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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
15/108,704	06/28/2016	Zitao Xu	001001.2014-IP-096412 US	4970
99701	7590	10/18/2018	EXAMINER	
Howard L. Speight 742 Central Avenue Napa, CA 94558			MARTELLO, EDWARD	
			ART UNIT	PAPER NUMBER
			2613	
			NOTIFICATION DATE	DELIVERY MODE
			10/18/2018	ELECTRONIC

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UNITED STATES PATENT AND TRADEMARK OFFICE

BEFORE THE PATENT TRIAL AND APPEAL BOARD

Ex parte ZITAO XU, GENBAO SHI, ANDRES CESAR CALLEGARI,
CHIKANG DAVID CHIEN, and JEFFREY MARC YARUS

Appeal 2018-005718
Application 15/108,704
Technology Center 2600

Before ALLEN R. MacDONALD, JASON V. MORGAN, and
SHARON FENICK, *Administrative Patent Judges*.

MacDONALD, *Administrative Patent Judge*.

DECISION ON APPEAL¹

Appellants appeal under 35 U.S.C. § 134(a) from a final rejection of claims 1–9 and 13–21, which are all of the pending claims. App. Br. 5. Appellants cancelled claims 10–12 and 22–24. Final Act. 16. We have jurisdiction under 35 U.S.C. § 6(b). We AFFIRM the rejection under 35 U.S.C. § 101. We REVERSE all other rejections.

¹ Appellants indicate the real party in interest is Landmark Graphics Corporation. App. Br. 1.

*Illustrative Claims*²

Illustrative claims 1 and 13 (the latter reproduced only in-part) under appeal read as follows (emphasis and bracketed materials added):

1. A method comprising:

- [A.] receiving a plurality of data points whose coordinates are established in a coordinate system comprising:
 - [i.] an x-axis along a first dimension;
 - [ii.] a y-axis along a second dimension orthogonal to the first dimension;
 - [iii.] a z-axis along a third dimension orthogonal to the first dimension and the second dimension;
 - [iv.] a time-axis along a fourth dimension orthogonal to the first dimension, the second dimension and the third dimension;
- [B.] selecting a consecutive set of data points comprising P1, P2, P3, and P4 wherein:
 - [i.] an x-axis coordinate of P1 < an x-axis coordinate of P2,
 - [ii.] the x-axis coordinate of P2 < an x-axis coordinate of P3, and
 - [iii.] the x-axis coordinate of P3 < an x-axis coordinate of P4;
- [C.] creating a first line through P1 and P3;

² Claims 1 and 13 are identical other than their preambles and trivial, non-substantive differences in the wording in steps [B], [D], and [F] of claim 1 and in the counterpart recitations of claim 13.

- [D.] creating a first tangent vector originating at P2, parallel to the first line, and having a direction such that the projection of the first tangent vector onto the x-axis is in the direction of a projection of P3 onto the x-axis;
 - [E.] creating a second line through P2 and P4;
 - [F.] creating a second tangent vector through P3, wherein the second tangent vector is parallel to the second line, originates at P3, is parallel to the second line, and has a direction such that the projection of the second tangent vector onto the x-axis is in the direction of a projection of P2 onto the x-axis;
 - [G.] creating a baseline through P2 and P3;
 - [H.] *creating a Bezier curve between P2 and P3, wherein the Bezier curve has a degree;* and
 - [I.] *determining the degree of the Bezier curve based on a comparison of the first tangent vector, the second tangent vector, and the baseline.*
13. *A non-transitory computer-readable medium, on which is recorded a computer program that, when executed, performs* a method comprising:
- ...
 - [B.] selecting a consecutive set of data points comprising *a P1, a P2, a P3, and a P4 point* wherein:
 - ...
 - [D.] creating a first tangent vector originating at P2, parallel to the first line, and having a direction such that the projection of the first tangent vector onto the x-axis is in the direction of a projection of P3 *on* the x-axis;
 - ...

- [F.] creating a second tangent vector through P3 ***parallel to the second line originating at P3, parallel to the second line***, and ***having*** a direction such that the projection of the second tangent vector onto the x-axis is in the direction of a projection of P2 ***on*** the x-axis;
- ...
- [I.] determining the degree of the Bezier curve based on a comparison of the first tangent vector, the second tangent vector, and the baseline.

*References*³

Sasaki	US 2002/0005856 A1	Jan. 17, 2002
Chen et al.	US 2005/0018885 A1	Jan. 27, 2005
Spicer et al.	US 2005/0246130 A1	Nov. 3, 2005

I. REJECTIONS⁴

I.A.

The Examiner rejects claims 1–9 and 13–21 under 35 U.S.C. § 101 “because the claimed invention is directed to a judicial exception (i.e., a law of nature, a natural phenomenon, or an abstract idea) without significantly more,” i.e., because the subject matter of the claimed invention is patent-ineligible. Final Act. 3.

For this rejection, Appellants argue claims 1–9 as a group. App. Br. 5–9. We select claim 1 as representative. *See* 37 C.F.R. § 41.37(c)(1)(iv) (2017). Appellants also argue claims 13–21 as a group, but only with

³ All citations herein to these references are by reference to the first named inventor only.

⁴ All citations herein to the “Final Action” are to a Final Action mailed on July 3, 2017.

reference to the arguments directed to claim 1. *See* App. Br. 9–10. However, as discussed below, at least one claim 1 argument is not reasonably applicable to claim 1, yet is applicable to claim 13. Therefore, we exercise our discretion and treat claims 13–21 as a separately argued group to the extent that any claim 1 arguments are uniquely applicable to claims 13–21. We select claim 13 as representative with respect to claims 13–21. Except for our ultimate decision, we do not discuss this rejection of claims 2–9 and 14–21 further herein.

I.B.

The Examiner rejects claims 13–21 under 35 U.S.C. § 112(b), as being incomplete for omitting essential elements where the omitted elements are: a specific means or structure for performing the methods of the claims. Final Act. 5.

For this rejection, Appellants argue claims 13–21 as a group. App. Br. 10–12. We select claim 13 as representative. *See* 37 C.F.R. § 41.37(c)(1)(iv) (2017). Except for our ultimate decision, we do not discuss this rejection of claims 14–21 further herein.

I.C.

The Examiner rejects claims 1, 9, 13, and 21 under 35 U.S.C. § 103(a) as being unpatentable over Chen. Final Act. 7–9.

For this rejection, Appellants argue claims 1, 9, 13, and 21 as a group. App. Br. 12–16. We select claim 1 as representative. *See* 37 C.F.R. § 41.37(c)(1)(iv) (2017). Except for our ultimate decision, we do not discuss this rejection of claims 9, 13, and 21 further herein.

I.D.

The Examiner rejects claims 2–7 and 14–19 under 35 U.S.C. § 103(a) as being unpatentable over the combination of Chen and Sasaki. Final Act. 9–16.

For this rejection, Appellants argue claims 2–7 and 14–19 as a group. App. Br. 16–18. We select claim 2 as representative. *See* 37 C.F.R. § 41.37 (c)(1)(iv) (2017). Except for our ultimate decision, we do not discuss this rejection of claims 3–7 and 14–19 further herein.

I.E.

The Examiner rejects claims 8 and 20 under 35 U.S.C. § 103(a) as being unpatentable over the combination of Chen, Sasaki, and Spicer. Final Act. 17.

For this rejection, Appellants argue patentability for claims 8 and 20 only by reference to claim 1. App. Br. 18. Thus, the rejection of these claims turns on our decision as to claim 1. Except for our ultimate decision, we do not discuss the § 103 rejection of claims 8 and 20 further herein.

Issues on Appeal

Has the Examiner erred in rejecting claims 1 and 13 as being patent-ineligible subject matter?

Has the Examiner erred in rejecting claim 13 as being incomplete?

Has the Examiner erred in rejecting claims 1 and 2 as being obvious?

II. ANALYSIS⁵

We have reviewed the Examiner’s rejections in light of Appellants’ Appeal Brief and Reply Brief arguments that the Examiner has erred.

II.A. *Section 101*

Under 35 U.S.C. § 101, a patent may be obtained for “any new and useful process, machine, manufacture, or composition of matter, or any new and useful improvement thereof.” The Supreme Court has “long held that this provision contains an important implicit exception: Laws of nature, natural phenomena, and abstract ideas are not patentable.” *Alice Corp. v. CLS Bank Int’l*, 134 S. Ct. 2347, 2354 (2014) (quoting *Ass’n for Molecular Pathology v. Myriad Genetics, Inc.*, 569 U.S. 576, 589 (2013)).

Accordingly, in applying the § 101 exception, the Supreme Court cautioned:

[W]e must distinguish between patents that claim the “buildin[g] block[s]” of human ingenuity and those that integrate the building blocks into something more, thereby “transform[ing]” them into a patent-eligible invention. The former “would risk disproportionately tying up the use of the underlying” ideas, and are therefore ineligible for patent protection. The latter pose no comparable risk of pre-emption, and therefore remain eligible for the monopoly granted under our patent laws.

Alice, 134 S. Ct. at 2354–55 (alterations, except first alteration, in original) (citations omitted).

The Supreme Court in *Alice* reiterated the two-step framework previously set forth in *Mayo Collaborative Services v. Prometheus Laboratories, Inc.*, 566 U.S. 66, 82–83 (2012), “for distinguishing patents that claim laws of nature, natural phenomena, and abstract ideas from those

⁵ All Manual of Patent Examining Procedure (MPEP) citations herein are to MPEP Rev. 08.2017, January 2018.

that claim patent-eligible applications of those concepts.” *Alice*, 134 S. Ct. at 2355. The first step in that analysis is to “determine whether the claims at issue are directed to one of those patent-ineligible concepts,” such as an abstract idea. *Id.* For example, a fundamental economic practice is an abstract idea:

[In *Bilski v. Kappos*, 561 U.S. 593, 611 (2010)], the Court grounded its conclusion that all of the claims at issue were abstract ideas in the understanding that risk hedging was a “fundamental economic practice.”

Alice, 134 S. Ct. at 2357. In addition, merely implementing a mathematical algorithm/formula is an abstract idea:

[In *Parker v. Flook*, 437 U.S. 584 (1978)], we examined a computerized method for using a mathematical formula to adjust alarm limits for certain operating conditions (e.g., temperature and pressure) that could signal inefficiency or danger in a catalytic conversion process. 437 U.S., at 585–586, 98 S.Ct. 2522. Once again, the formula itself was an abstract idea, see *supra*, at 2355, and the computer implementation was purely conventional. 437 U.S., at 594, 98 S.Ct. 2522 (noting that the “use of computers for ‘automatic monitoring-alarming’” was “well known”).

Alice, 134 S. Ct. at 2358.

The Court acknowledged in *Mayo* that “all inventions at some level embody, use, reflect, rest upon, or apply laws of nature, natural phenomena, or abstract ideas.” *Mayo*, 566 U.S. at 71. We, therefore, look to whether the claims focus on a specific means or method that improves the relevant technology or are instead directed to a result or effect that itself is the abstract idea and merely invoke generic processes and machinery. See *Enfish, LLC v. Microsoft Corp.*, 822 F.3d 1327, 1335–36 (Fed. Cir. 2016).

If the claims are not directed to an abstract idea or other patent-ineligible concept (e.g., a law of nature), the inquiry ends. *Id.* at 1339. Otherwise, the inquiry proceeds to the second step where the elements of the claims are considered “individually and ‘as an ordered combination’ to determine whether the additional elements ‘transform the nature of the claim’ into a patent-eligible application.” *Alice*, 134 S. Ct. at 2355 (quoting *Mayo*, 566 U.S. at 79, 78).

II.B. *Examiner’s §101 Rejection – Alice/Mayo – Steps 1 and 2*

II.B.1. *Claim 1*

Applying step 1 of the *Alice/Mayo* analysis, the Examiner concludes claim 1 is directed to a “judicial exception” because:

Claim 1 is directed to a method for determining the degree of a Bezier curve, comprising steps: (1) receiving a plurality of data points; (2) setting a four dimensional coordinate frame (3) ordering four points along the x-axis of the coordinate frame; (4) creating a first line through the first and third points (5) creating a tangent vector segment at the second point based on the first line (6) creating a second line through the second and fourth points (7) creating a tangent vector segment at the third point based on the second line (8) creating a base line through the center two points (9) and creating a Bezier curve between the second and third points and (10) determining the degree of the Bezier curve based on a comparison between the two tangent vectors and the baseline.

Final Act. 3.

Applying step 2 of the *Alice/Mayo* analysis, the Examiner concludes claim 1 is “without significantly more” because:

These [ten] steps do not inherently require any disclosed particular machine, article of manufacture or composition of matter as they can be performed manually by a person using

pencil and paper or the like to draw out the lines and to make the comparisons and determine the degree of the curve. . . .

The claim does not include additional elements that are sufficient to amount to significantly more than the judicial exception because the steps are a mere recitation of a conceptual process such as one would present in a flow chart without any . . . **showing of physical elements** or specific teachings of unique algorithms to determine the degree of the Bezier curve. The claim and indeed the description in the specification of the instant application is a **software only implementation which is functional descriptive material and is a non-statutory category of invention.**

. . .

[C]laim 1 [does] not provide any physical element that might be capable of executing the computer program.

Final Act. 3–4.

II.B.2. *Claim 13*

The Examiner also concludes claim 13 is directed to a judicial exception without significantly more because:

Claim 13 is merely a non-transitory computer-readable medium containing a computer program that incorporates the methods of claim 1 and is subject to the same analysis as claim 1 above.

Final Act. 4.

II.C. *Appellants' § 101 Arguments*

II.C.1.

Appellants first raise the following arguments in contending that the Examiner erred in rejecting claim 1 as being patent-ineligible subject matter because the claim satisfies *step one* of the *Alice/Mayo* analysis.

II.C.1.a.

Appellants contend:

The Examiner argued that “the claimed invention is directed to a judicial exception . . . without significantly more,” but *was not specific* about which of the judicial exceptions applies to claim 1. Appellant assumes the Examiner’s assertion is that claim 1 is directed to an abstract idea.

App. Br. 6 (emphasis added).

First, the Examiner is quite specific in concluding that claim 1 is “directed to a method for determining the degree of a Bezier curve.” Final Act. 3. The definition of a Bezier curve is “a parametric polynomial defined by a degree, n , and a sequence of $n+1$ ‘control points’, P_0, \dots, P_n .”⁶

Second, Appellants’ Specification presents a “formula” (i.e., mathematical formula) for a first curve segment of a Bezier curve. Spec. ¶¶ 24–27. Third, the Specification’s description, of its Bezier curve process, is replete with terminology (and its usage) that is specific to mathematics (i.e., geometry

⁶ Bézier curve. Encyclopedia of Mathematics. URL: http://www.encyclopediaofmath.org/index.php?title=B%C3%A9zier_curve&oldid=23190; last modified on Mar. 26, 2012; last visited Oct. 15, 2018.

The resulting curve is then

$$B(t) = \sum_{k=0}^n \binom{n}{k} t^k (1-t)^{n-k} P_k, \quad t \in [0, 1].$$

These curves are closely related to Bernstein polynomials, and are sometimes called Bernstein–Bézier curves. The major difference between Bézier curves and Bernstein polynomials is that Bézier curves are a parametric vector-valued representation based on control points, whereas Bernstein polynomials are usually thought of as a sequence of real-valued approximants to another function.

and numerical analysis), such as, degree, linear, quadratic, cubic, trilinear, interpolate, and spline.⁷ Spec. ¶¶ 24, 36–38, 40; Figure 6.

If Appellants’ premise is that the Examiner is required to do more to show the “Bezier curve” mathematical algorithm is an abstract idea (i.e., judicial exception), then we are unpersuaded by Appellants’ argument. The Supreme Court and Federal Circuit are clear that a mathematical formula is an abstract idea. For example, “if a claim is directed essentially to a method of calculating, using a mathematical formula, even if the solution is for a specific purpose, the claimed method is nonstatutory.” *Flook*, 437 U.S. at 595 (quoting *In re Richman*, 563 F.2d 1026, 1030 (CCPA 1977)).

II.C.1.b.

Appellants also argue:

The Federal Circuit, in a non-precedential opinion, observed that

specific technologic modifications to solve a problem or improve the functioning of a known system generally produce patent-eligible subject matter. In *DDR Holdings, LLC v. Hotels.com, L.P.*, 773 F.3d 1245 (Fed. Cir. 2014), the court upheld the patent eligibility of claims ‘necessarily rooted in computer technology’ that ‘overcome a problem specifically arising in the realm of computer networks.’ *Id.* at 1257. Similarly, ‘claimed process[es] us[ing] a combined order of specific rules’ that improved on existing technological processes were deemed patent-eligible in *McRO, Inc. v. Bandai Namco Games America Inc.*, 837 F.3d 1299, 1315 (Fed. Cir. 2016). Claims that were ‘directed to a specific improvement to the way

⁷ See The Harper Collins Dictionary of Mathematics; Borowski et al.; Harper Collins Publishers; 1991.

computers operate, embodied in [a] self-referential table,’ were deemed eligible in *Enfish, LLC v. Microsoft Corp.*, 822 F.3d 1327, 1334 (Fed. Cir. 2016).

Trading Tech[s]. Int’l, Inc. v. CQG, Inc., 675 Fed. Appx. 1001, 1004–05 (Fed. Cir. 2017) (non-precedential).

While the *Trading Tech[s].* case is non-precedential, the reasoning is sound and is derived from several precedential cases.

App. Br. 6–7.

We agree with Appellants that the stated legal propositions are accurate. However, Appellants’ quotation overlooks further guidance in *Trading Technologies*:

Illustrating the operation of this principle to facts that negated patent eligibility, claims “drawn to the idea itself” of “out-of-region broadcasting on a cellular telephone,” ***without implementing programmatic structure, were deemed ineligible*** in *Affinity Labs of Tex. v. DIRECTV, LLC*, 838 F.3d 1253, 1258 (Fed. Cir. 2016). Similarly, claims directed to the “idea of generating a second menu from a first menu and sending the second menu to another location” were held patent-ineligible in *Apple, Inc. v. Ameranth, Inc.*, 842 F.3d 1229 (Fed. Cir. 2016). Claims directed to the “process of gathering and analyzing information of a specified content, then displaying the results,” ***without “any particular assertedly inventive technology for performing those functions,”*** were held ineligible in *Electric Power Grp., LLC v. Alstom S.A.*, 830 F.3d 1350, 1354 (Fed. Cir. 2016). As these cases illustrate, ***ineligible claims generally lack steps or limitations specific to solution of a problem, or improvement in the functioning of technology.***

Trading Techs. Int’l, 675 F. App’x. at 1005 (emphases added). We also note that in determining patent eligibility, we consider whether the claim “purport[s] to improve the functioning of the computer itself” or “any other technology or technical field.” *Alice*, 134 S. Ct. at 2359.

This consideration has also been referred to as the search for a **technological solution to a technological problem**. See e.g., *DDR Holdings, LLC. v. Hotels.com, L.P.*, 773 F.3d 1245, 1257 (Fed. Cir. 2014); *Amdocs (Israel), Ltd. v. Openet Telecom, Inc.*, 841 F.3d 1288, 1300–01 (Fed. Cir. 2016).

MPEP § 2106.05(a) (emphasis added, parallel citations omitted).

II.C.1.c.

Appellants further argue that, like with *Trading Techs. Int'l*:

The instant claims are such a “specific technologic modification[] to solve a problem or improve the functioning of a known system.” The problem to be solved is identified in **paragraph [0001]**: “Tri-cubic produces smooth results, but generates **large computational loads** even when using a powerful computer. It is challenging to perform 3D texture rendering that is **both smooth and fast**.”

The “**specific technologic modification**” in the instant matter is to use “non-cubic (i.e., linear or quadratic) interpolation for at least some of the curve segments” in the curve being rendered, which significantly reduces the computation load. **Specification ¶ [0038]**. Independent claim 1 describes a technique for **choosing the degree of the Bezier curve used for the interpolation**.

Independent claim 1 is directed to significantly **reducing the computational load** associated with determining a curve, such as curves used to “render three-dimensional (3D) volumetric seismic data,” **Specification ¶¶ [0001], [0034]**, and is, therefore, directed to a [sic] “a specific improvement to the way computers operate . . .” *Enfish*, 822 F.3d at 1336. As such, claim 1 satisfies the first step of the Alice analysis. See also *McRO*, [837 F.3d 1299] (ruling that claims that incorporate “specific features” of “rules” for computer animation, analogous to the instant procedure for determining the degree of a Bezier curve, satisfied the first step of the Alice analysis).

App. Br. 7–8 (alterations in original, other than addition of [sic] and omissions from McRO citation) (emphases added).

[T]he instant *application is directed* to improving performance in three-dimensional (hereinafter “3D”) texture rendering. *Specification* at ¶ [0001].

...

Appellant’s *application* describes *an improved system that reduces the computational load* because it uses (1) cubic interpolation, which creates the most computational load, only when necessary, i.e., where there are inflection points in the curve to be rendered, (2) quadratic interpolation, which creates less computational load than cubic interpolation but more than linear interpolation, when there is no inflection point, and (3) linear interpolation when the data values are almost homogeneous. *Specification* at ¶¶ [0039]–[0040]; Fig. 6.

A cubic interpolation requires six (6) weighted average computations to evaluate a point, while a quadratic interpolation requires three (3) such computations, and a linear interpolation requires only one (1). *Specification* at ¶ [0036].

...

[C]ontrary to the Examiner’s argument, Examiner’s Answer at 8, the claims are directed to the functioning of *a computer* rather than performing calculations by hand.

...

The instant claims produce an improvement in the computer technology by reducing the computational load associated with 3D texture rendering.

Therefore, like the claims in *Enfish, McRO, and Finjan Inv. v. Blue Coat Systems, Inc.*, 879 F.3d 1299 (Fed. Cir. 2018) . . . , the instant claims are *non-abstract improvements to computer technology* and should be deemed to be patent-eligible under Step 2A of the Office’s subject matter eligibility guidance.

Reply Br. 3–4 (emphases added).⁸

⁸ We assume Appellants’ reference to the “Examiner’s Answer at 8” should read “Examiner’s Answer at 7.” At page 7 of the Answer, the Examiner determines, “the steps of claim 1 do not inherently require any disclosed

The essence of Appellants' argument is that "[t]he instant claims produce an improvement in the computer technology by reducing the computational load associated with 3D texture rendering." Reply Br. 4. We are unpersuaded by this argument.

II.C.1.c.i

First, Appellants argue claim 1 "produce[s] an improvement in the computer technology *by reducing the computational load* associated with 3D texture rendering." Reply Br. 4 (emphasis added). Although in many instances "reducing the computational load" might be a technological solution to a technological problem, in this instance it is not. Rather, it is merely a mathematical solution to a mathematical problem.

In both mathematics (manual calculations) and computers (automated calculations), reduced computational load (i.e., faster processing speed) is a challenge. In mathematics, this is a non-technological problem (e.g., use of a different mathematical algorithm), and in the field of computers, it is both a technological and a non-technological problem (as any manual computational load reduction solutions in mathematics are equally applicable to the field of computers). We look closely at Appellants' mechanism for achieving the argued "reducing the computational load." Unlike a technological solution to a technological problem, we find no change to the generic computer in either its underlying standard operations or hardware. Rather, Appellants' mechanism reduces the computational

particular machine, article of manufacture or composition of matter as they can be **performed manually by a person using a pencil and paper** or the like to draw out the lines and curves and to perform the comparisons presented in the claim and then could determine the degree of the curve."

load by not using the known complex mathematical algorithm when a simpler mathematical algorithm will suffice. We conclude this is not a technological solution to a technological problem, but rather a mathematical solution to a mathematical problem. As the Examiner correctly points out, “the Appellant has failed to **positively demonstrate any improvement** in existing computational functionality.” Ans. 6.⁹

That we have before us a mathematical solution to a mathematical problem is reinforced by Appellants at page 3 of the Reply Brief (emphases added):

Appellant’s application describes an improved system that *reduces the computational load because it uses* (1) *cubic interpolation*, which creates the most computational load, only when necessary, i.e., where there are inflection points in the curve to be rendered, (2) *quadratic interpolation*, which creates less computational load than cubic interpolation but more than linear interpolation, when there is no inflection point, and (3) *linear interpolation* when the data values are almost homogeneous.

A cubic interpolation requires six (6) weighted average computations to evaluate a point, while a quadratic [sic] interpolation requires three (3) such computations, and a linear interpolation requires only one (1).

We determine this describes a mathematical solution to a mathematical problem. Contrary to Appellants’ argument, Appellants’ claim 1 is not like the claimed inventions in *Enfish* and *McRO*.

⁹ However, as we agree with Appellants that the Examiner’s computer performance examples (Ans. 6) are unsupported and unnecessary, we give no weight to and do not rely on these performance examples.

II.C.1.c.ii.

Second, in support of their argument (portions are reproduced above), Appellants repeatedly cite to the Specification and quote language therefrom. However, Appellants do not direct us to, nor do we find, any corresponding language or limitations in claim 1. Appellants' statements that Appellants' *application* describes a system directed to the required technological solution to a technological problem do not show that the claims are limited as such. "[A] particular embodiment appearing in the written description may not be read into a claim when the claim language is broader than the embodiment." *SuperGuide Corp. v. DirectTV Enters, Inc.*, 358 F.3d 870, 875 (Fed. Cir. 2004). *See also* MPEP § 2111.01 II – It Is Improper To Import Claim Limitations From The Specification. Contrary to Appellants' argument that claim 1 is analogous to the claims the courts have found patent-eligible, Appellants' claim 1 does not include limitations (e.g., computer technology) showing a technological solution to a technological problem.¹⁰ No matter how worthy and groundbreaking—how novel and non-obvious—a disclosed invention might be, merely claiming an improved abstraction is not sufficient to result in patent-eligible subject matter. "Groundbreaking, innovative, or even brilliant discovery does not by itself satisfy the § 101 inquiry." *Ass'n for Molecular Pathology v. Myriad Genetics, Inc.*, 133 S. Ct. 2107, 2117 (2013). Appellants argue that "contrary to the Examiner's argument, . . . [claim 1 is] directed to the functioning of *a computer* rather than performing calculations by hand."

¹⁰ We note that the Examiner describes claim 1 as "a software only implementation." Final Act. 4. Although Appellants' claim 13 is software based, claim 1 is not limited to software.

Reply Br. 4 (emphasis added). However, as to claim 1, we agree with the Examiner's determination that:

[T]he steps of claim 1 do not inherently require any disclosed particular machine, article of manufacture or composition of matter as they can be **performed manually by a person using a pencil and paper** or the like to draw out the lines and curves and to perform the comparisons presented in the claim and then could determine the degree of the curve.

Ans. 7.

At best, Appellants' claim 1 is analogous to a hypothetical *Diehr* claim (see *Diamond v. Diehr* 450 U.S. 175 (1981)) where the disclosure is as presented in *Diehr* (i.e., fully directed to ensuring the production of molded articles which are properly cured), but the hypothetical claim is directed only to the Arrhenius equation. In such a situation, the hypothetical claim would not be directed to an application of that mathematical equation to a known structure or process so as to be deserving of patent protection. See *Diehr* 450 U.S. at 188, n. 11 ("If there is to be invention from such a discovery, it must come from the application of the law of nature to a new and useful end." (quoting *Funk Bros. Seed Co. v. Kalo Inoculant Co.*, 333 U.S. 127, 130 (1948))).

To summarize, Appellants' claim 1 does not recite the argued technical solution to a technical problem. We conclude that when considered as a whole, Appellants' claim 1 is silent as to any patent-eligible application.¹¹

¹¹ To the extent that Appellants' application as filed may disclose a technological solution to a technological problem, Appellants are not precluded from amending the claims to reflect fully that disclosure.

II.C.1.c.iii.

Appellants direct nearly all their arguments to the premise that the invention is “reducing the computational load” using “a technological solution to a technological problem.” We disagree, as we discuss above. Although still not recited in claim 1, Appellants also briefly mention a second challenge in performing 3D texture rendering, that being the challenge of attaining “smooth” results (App. Br. 7; Reply Br. 3), or as Appellants describe it, “[t]ri-linear [interpolation] is fast but may not produce smooth-looking results.” Spec. ¶ 1.

Appellants further describe this challenge as the “elimination of the processing artifacts” (Spec. ¶ 3) or “reduc[ing] the number of artifacts” (Spec. ¶ 21). Appellants disclose:

A conventional three-dimensional (3D) texture shader renders raw volumetric data into a two-dimensional (2D) or 3D image using interpolation, in which pixel or voxel values are derived from neighboring data values. As illustrated in Fig. 1, images rendered using tri-linear interpolation include artifacts, such as lines, that are not accurate representations of the data. A user who relies on such an artifact in the image may interpret the data incorrectly. For example, one of the lines may be misinterpreted as a void or as a feature, and relying on that misinterpretation may have costly consequences. For example, in the oil field, incorrectly analyzing raw seismic data may result in incorrect placement of an oil well. In the medical field, incorrectly analyzing magnetic resonance imaging (MRI) data may result in a misdiagnosis.

Fig. 2 shows the data from Fig. 1 analyzed using a tri-cubic interpolation, which reduces the number of artifacts.

Fig. 3 shows a tri-linear interpolation, which includes artifacts.

Fig. 4 shows the data from Fig. 3 analyzed using a tri-cubic interpolation, which reduces the number of artifacts.

Spec. ¶¶ 20–23.

Although we do not find it recited in claim 1, we do see at least some potential that processing artifacts (generated from raw volumetric data collected from physical objects) as disclosed are a technological problem, for which a technological solution (using particular computer processing to eliminate or reduce processing artifacts in display data representative of the physical objects) is presented in the disclosure, particularly given the product (rendered image) is improved.

While the result may not be tangible, there is nothing that requires a method “be tied to a machine or transform an article” to be patentable. *Bilski*, 561 U.S. at 603, 130 S.Ct. 3218 (discussing 35 U.S.C. § 100(b)). The concern underlying the exceptions to § 101 is not tangibility, but preemption. *Mayo*, 132 S.Ct. at 1301.

McRO, 837 F.3d at 1315.

We note Appellants acknowledge there is already a known solution (tri-cubic interpolation) in the image processing field for this processing artifact problem. Spec. ¶ 1. Although some decisions speak to a claimed solution as being better than previous solutions (*see Thales Visionix Inc. v. United States*, 850 F.3d. 1343, 1348 (Fed. Cir. 2017)), we believe this benefit is descriptive of the particular solution, rather than a requirement of the *Alice/Mayo* analysis. We are unaware of any § 101 case law that precludes the patenting of an alternative technological solution to a known technological problem with a known technological solution.

II.C.2.

Appellants also raise the following arguments in contending that the Examiner erred in rejecting claim 1 as being patent-ineligible subject matter because the claim satisfies *step two* of the *Alice/Mayo* analysis.

II.C.2.a.

The instant claims are like the claims in *Research Corp. Technologies, Inc. v. Microsoft*, 627 F.3d 859 (Fed. Cir. 2010), which is cited . . . in the “June 2017: Interim Eligibility Guidance Quick Reference Sheet *Decisions Holding Claims Eligible*” as one of the cases in which [the] “claim as a whole amounts to significantly more than the recited judicial exception, i.e., the claim recites an inventive concept.”

. . .

The instant claims are similar. The claims include elements that reduce the computational load on a computer by permitting the use of a non-cubic Bezier curve in some circumstances, as described above. The multiple elements in the claim and the improvement in the functioning of the computer as the result of applying these elements qualify the instant claims as patent eligible under step 2 of the *Alice* analysis.

App. Br. 8–9 (emphases added).

The Examiner points out:

[C]laim 1 does not recite any processing element to perform the steps of the methods[,] so that the claim cannot be determined to be or provide an improvement upon the functioning of a computer.

Ans. 8.

Appellants, in turn, argue:

The Examiner did not substantively respond to Appellant’s argument that the pending claims are patent eligible under [step two of the *Alice/Mayo* analysis]. Instead, the Examiner argued that the claims “do not recite any processing elements to perform the steps of the methods in the respective

claims,” so the claims “cannot be determined to be an improvement in the functioning of a computer. . . .” Examiner’s Answer at 8.

Reply Br. 5 (elliptical omission in original).

We are unpersuaded by this argument. For the reasons we discuss above, we find no technological limitations in claim 1. Because we find no such limitations in claim 1, the correct answer to the Court’s *Alice/Mayo* analysis step two question (“What else is there in the claims before us?” *Mayo*, 566 U.S. at 78) is “nothing.” The Examiner’s reasoning and conclusion for step two are correct. Essentially, for a claim reciting only an abstract idea, the *Alice/Mayo* analysis ends after step one.¹² “It has been clear since *Alice* that a claimed invention’s use of the ineligible concept to which it is directed cannot supply the inventive concept that renders the invention ‘significantly more’ than that ineligible concept.” *BSG Tech LLC v. BuySeasons, Inc.*, 899 F.3d 1281, 1290 (Fed. Cir. 2018).

II.C.2.b.

Appellants argue:

[T]he instant claims are like those of *Berkheimer v. HP, Inc.*, 881 F.3d 1360 (Fed. Cir. 2018), which is discussed in the [Bahr Memorandum].¹³ The specification in *Berkheimer* explains that

¹² A claim reciting only an abstract idea provides the opposite end of the spectrum from the claim at issue in *Enfish* where the court stated, “[b]ecause the claims are not directed to an abstract idea under step one of the *Alice* analysis, we do not need to proceed to step two of that analysis.” 822 F.3d at 1339.

¹³ Memorandum from Robert W. Bahr, Deputy Commissioner for Patent Examination Policy to the Patent Examining Corps, entitled “Changes in Examination Procedure Pertaining to Subject Matter Eligibility, Recent Subject Matter Eligibility Decision (*Berkheimer v. HP, Inc.*)” (April 19, 2018) (“Bahr Memorandum”).

“the system eliminates redundant storage of common text and graphical elements, which improves system operation efficiency and reduces storage costs.” *Id.* at 2. The *Berkheimer* court found that some of the ***claims contained*** “limitations directed to purported improvements described in the specification . . . raising a genuine issue of material fact as to whether the purported improvements were more than well-understood, routine, conventional activity previously known in the industry.” *Id.* As discussed in the previous section, the instant claims are directed to improvements ***described in the specification***, i.e., to determining the degree of the Bzier curve to be computed. As such, following the reasoning in the *Berkheimer* case and in the April 19, 2018 Bahr Memorandum, the instant claims are patent eligible under [*step two* of the *Alice/Mayo* analysis].

The *Berkheimer* court cautioned that “the mere fact that something is disclosed in a piece of prior art does not mean it was a well-understood, routine, conventional activity or element.” *Id.* Following the teachings of the *Berkheimer* case, the April 19, 2018 Bahr Memorandum requires that, when performing an analysis to determine whether “an additional element (or combination of elements) is not well-understood, routine or conventional,” an Examiner must support such a rejection with a written finding of one or more of the following:

[“]1. A citation to an express statement in the specification or to a statement made by an applicant during prosecution that demonstrates the well-understood, routine, conventional nature of the additional element(s),”

“2. [a] citation to one or more of the court decisions discussed in MPEP § 2106.05(d)(II) as noting the well-understood, routine, conventional nature of the additional element(s),”

“3. [a] citation to a publication that demonstrates the well-understood, routine, conventional nature of the additional element(s),”
or

“4. [a] statement that the examiner is taking official notice of the well-understood, routine, conventional nature of the additional element(s).”
April 19, 2018 Memorandum at 3 – 4.

Here, the Examiner has done none of these and thus has not made a *prima facie* showing that the claims are ineligible under [step two of the *Alice/Mayo* analysis].

Reply Br. 6–7 (elliptical omission in original) (some emphases added).

We are unpersuaded by this argument. For the reasons we discuss above, we find no technological limitations in claim 1. Because we find no such limitations in claim 1, there is no disputed factual issue (*Alice/Mayo* analysis step two) to which Appellants’ *Berkheimer* argument is relevant.¹⁴

II.C.3.

To the extent that Appellants’ *Berkheimer* claim 1 argument yields a different analysis when applied to claim 13, we treat the claim 1 argument as separately contending that the Examiner erred in rejecting claim 13 as being patent-ineligible subject matter because the claim satisfies *step two* of the *Alice/Mayo* analysis.

Claim 13 recites more than the abstract idea we find in claim 1, that “more” being the recitation of “[a] non-transitory computer-readable medium, on which is recorded a computer program” which performs the patent ineligible mathematical algorithm of claim 1. Although claim 13 recites more under step two of the *Alice/Mayo* analysis, we conclude the “more” is not significant. Rather, the case law shows this “more” to be the epitome of a well-understood, routine, conventional element/combination previously known in the industry. *See Alice*, 134 S. Ct. at 2360

¹⁴ Again we note that although Appellants’ claim 13 is software based, claim 1 is not so limited.

(“[P]etitioner’s . . . media claims add nothing of substance to the underlying abstract idea.”); *Fairwarning IP, Inc. v. Iatric Sys., Inc.*, 839 F.3d 1089, 1096 (Fed. Cir. 2016) (“Claims 15–17 . . . add nothing more than similar nominal recitations of basic computer hardware, such as ‘a non-transitory computer-readable medium with computer-executable instructions’ and a microprocessor.”).

Because claim 13, in addition to the abstract idea, recites only a well-understood, routine, conventional element/combination previously known in the industry, we conclude the case law shows there is no genuine issue of material fact regarding step two of the Examiner’s *Alice/Mayo* analysis. Therefore, we are unpersuaded by Appellants’ *Berkheimer* argument. We sustain this rejection based on the Examiner’s primary theory of the claim 13 § 101 rejection.

In the Answer, the Examiner presents an additional separate § 101 theory for claim 13. The Examiner postulates:

[T]he computer program *may be a text file listing* of a high[-] level language of the program that a person of ordinary skill in the art at the time of the invention could read and that, when executed (by the person with a pencil and paper), performs a method in accordance with the steps provided in claim 13.

Ans. 8–9 (emphasis added). Because we conclude an artisan would understand the “when executed” clause of claim 13 to require the claimed “computer program” to be “executable,” the Examiner’s “text file” theory is precluded. Although we sustain the § 101 rejection of claim 13 based on the Examiner’s primary theory, we do not sustain the Examiner’s additional claim 13 theory of the § 101 rejection.

II.D. *Redirecting Claim 1 Towards Integrating The Judicial Exception Into A Patent-Eligible Application*

In the event there is further prosecution, we exercise our discretion and discuss amendments that might potentially redirect claim 1 towards a technological solution to a technological problem (i.e., integrate the judicial exception into a patent-eligible application). Because of the complexity of the issues before us, this is not a definitive resolution. We are not stating that any future Section 101 rejection by Examiner will not be affirmed. Rather, we merely point out what appears to be Appellants' best option. We emphasize that significant prosecution analysis would remain.

Particularly, the sparseness of Appellants' technological disclosure makes difficult any attempt to amend the claims without introducing new matter not supported in the disclosure as originally filed. Contrast the limited technological depth of Appellants' disclosure to that found in subject-matter-eligible patents such as in *Diehr* (US 4,344,142) and *Thales* (US 6,474,159). Although Appellants have not eliminated all disclosure of the technological foundation of the invention, the sparseness of the Disclosure's technological foundation does hinder amending the claim.

Appellants correctly point out:

“[S]ome inventions pertaining to improvements in computer functionality or to improvements in other technologies are not abstract *when appropriately claimed.*” MPEP § 2106.04(a)(I)(emphasis added).

Reply Br. 2 (bold emphasis added). We conclude above that Appellants' claim 1 *does not* “appropriately claim” an improvement to computer functionality or other technologies. However, Appellants are not precluded from amending the claims to recite any disclosed technological solution to a

technological problem. MPEP 2106.05(a) provides significant guidance on determining when the improvement is appropriately claimed.

If there is further prosecution, we suggest the following claim 1 amendments as a starting point. First, in the claim's preamble, specify the technological problem and solution (reduction of processing artifacts during three-dimensional image rendering).

Additionally, although they are data gathering steps, recite initial claim steps that specify collecting signals after they pass through a physical object and generating raw volumetric data (RVD) from the collected signals. Further, specify the RVD is representative of the physical object and the RVD includes data points with coordinates established in a coordinate system tied into the recited steps of current claim 1.

Lastly, conclude the method of claim 1 by completing the implementing of a patent-eligible application of the judicial exception (e.g., rendering a reduced artifact three-dimensional image representative of the physical object on a display using the claimed Bezier curve).

Although subject to the Examiner's further analysis and possible further appellate review, adopting these steps would be helpful in presenting claim 1 in a form more likely to be patent-eligible under 35 U.S.C. § 101.

II.E. Section 112(b) Argument

Appellants raise the following argument in contending that the Examiner erred in rejecting claim 13 under 35 U.S.C. § 112(b).

The Examiner erred in applying the test for indefiniteness of a means-plus-function limitation to non-means-plus-function limitations in the rejection of claims 13 – 21 under 35 [U.S.C.] § 112(b).

App. Br. 10.

We agree. In our review of the § 112(b) rejection we do not find where the Examiner has explained why the claim is required to recite “specific means or structure for performing the methods of the claims” (Final Act. 5) in order to comply with 35 U.S.C. § 112(b). Nor has the Examiner explained why the specification is required to recite “specific means or structure for performing the methods of the claims” (*id.*) in order for the claim to comply with 35 U.S.C. § 112(b).

Therefore, we conclude that there is insufficient explanation to support the Examiner’s conclusion that claim 13 is incomplete for omitting essential elements. *See* MPEP § 2173.02 III. B. – An Office Action Should Provide a Sufficient Explanation.

II.F. *Section 103 Arguments*¹⁵

Appellants raise the following argument in contending that the Examiner erred in rejecting claim 1 under 35 U.S.C. § 103(a).

The Examiner erred in finding that Chen teaches “**determining the degree of the Bezier curve** based on a comparison of the first tangent vector, the second tangent vector, and the baseline,” as required by independent claims 1 and 13. . . . Chen uses only a cubic Bezier curve and is not required to determine the degree of the Bezier curve (i.e., linear, quadratic, or cubic) at all, much less make such a determination based “on a comparison of the first tangent vector, the second tangent vector, and the baseline,” as required by independent claims 1 and 13.

The Examiner argued that the instant claims require[] “picking a random number that is reasonable for a Bezier curve as no[] metrics are given in the claim.” Final Office Action at p. 18. The Examiner is incorrect because claim 1 requires “a

¹⁵ The contention we discuss is determinative as to all § 103 rejections on appeal. Therefore, Appellants’ other § 103 contentions are not discussed herein.

comparison of the first tangent vector, the second tangent vector, and the baseline,” none of which are taught by Chen.

App. Br. 15 (emphasis added).

We conclude, after reviewing the Examiner’s rejection and consistent with Appellants’ above argument as to claim 1, there is insufficient articulated reasoning to support the Examiner’s findings that Chen discloses the argued determining the degree of the Bezier curve limitation. Therefore, we conclude that there is insufficient articulated reasoning to support the Examiner’s conclusion that claim 1 is rendered obvious by Chen based on the Examiner’s articulated reasoning.

CONCLUSIONS

(1) The Examiner has not erred in rejecting claims 1–9 and 13–21 under 35 U.S.C. § 101, as being patent-ineligible subject matter.

(2) Appellants have established that the Examiner erred in rejecting claims 13–21 as being unpatentable under 35 U.S.C. § 112(b).

(3) Appellants have established that the Examiner erred in rejecting claims 1–9 and 13–21 as being unpatentable under 35 U.S.C. § 103(a).

(4) Claims 1–9 and 13–21 are not patentable.

DECISION

The Examiner’s rejection of claims 1–9 and 13–21 under 35 U.S.C. § 101, as being patent-ineligible subject matter, is **affirmed**.

The Examiner’s rejection of claims 13–21 as being unpatentable under 35 U.S.C. § 112(b) is **reversed**.

The Examiner's rejection of claims 1–9 and 13–21 as being unpatentable under 35 U.S.C. § 103(a) is **reversed**.

Because we have affirmed at least one ground of rejection with respect to each claim on appeal, the Examiner's decision is affirmed. *See* 37 C.F.R. § 41.50(a)(1).

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).

AFFIRMED¹⁶

¹⁶ As the Examiner has shown all the claims are unpatentable under 35 U.S.C. § 101, we do not also newly reject Appellants' claims 14–21 (method claims) under 35 U.S.C. § 112(d) as not including all the limitations of claim 13 (a non-transitory computer-readable medium claim that when executed performs a method) from which they depend. However, should there be further prosecution of these claims; we direct the Examiner's attention to this issue.

When examining a dependent claim, the Examiner should determine whether the claim complies with 35 U.S.C. 112(d), which requires that dependent claims contain a reference to a previous claim in the same application, specify a further limitation of the subject matter claimed, and ***include all the limitations of the previous claim***.

MPEP § 608.01(n) II – Treatment of Improper Dependent Claims (emphasis added).