of the reconstructed volume," "e) selecting and implementing . . . an overall cost[3] function," "f) jointly estimating . . . the real positions . . . of the sections," "and g) using a reconstruction algorithm to generate and display the volume of the object." In short, the claim recites a particular asserted improved method for reconstructing the volume and, thus, does not preempt all methods for doing so.

In view of the above, we are persuaded that the Examiner "fail[ed] to account for the specific requirements of the claim[]" and did not adequately address the question of whether the claimed invention is directed to an improvement in a technology, i.e., "reconstructing the volume of an object from a sequence of section images of said object acquired by an observation instrument." *See McRO*, 837 F.3d at 1313; *see also* Claim 1.

The Examiner's subsequent analysis of whether the claims are directed to patent-eligible subject matter proceeds from this flawed determination of to what the claims are directed.

Therefore, we find that the Examiner does not sufficiently establish that the claims are directed to an abstract idea under step one of the *Alice* framework. *See Alice*, 134 S. Ct. at 2355. We will reverse the rejection of claim 1 under § 101. Claims 16, 21, 22, 23, and 29 all refer either directly or indirectly to claim 1, although they are not written in traditional dependent claim format. Claim 16 recites "estimating relative positions . . . by a method according to claim 1," claim 21 recites "a preliminary reconstruction

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[3] The Specification refers to "selecting an overall cost function or 'coherence function.'" (Spec. 17, ll. 25–26.)

of said volume . . . using a method according to claim 1," claim 22 recites "a preliminary reconstruction of said volume . . . using a method according to claim 16," claim 23 recites "a preliminary reconstruction of said volume . . . by a method according to claim 1," and claim 29 recites "the data processor adapted to implement a method according to claim 1." For the reasons discussed above, we find that the Examiner does not sufficiently establish that claims 16, 21, 22, 23, and 29, and dependent claims 2–15, 17–20, 24–28, and 30, are directed to an abstract idea under step one of the *Alice* framework.

The § 103(a) rejections of claims 1–30

As an initial matter, Appellants argue that Edic is non-analogous art. (Appeal Br. 4–5.)

"The analogous-art test requires that the Board show that a reference is either in the field of the applicant's endeavor or is reasonably pertinent to the problem with which the inventor was concerned in order to rely on that reference as a basis for rejection." *In re Kahn*, 441 F.3d 977, 986–87 (Fed. Cir. 2006). In determining the field of endeavor, "the examiner and the Board must consider the 'circumstances' of the application—the full disclosure—and weigh those circumstances from the vantage point of the common sense likely to be exerted by one of ordinary skill in the art in assessing the scope of the endeavor." *In re Bigio*, 381 F.3d 1320, 1326 (Fed. Cir. 2004).

The Examiner finds that Edic is analogous art and that "Edic and [the] current invention [are] both directed to [the] field of reconstructing the volume of [an] object from a sequence of section images and solve [a]

particular problem of accounting [for] differences due to movements in rotation of the section planes." (Answer 3.)

Appellants argue that Edic "describes a method for taking multiple x-rays of a beating heart such that each x-ray is taken when the heart is at the same point in the cardiac cycle." (Appeal Br. 4.) In contrast, Appellants argue, the "claimed invention is directed to confocal microscopy." (*Id.*, emphasis omitted.) In particular, Appellants argue that "Edic and the claimed invention are not directed to the same field of endeavor" because "Edic's process for scanning a cyclically moving object with a CT imaging system [is] not in the same field of endeavor as utilizing confocal microscopy for the reconstruction of a microscopic object." (*Id.* at 5.)

Appellants further argue that

> Edic is not reasonably pertinent because it neither (1) addresses the same problem (e.g., reconstruction of a microscopic object where the positions and the orientations of the section planes relative to the object are uncertain) nor (2) serves the same purpose as the device of claim 1 (e.g[.], confocal microscopy).

(*Id.* at 6.)

We do not find these arguments persuasive of error. First, Appellants do not point to any language in claim 1 limiting the scope of the claim to confocal microscopy or to the reconstruction of microscopic objects. Second, Appellants' Specification discloses that "the invention is not limited to the field of microscopy." (Spec. 11, ll. 3–4.)

With regard to limitation "a" of claim 1, Appellants argue that "Edic fails to teach or suggest 'selecting a finite base of functions representative of densities on which the volume for reconstruction can be decomposed … .'" (Appeal Br. 8.) Specifically, Appellants argue that the Examiner "confuses the division of a period of the cyclically moving object into a discrete

number of phases with the decomposition of the volume of reconstruction into a finite base of functions." (*Id.*) Moreover, Appellants argue, this limitation "cannot be interpreted as equivalent to the selecting of phases and identifying projection data at a phase in Edic since a function cannot be compared to an image (projection data)." (*Id.*)

However, it is the disclosure in Edic of "identifying an initial set of projection data at a desired phase of a first cycle at a first angle, identifying at least one subsequent set of projection data at the same desired phase of a subsequent cycle at an angle that is different from the first angle" (Edic ¶ 8), that the Examiner considers "as a finite base of functions" (Answer 4). In other words, the Examiner considers Edic's disclosure not of just a lone image, but of an initial set of projection data and at least one subsequent set of projection data, as disclosing a finite base of functions. Therefore, we do not find Appellants' argument persuasive of error.

Additionally, Appellants assert, but do not persuasively argue *why*, under a broadest reasonable interpretation of "function," "a function cannot be compared to an image (projection data)." (Appeal Br. 8.) Nor do Appellants persuasively argue *why*, under a broadest reasonable interpretation of "function," an initial set of projection data and at least one subsequent set of projection data does not disclose a finite base of functions.

Also with regard to limitation "a" of claim 1, Appellants argue that the Examiner erred in finding that Kaufman discloses "selecting a finite base of functions representative of densities on which the volume for reconstruction can be decomposed, each spatial function being represented by a finite number of coefficients." (Appeal Br. 12.) In particular, Appellants argue that "Kaufman is directed to using 2D image filtering to

provide a particular spatial resolution" and that "Kaufman fails to provide any disclosure, teaching, or suggestion in regard to volume reconstruction." (*Id.*) Appellants acknowledge that Kaufman discloses using filters "on a reconstructed image to adjust the resolution . . . to a desired value," and "measuring . . . spatial resolution, where the spatial resolution of [a] phantom [i.e., known object provided for calibration] can be determined using a particular set of expressions." (*Id.*)

The Examiner finds that "Kaufman teaches selecting a finite base of functions representative of densities on which the volume for reconstruction can be decomposed, each spatial functions [sic] being represented by a finite number of coefficients; (See at least paragraph [0020] & [0091]-[0095])." (Final Action 5, emphasis omitted.) Specifically, the Examiner finds "that spatial resolution is a term that refers to the number of pixels utilized in construction of a digital image. The spatial resolution of a digital image is related to the spatial density of the image and optical resolution of the microscope used to capture the image." (Answer 7, citing Kaufman ¶¶ 85–88.)

Appellants' Specification discloses that "[t]he idea on which the present invention is based is to estimate simultaneously the positions $\{\Phi_i\}$ of the sections and the function $\underline{f}$ of the densities of the object. . . . The estimated volume is determined so as to optimize the spatial coherence of the densities of the volume." (Spec. 14, ll. 22–28.) In other words, the Specification refers to the spatial density of the object rather than spatial density of the image. Applying a broadest reasonable interpretation, we determine that here, the claim term density refers to object density. The Examiner does not provide sufficient articulated reasoning for us to fully

evaluate the Examiner's position as to why the disclosure in Kaufman of measuring spatial resolution, i.e., the number of pixels utilized in constructing the image, and its relation to the image density (Answer 7), teaches "selecting a finite base of functions representative of [object] densities on which the volume for reconstruction can be decomposed."

Therefore, we reverse the rejection of claim 1 under § 103(a). For the same reason, we also reverse the rejection of claims 2, 3, 7–15, 21, 23–26, and 29. The additional art relied on by the Examiner in rejecting claims 4–6, 16–19, 22, 27, 28, and 30 does not cure to above noted deficiency and, therefore, we also reverse the rejection of claims 4–6, 16–19, 22, 27, 28, and 30 under § 103(a).

DECISION

The Examiner's rejection of claims 1–30 under 35 U.S.C. § 101 is reversed.

The Examiner's rejections of claims 1–19 and 21–30 under 35 U.S.C. § 103(a) are reversed.

REVERSED