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UNITED STATES PATENT AND TRADEMARK OFFICE

BEFORE THE PATENT TRIAL AND APPEAL BOARD

Ex parte STEFAN HARTMANN

Appeal 2017-006297
Application 14/051,559[1]
Technology Center 2100

Before CARLA M. KRIVAK, HUNG H. BUI, and JON M. JURGOVAN, *Administrative Patent Judges*.

BUI, *Administrative Patent Judge*.

DECISION ON APPEAL

Appellant seeks our review under 35 U.S.C. § 134(a) of the Examiner's Final Rejection of claims 1–18, which are all the claims pending in the application. We have jurisdiction under 35 U.S.C. § 6(b).

We AFFIRM.[2]

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[1] According to Appellant, the real party in interest is Livermore Software Technology Corporation. App. Br. 1.

[2] Our Decision refers to Appellant's Appeal Brief ("App. Br.") filed November 28, 2016; Reply Brief ("Reply Br.") filed February 28, 2017; Examiner's Answer ("Ans.") mailed February 2, 2017; Final Office Action ("Final Act.") mailed June 30, 2016; and original Specification ("Spec."), filed October 11, 2013.

STATEMENT OF THE CASE

Appellant's invention relates to "methods and systems for joining imperfectly-matching Non-Uniform Rational Basis Splines (NURBS) patches to form a computerized model suitable for Finite Element Analysis (FEA)." Spec. ¶ 1; Title (capitalization altered); Abstract. NURBS-based curves and surfaces are used in computer-aided design (CAD) for representing an object's geometry by surface modeling, while FEA is a computerized method used to model an object using a mesh model of the object's geometric description and the object's material properties at each point within the model. Spec. ¶¶ 2–4. Appellant's invention enables imperfectly or partially-matching NURBS patches describing an object under analysis, to be joined together along a physical boundary to form a computerized model suitable for finite element analysis of the object. Spec. ¶¶ 5–6, 8, 10, 26, 38.

Claims 1, 7, and 13 are independent. Claim 1 illustrates Appellant's invention, as reproduced below:

> 1. A method of joining imperfectly-matching Non-Uniform Rational Basis Splines (NURBS) patches to form a computerized model suitable for finite element analysis (FEA), said method comprising:
>
> receiving, in a computer system having an application module installed thereon, definitions of a first NURBS patch and a second NURBS patch, the first and second NURBS patches to be joined together along a physical boundary defined in a first curve with a first set of control points, associated weights and a corresponding first plurality of knot-vector values in the first NURBS patch and defined in a second curve with a second set of control points, associated weights and a corresponding second plurality of knot-vector values in the second NURBS patch, wherein the first set of control points and said first plurality of

knot-vector values are different from the second set of control points and said second plurality of knot-vector values;

normalizing said first plurality of knot-vector values such that the first curve's parametric length equals the first curve's physical length in the first NURBS patch;

normalizing said second plurality of knot-vector values such that the second curve's parametric length equals the second curve's physical length in the second NURBS patch;

determining a common curve as an overlapped section of the first and the second curves to represent the physical boundary;

adjusting the first and the second curves such that first and second projection points correspond to starting and end locations of the common curve, respectively;

designating one of the first and second curves having less number of control points along the common curve as a master curve, the other as a slave curve; and

determining a set of linear constraint equations for numerically connecting the first and second NURBS patches along the physical boundary by computing dependencies of the slave curve's control points to the master curve's control points, whereby the first and second NURBS patches together with the set of linear constraint equations for the control points along the physical boundary enable a computerized model created therefrom suitable for finite element analysis.

App. Br. 12–17 (Claims App.).

Examiner's Rejection

Claims 1–18 stand rejected under 35 U.S.C. § 101 because the claimed invention is directed to non-statutory subject matter. Final Act. 3.

ANALYSIS

In *Alice Corp. Pty. Ltd. v. CLS Bank International*, 134 S. Ct. 2347 (2014), the Supreme Court reiterates an analytical two-step framework previously set forth in *Mayo Collaborative Services v. Prometheus Laboratories, Inc.*, 566 U.S. 66, 79 (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. 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.* (citing *Mayo*, 566 U.S. at 78–79). 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.* (citing *Mayo*, 566 U.S. at 72–73).

In rejecting independent claims 1, 7, and 13 and dependent claims 2–6, 8–12, and 14–18 under 35 U.S.C. § 101, the Examiner finds these claims are directed to an abstract idea of "a *mathematical concept*" in which "a number of mathematical steps are performed which *enable* the creation of a computerized mathematical model." Ans. 2, 4. The Examiner also finds the claims do not

> provide anything that amounts to significantly more than the judicial exception, as the claims merely provide a number of mathematical steps that *merely enable* the creation of a

> computerized mathematical model using a computational processor, a well-known routine, conventional suitable for FEA; and . . . all the steps set forth including the steps of receiving, *in a computer having application stored thereon*, definition of a first and second NURBS patches representing the curves, normalizing a first and second knot-vectors values, [] determining a common [curve] as an overlapped section; the claims further include additional steps of adjusting the first and second curves, and designating one of the first and second curve to determine a set of linear constraint equations where set of linear constraints equations enable the creation of computerized mathematical model suitable for FEA, are concepts that have been identified by the courts as abstract such as a formula for computing in *Flook* . . . .

Ans. 2–3.

As to the first step of the *Alice* inquiry, Appellant contends independent claims 1, 7, and 13 are not directed to an abstract idea; instead, Appellant argues these claims "convert one computerized model (i.e., NURBS patches for CAD) to another computerized model (i.e., FEA mesh model for CAE [computer aided engineering])." App. Br. 7; *see also* Reply Br. 3. Appellant argues the claims' "conversion is not simply [a] mathematical concept [or] purely mental activity . . . because the conversion of a CAD model to a CAE model is a mechanical engineering design analysis activity performed using a specialized computer under directions of engineers/scientists who design the product (e.g., car, airplane)." App. Br. 7. In the Reply, Appellant further argues "the present claims are directed to an improvement in the functioning of a computer (i.e., joining mis-matched NURBS patches (CAD models) to a computerized model suitable for finite element analysis (F[E]A))." Reply Br. 4.

We are not persuaded by Appellant's arguments. As correctly recognized by the Examiner, Appellant's claims 1, 7, and 13, when

considered in light of Appellant's Specification, recite "mathematical concepts in which a number of mathematical steps are performed which *enable* the creation of a computerized mathematical model" by manipulating data including NURBS patches, knot-vector values, and first and second curves correlated by linear constraint equations. Ans. 2; *see also* Final Act. 2.

We agree with the Examiner that claims 1, 7, and 13 are directed to the abstract idea of manipulating data through mathematical relationships, which is similar to the computing formula discussed in *Parker v. Flook*, 437 U.S. 584 (1978), and the Arrhenius formula in *Diamond v. Diehr*, 450 U.S. 175 (1981). Particularly, Appellant's claim 1, and similarly claims 7 and 13, manipulate data including: mathematical curves ("Non-Uniform Rational Basis Splines (NURBS)," *see* Spec. ¶¶ 1, 39) and surfaces ("NURBS patches" of a "NURBS surface description," *see* Spec. ¶¶ 5, 38); control and projection points representing curves (*see* Spec. ¶¶ 26, 29, 38–39, 42); weight values at control points (*see* Spec. ¶¶ 26, 39); knot-vector values associated with curve points (*see* Spec. ¶¶ 26, 33, 39); and curves' lengths ("knot-vector values of the first curve are normalized" by, e.g., "evaluat[ing] the physical length of the curve (e.g., by numerical integration) first, then the knot-vector representing the curve is scaled in such a way that the difference between the first and the last knot-vector value matches the physical length," *see* Spec. ¶ 27). Additionally, the claimed "determining a set of linear constraint equations" merely determines dependencies between curves' control points by, e.g., matrix operations between arrays of control points. *See* Spec. ¶¶ 31, 44–45, Fig. 7F.

Furthermore, information as such is intangible, and data analysis and algorithms are abstract ideas. *See, e.g.*, *Microsoft Corp. v. AT & T Corp.*, 550 U.S. 437, 451 n.12 (2007); *Alice*, 134 S. Ct. at 2355; *Flook*, 437 U.S. at 589, 594–95 ("Reasoning that an algorithm, or mathematical formula, is like a law of nature, *Benson* applied the established rule that a law of nature cannot be the subject of a patent."); and *Gottschalk v. Benson*, 409 U.S. 63, 71–72 (1972). Information collection and analysis, including when limited to particular content, is within the realm of abstract ideas. *See, e.g.*, *Internet Patents Corp. v. Active Network, Inc.*, 790 F.3d 1343, 1349 (Fed. Cir. 2015); *Digitech Image Techs., LLC v. Elecs. for Imaging, Inc.*, 758 F.3d 1344, 1351 (Fed. Cir. 2014); and *CyberSource Corp. v. Retail Decisions, Inc.*, 654 F.3d 1366, 1370 (Fed. Cir. 2011). That is, "[w]ithout additional limitations, a process that employs mathematical algorithms to manipulate existing information to generate additional information is not patent eligible." *Digitech*, 758 F.3d at 1349–51 ("Data in its ethereal, non-physical form is simply information that does not fall under any of the categories of eligible subject matter under section 101").

Appellant also argues "a computer is required for performing the claimed method," as the "[i]ndependent claims are inextricably tied to creating a computerized (FEA) model," thereby removing the claims from the realm of "abstract ideas." App. Br. 7. We remain unpersuaded by Appellant's argument. All the steps of Appellant's claim 1 (and similarly claims 7 and 13), including, for example: i) receiving definitions of NURBS patches; ii) normalizing knot-vector values; iii) determining a common curve and adjusting the first and second curves; and iv) determining a set of linear constraint equations by computing dependencies between curves' control

points, are abstract mathematical concepts and algorithms that could be performed in the human mind, or by a human using a pen and paper, without need of any computer or other machine. *See CyberSource*, 654 F.3d at 1373 ("[A] method that can be performed by human thought alone is merely an abstract idea and is not patent-eligible under § 101."); *see also In re Comiskey*, 554 F.3d 967, 979 (Fed. Cir. 2009) ("[M]ental processes–or processes of human thinking–standing alone are not patentable even if they have practical application."); *Benson*, 409 U.S. at 67 ("Phenomena of nature . . . , *mental processes*, and abstract intellectual concepts are not patentable, as they are the basic tools of scientific and technological work" (emphasis added)). Additionally, mental processes remain unpatentable even when automated to reduce the burden on the user of what once could have been done with pen and paper. *CyberSource*, 654 F.3d at 1375 ("That purely mental processes can be unpatentable, even when performed by a computer, was precisely the holding of the Supreme Court in *Gottschalk v. Benson*.").

We are also not persuaded by Appellant's argument that "the method claimed in independent claims is a method to convert one computerized model (i.e., NURBS patches for CAD) to another computerized model (i.e., FEA mesh model for CAE)[, which] is NOT an abstract idea." App. Br. 7. As the Examiner finds, "the claims do not explicitly recite the conversion of one model to another." Ans. 5; *see also* Ans. 2. Thus, Appellant's argument is not supported by corresponding language in claims 1, 7, and 13. Ans. 2, 5.

Claims 1, 7, and 13 also do not recite a CAD model, a computer aided engineering (CAE) model, or "a mechanical engineering design analysis" for a "product (e.g., car, airplane)," as advocated by Appellant. App. Br. 5, 7.

The claims' only real-world element is the "physical boundary" along which the first and second NURBS patches are to be joined. The claimed "physical boundary," however, is not tied to an engineering application or to an actual product to be modeled; rather, claim 1, and similarly claims 7 and 13, merely recite that "first and second NURBS patches to be joined together *along a physical boundary* defined in a first curve . . . and defined in a second curve," the curves having an overlapped section "*represent*[ing] *the physical boundary*." App. Br. 12 (emphasis added). The claims further recite "the first and second NURBS patches together with the set of linear constraint equations for the control points *along the physical boundary* enable a computerized model created therefrom suitable for finite element analysis." App. Br. 12–13 (emphasis added). This limitation, again, does not tie the "computerized model" to an engineering application, and does not specify what the model is used for.

Thus, we find claims 1, 7, and 13 are directed to an abstract idea of manipulating data through mathematical relationships, which is similar to the computing formula discussed in *Flook*, and the Arrhenius formula in *Diehr*.

Appellant further argues claims 1, 7, and 13 are similar to the claims in *Enfish, LLC v. Microsoft Corp.*, 822 F.3d 1327 (Fed. Cir. 2016), in that these claims "are directed to an improvement in the functioning of a computer (i.e., joining mis-matched NURBS patches (CAD models) to a computerized model suitable for finite element analysis (F[E]A))." Reply Br. 3–4 (citing Spec. ¶¶ 5, 8). Appellant, however, does not present evidence to establish claims 1, 7, and 13 recite a specific improvement to the computers. *See Enfish*, 822 F.3d at 1336. Appellant also has not

demonstrated the claims "improve the way a computer stores and retrieves data in memory," as the claims in *Enfish* did via a "self-referential table for a computer database." *See Enfish*, 822 F.3d at 1336, 1339. For example, claims 1, 7, and 13 merely require determining linear constraint equations for numerically connecting NURBS patches, and enabling a computerized model to be created therefrom suitable for finite element analysis, which does not demonstrate an actual improvement to the way computers (or computers' memory) operate. Rather, Appellant's claims 1, 7, and 13 recite a mathematical determination of equations for joining imperfectly-matching spline-modeled surfaces. Such mathematical determination involves conventional matrix operations (*see* Spec. ¶¶ 31, 44–45, Fig. 7F), which could be performed, equally, by a human using pen and paper, and by a conventional computer.

Under step two of the *Alice* framework, we agree with and adopt the Examiner's findings on pages 2–3 and 5 of the Answer. We find that the additional limitations, taken individually and as a whole in the ordered combination, do not add significantly more to the abstract idea of manipulating data through mathematical relationships or transform the abstract idea into a patent-eligible application. *Alice*, 134 S. Ct. at 2357. Particularly, claims 1, 7, and 13 recite well-understood, routine, and conventional elements (i.e., computer system having an application module, memory, processor, and computer readable storage medium) that enable the creation of a computerized model using a "generic computer structure that serves to perform generic computer functions that are well-understood, routine, and conventional." Final Act. 3; *see also* Ans. 5. "[T]he use of generic computer elements like a microprocessor or user interface do not

alone transform an otherwise abstract idea into patent-eligible subject matter." *FairWarning IP, LLC v. Iatric Sys., Inc.*, 839 F.3d 1089, 1096 (Fed. Cir. 2016) (citing *DDR Holdings, LLC, v. Hotels.com, L.P.*, 773 F.3d 1245, 1256 (Fed. Cir. 2014)); *see also Ultramercial, Inc. v. Hulu, LLC*, 772 F.3d 709, 715–16 (Fed. Cir. 2014) (claims merely reciting the abstract idea of using advertising as currency as applied to particular technological environment of the Internet are not patent eligible); *Accenture Global Servs., GmbH v. Guidewire Software, Inc.*, 728 F.3d 1336, 1344–45 (Fed. Cir. 2013) (claims reciting "generalized software components arranged to implement an abstract concept [of generating insurance-policy-related tasks based on rules to be completed upon the occurrence of an event] on a computer" are not patent eligible); and *Dealertrack, Inc. v. Huber*, 674 F.3d 1315, 1333–34 (Fed. Cir. 2012) ("[s]imply adding a 'computer aided' limitation to a claim covering an abstract concept, without more, is insufficient to render [a] claim patent eligible").

Further, under the second step of the *Alice* inquiry, Appellant argues "[c]laim 1 defines significantly more than an abstract idea because [it] cover[s] an improvement to the technology in mechanical engineering design and analysis with an improved method of converting a CAD model (i.e., NURBS patches) to a CAE model (i.e., FEA mesh model)." App. Br. 7 (emphasis removed). We are not persuaded by Appellant's argument. As discussed *supra*, we agree with the Examiner that independent claims 1, 7, and 13 do not recite converting a CAD model to another model. The claims also do not recite "special purpose computers (e.g., a computer with CAD software, FEA software[])" as advocated by Appellant. *See* App. Br. 8–9.

Appellant also argues "like the claims in *DDR Holdings* that recite 'a specific way' of creating a composite web page, Appellant's Claim 1 defines a specific way of converting a CAD model (i.e., first and second NURBS patches) to a CAE model (i.e., a computerized model suitable for FEA)." App. Br. 8 (citing *DDR Holdings*). We remain unpersuaded, as Appellant has not demonstrated their claimed generic computer components are able in combination to perform *functions that are not merely generic*, as the claims in *DDR*. *See DDR Holdings*, 773 F.3d at 1258 (holding the claims at issue patent eligible because "they do not broadly and generically claim 'use of the Internet' to perform an abstract business practice (with insignificant added activity)," and "specify how interactions with the Internet are manipulated to yield a desired result—a result that overrides the routine and conventional sequence of events ordinarily triggered by the click of a hyperlink"). As discussed *supra*, Appellant's claims 1, 7, and 13 merely recite data processing steps that can be performed by conventional matrix operations. *See* Spec. ¶¶ 44–45, Fig. 7F.

Because Appellant's claims 1–18 are directed to a patent-ineligible abstract concept and do not recite something "significantly more" under the second prong of the *Alice* analysis, we sustain the Examiner's rejection of these claims under 35 U.S.C. § 101.

CONCLUSION

On the record before us, we conclude Appellant has not demonstrated the Examiner erred in rejecting claims 1–18 under 35 U.S.C. § 101.

DECISION

As such, we affirm the Examiner's final rejection of claims 1–18.

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