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EXAMINER

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UNITED STATES PATENT AND TRADEMARK OFFICE

BEFORE THE PATENT TRIAL AND APPEAL BOARD

Ex parte WEI SHAO and SONGHUA CHEN

Appeal 2018-005435
Application 14/397,835
Technology Center 2800

Before ADRIENE LEPIANE HANLON, N. WHITNEY WILSON, and
LILAN REN, *Administrative Patent Judges*.

WILSON, *Administrative Patent Judge*.

DECISION ON APPEAL

Appellants¹ appeal under 35 U.S.C. § 134(a) from the Examiner's October 27, 2017 decision finally rejecting claims 1–25 (“Final Act.”). We have jurisdiction over the appeal under 35 U.S.C. § 6(b).

We reverse.

¹ Appellants identify the real party in interest as Halliburton Energy Services, Inc. (Appeal Br. 3).

CLAIMED SUBJECT MATTER

Appellants' invention relates to a method of training a subterranean formation permeability model based on nuclear magnetic resonance (NMR) data, a system which can be used to carry out the method, and a non-transitory computer readable medium storing instructions that are operable to carry out the steps of training the model (Abstract). Details of the claimed invention are set forth in representative claims 1 and 9, which are reproduced below from the Claims Appendix to the Appeal Brief:

1. A method of training a subterranean formation permeability model based on nuclear magnetic resonance (NMR) data, the method comprising:
 - acquiring NMR measurements associated with at least one subterranean region using a downhole NMR logging tool;
 - accessing a plurality of relaxation-time distributions generated from the NMR measurements;
 - normalizing the plurality of relaxation-time distributions;
 - generating multiple sets of principal components from the normalized relaxation-time distributions by applying a principle component analysis to the normalized relaxation-time distributions, each set of principal components representing a respective one of the normalized relaxation-time distributions;
 - computing parameters for a plurality of weighted radial basis functions based on the sets of principal components and measured permeability values of the at least one subterranean region; and
 - producing a subterranean formation permeability model that includes the weighted radial basis functions and the computed parameters.

9. A system comprising:

a downhole NMR logging tool adapted to acquire NMR measurements of at least one subterranean region;

a computing system comprising:

a communication interface operable to receive the NMR measurements; and

a data processing apparatus operable to perform operations that include:

generating a plurality of relaxation-time distributions from the NMR measurements;

normalizing the plurality of relaxation-time distributions;

generating multiple sets of principal components from the normalized relaxation-time distributions by applying a principle component analysis to the normalized relaxation-time distributions, each set of principal components representing a respective one of the relaxation-time distributions;

computing parameters for a plurality of weighted radial basis functions based on the sets of principal components and measured permeability values of the at least one subterranean region; and

producing a subterranean formation permeability model that includes the weighted radial basis functions and the computed parameters.

REJECTIONS

I. Claims 1–25 are rejected under 35 U.S.C. § 101 for being directed to non-statutory subject matter.

II. Claims 1, 2, 5–12, 15–19, and 22–25 are rejected under 35 U.S.C. § 103(a) as unpatentable over Wu² in view of Niemeyer.³

III. Claims 3, 4, 13, 14, 20, and 21 are rejected under 35 U.S.C. §103(a) as unpatentable over Wu in view of Niemeyer, and further in view of Parker.⁴

DISCUSSION

Rejection I. Claims 1–25 are rejected under 35 U.S.C. § 101 for being directed to non-statutory subject matter (Final Act. 2–4). The Examiner finds that each of the claims is directed to the abstract idea of a mathematical algorithm for producing/training a subterranean formation permeability model (Final Act. 2). The Examiner further finds that the claims do not include:

[a]dditional elements that are sufficient to amount to significantly more than the judicial exception because the additional element(s) or combination of elements in the claim(s) other than the abstract idea per se amount(s) to no more than: mere instructions to implement the idea on a computer, and/or recitation of generic computer structure that serves to perform generic computer functions that are well-understood, routine, and conventional activities previously known to the pertinent industry [The recited computing system, communication interface, data processing apparatus, and computer readable medium amount to the recitation of general purpose computer components. The recited NMR measurement system of Claim 9 does not distinguish the claim from the recitation of the abstract idea itself because such a system would be required in order to obtain the information used by the algorithm. The laboratory NMR system of Claim 11 does not distinguish from the recitation of the abstract idea itself because, under a reasonably broad

² Wu et al., US 2012/0065888 A1, published March 15, 2012.

³ Niemeyer et al., US 2009/0125239 A1, published May 14, 2009.

⁴ Parker et al., US 2002/0146160 A1, published October 10, 2002.

interpretation of that term, a laboratory NMR system would be read on by a general purpose computer. The recitation of a downhole NMR logging tool does not distinguish that claim from the recitation of the abstract idea because the use of such a tool in logging underground NMR data is a well-understood, routine, and conventional practice [*For example see Paragraph [0060] of Wu et al. (US 2012/0065888 A 1) - "At 903, NMR measurements are made using a sensor on a wireline or while drilling." See Paragraph [0046] of Niemeyer (US 2009/0125239 A 1) - "The drilling assembly 90 makes various measurements including the pulsed nuclear magnetic resonance measurements while the borehole 26 is being drilled.*]. Viewed as a whole, these additional claim element(s) do not provide meaningful limitation(s) to transform the abstract idea into a patent eligible application of the abstract idea such that the claim(s) amounts to significantly more than the abstract idea itself. Therefore, the claim(s) are rejected under 35 U.S.C. 101 as being directed to non-statutory subject matter.

(Final Act. 3–4).

The Supreme Court has long held that “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.*, 133 S. Ct. 2107, 2116 (2013)). The “abstract ideas” category embodies the longstanding rule that an idea, by itself, is not patentable. *Alice*, 134 S. Ct. at 2354 (quoting *Gottschalk v. Benson*, 409 U.S. 63, 67 (1972)).

In *Alice*, the Supreme Court reiterated an analytical two-step framework previously set forth in *Mayo Collaborative Servs. v. Prometheus Labs., 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 Corp.*, 134 S. Ct at 2355. The first step in the analysis is to “determine whether the claims at issue are directed to one of those patent-ineligible concepts,” such as an

abstract idea. *Id.* If the claims are directed to a patent-ineligible concept, the second step in the analysis is to consider the elements of the claims “individually and ‘as an ordered combination’” to determine whether there are additional elements that “‘transform the nature of the claim’ into a patent-eligible application.” *Id.* (quoting *Mayo*, 566 U.S. 66 at 79, 78). In other words, the second step is to “search for an ‘inventive concept’—*i.e.*, an element or combination of elements that is ‘sufficient to ensure that the patent in practice amounts to significantly more than a patent upon the [ineligible concept] itself.’” *Id.* (brackets in original) (quoting *Mayo*, 566 U.S. 66 at 72–73).

Appellants make three general arguments urging that the § 101 rejections should be reversed: (1) the claims “do not tie up a mathematical relationship or algorithm” (Appeal Br. 7); (2) the claims as a whole amount to significantly more than an abstract idea (Appeal Br. 8); (3) the claims effect a transformation of an article into a different state (Appeal Br. 9)

In this instance, we agree with Appellants that the claims are not directed to an abstract idea. Instead, the claims are directed to specific process steps for producing a subterranean formation permeability model from NMR measurements made using a downhole NMR logging tool. The claims do not preempt the use of such NMR measurements for producing a subterranean formation permeability model, but recite a specific series of steps to solve the problem of creating such a model. *See, e.g., McRO, Inc. v. Bandai Namco Games Am. Inc.*, 837 F.3d 1299 (Fed. Cir. 2016).

Moreover, as argued by Appellants, the claims are directed to an improvement in a technical field, in particular the field of well logging and geophysical applications. Therefore, even if the claims were directed to an

abstract idea (which we do not determine to be the case), the claims as a whole would amount to significantly more than simply an abstract idea.

Accordingly, we agree with Appellants that the claims do constitute patentable subject matter, and reverse the rejection under §101.

Rejection II. With regards to claim 1, the Examiner finds that Wu discloses a system for a method of training a subterranean formation permeability model based on NMR data (Final Act. 4, citing Wu, ¶ 46). The Examiner further finds that Wu discloses (a) acquiring NMT measurements associated with at least one subterranean region using a downhole NMR logging tool, and (b) accessing a plurality of relaxation-time distributions generated from the NMR measurements (Final Act. 5, citing Wu ¶¶ 46, 54, 60). The Examiner further finds that Wu fails to disclose normalizing the plurality of relaxation-time distributions; or generating multiple sets of principal components from the normalized relaxation-time distributions by applying a principle component analysis to the normalized relaxation time distributions, each set of principal components representing a respective one of the normalized relaxation-time distributions (Final Act. 5).

The Examiner finds that Niemeyer discloses the use of principal component analysis on normalized sample data sets to reduce signal space and reduce noise (Final Act. 5–6, citing Niemeyer, ¶¶ 63, 64, 67). Therefore, according to Examiner, it would have been obvious to use this analysis on Wu’s data sets to reduce signal space and/or reduce noise (Final Act. 6). The Examiner further finds that the combination of Wu and Niemeyer would disclose the remaining limitations of claim 1 (Final Act. 6–7).

Appellants argue that the Examiner has not established an adequate reason to combine the teachings of Wu and Niemeyer (Appeal Br. 13). Appellants argue that because Wu's input relaxation-time distributions come from the laboratory core sample measurements, they have much smaller NMR measurement errors and do not require normalization (Appeal Br. 13–14).

Appellants further argue that the combination of Wu and Niemeyer do not teach or suggest “computing parameters for a plurality of weighted radial basis functions based on the sets of principal components and measured permeability values of the at least one subterranean region” (Appeal Br. 14–15). The Examiner finds that the parameters of the RBF interpolation of paragraphs 44–45 of Wu reads on these limitations when performed after performing normalization and PCA as taught by Niemeyer (Ans. 9–10). However, Appellants argue that the cited portions of Wu are silent with respect to using measured permeability values in computing parameters for radial basis functions (Reply Br. 10–11).

To establish a prima facie case of obviousness, the Examiner must show that each and every limitation of the claim is described or suggested by the prior art or would have been obvious based on the knowledge of those of ordinary skill in the art or the inferences and creative steps a person of ordinary skill in the art would have employed. *In re Fine*, 837 F.2d 1071, 1074 (Fed. Cir. 1988); *KSR Int'l Co. v. Teleflex Inc.*, 550 U.S. 398, 417 (2007). In the absence of a proper prima facie case of obviousness, an applicant who complies with the other statutory requirements is entitled to a patent. *In re Rouffet*, 149 F.3d 1350, 1355 (Fed. Cir. 1998); *see also In re Oetiker*, 977 F.2d 1443, 1445 (Fed. Cir. 1992). On the record before us, the

Examiner has not adequately shown that the limitation of “computing parameters for a plurality of weighted radial basis functions based on the sets of principal components and measured permeability values of the at least one subterranean region” was taught or suggested by, or otherwise rendered obvious, over the cited art. Accordingly, we reverse the rejection of claim 1. Moreover, because these limitations are common to each of the rejected claims, we reverse the obviousness rejection of each of these claims.

CONCLUSION

We REVERSE the rejection of claims 1–25 under 35 U.S.C. § 101 for being directed to non-statutory subject matter.

We REVERSE the rejection of claims 1, 2, 5–12, 15–19, and 22–25 under 35 U.S.C. § 103(a) as unpatentable over Wu in view of Niemeyer.

We REVERSE the rejection of claims 3, 4, 13, 14, 20, and 21 under 35 U.S.C. §103(a) as unpatentable over Wu in view of Niemeyer, and further in view of Parker.

REVERSED