UNITED STATES PATENT AND TRADEMARK OFFICE

UNITED STATES DEPARTMENT OF COMMERCE
United States Patent and Trademark Office
Address: COMMISSIONER FOR PATENTS
P.O. Box 1450
Alexandria, Virginia 22313-1450
www.uspto.gov

APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
14/293,221	06/02/2014	Lie-Quan Lee	8536P023	5279

81088 7590 10/30/2018
WOMBLE BOND DICKINSON (US) LLP / FIJI
Attn: IP Docketing
P.O. Box 7037
Atlanta, GA 30357-0037

EXAMINER	
STIFTER JR, TERENCE E	

ART UNIT	PAPER NUMBER
2865	

NOTIFICATION DATE	DELIVERY MODE
10/30/2018	ELECTRONIC

Please find below and/or attached an Office communication concerning this application or proceeding.

The time period for reply, if any, is set in the attached communication.

Notice of the Office communication was sent electronically on above-indicated "Notification Date" to the following e-mail address(es):

FIP_Group@bstz.com
PTO.MAIL@BSTZPTO.COM
PTO.MAIL@BSTZ.COM

UNITED STATES PATENT AND TRADEMARK OFFICE

BEFORE THE PATENT TRIAL AND APPEAL BOARD

Ex parte LIE-QUAN LEE,[1]
LEONID POSLAVSKY, and STILIAN IVANOV PANDEV

Appeal 2018-006282
Application 14/293,221
Technology Center 2800

Before MARK NAGUMO, GEORGE C. BEST, and
N. WHITNEY WILSON, *Administrative Patent Judges*.

NAGUMO, *Administrative Patent Judge*.

DECISION ON APPEAL

Lie-Quan Lee, Leonid Poslavsky, and Stilian Ivanov Pandev ("Lee") timely appeal under 35 U.S.C. § 134(a) from the Final Rejection[2] of all pending claims 1–6, 8–10, 12–20, 22–24, 26, and 28–30 as being drawn to judicially excepted subject matter. We have jurisdiction. 35 U.S.C. § 6. We affirm.

---

[1] The real party in interest is identified as KLA-Tencor Corporation. (Appeal Brief, filed 21 November 2017 ("Br."), 3.)

[2] Office Action mailed 24 February 2017 ("Final Rejection"; cited as "FR").

OPINION

A. Introduction[3, 4, 5]

The subject matter on appeal is said to relate to the dynamic removal of highly correlated parameters for optical metrology. (Spec. 1, [0002].)

According to the ′221 Specification, algorithms such as the rigorous coupled wave analysis (RCWA) are widely used "for the study and design of diffraction structures." (*Id.* at [0003].) In these methods, the profiles of periodic structures are said to be "approximated by a given number of sufficiently thin planar grating slabs." (*Id.*) In addition to material-specific parameters, such as "the refractive index or n, k values" (*id.* at 29 [0096]), geometric parameters such as thicknesses, critical dimension, sidewall angle, height, edge roughness, corner rounding radius, etc., may be used to characterize the shape of the features being measured (*id.* at 30 [0097]). The Specification indicates that 30–50 or more of such parameters may go into the model of a two- or three[6]-dimensional element. (*Id.*) Simulated spectra

---

[3] Application 14/293,221, *Dynamic removal of correlation of highly correlated parameters for optical metrology*, filed 2 June 2014, claiming the benefit of a provisional application filed 3 June 2013. We refer to the "′221 Specification," which we cite as "Spec."

[4] Because this application claims the benefit of a preliminary application filed after the 16 March 2013, effective date of the America Invents Act, we refer to the AIA version of the statute.

[5] A petition to make special under Patent Prosecution Highway, filed 12 January 2015, was granted on 17 June 2015.

[6] In addition to repeated variation in height (along the z-axis), the grating may vary along the x-axis (e.g., rows of ridges; *see* Figure 6B, two-dimensional grating) or along both the x- and y-axes (e.g., rows and columns of blocks; *see* Figure 6A, three-dimensional grating).

for a periodic structure may be calculated by RCWA for such a model, followed by regression analysis to fit the model to a measured diffraction spectrum of the structure from which the model was generated.
(*Id.* at [0098].)

The Specification, however, teaches that many parameters may be highly correlated, by which the Specification means they are "correlated to any degree that may interfere with an operation." (*Id.* at 9 [0027].) In particular, during optimization of parameters to fit the model to the measured structure, the search directions for model optimization may become unstable because "the change of an objective function due to one parameter can be largely compensated by changes of its highly correlated parameter (or parameter set)" (*id.* at [0030]), resulting in toggling (*id.* at [0029]) and lack of convergence. A difficulty with prior art methods of addressing this problem is said to be the "re-parameterization" of the model, resulting in floating parameters that are abstract and that have no physical meaning. (*Id.* at 11–12 [0038].) As a result, "there may be no easy way to intuitively manipulate such abstract parameters." (*Id.* at 12.)

The Specification discloses methods that are said to simplify the problem without changing the model, in particular, without altering the parameters that are to be modified to arrive at an optimized fit of the calculated properties of the model to the values measured from the physical device.[7]

---

[7] The mathematically inclined reader is directed to the discussion in the Specification at page 10, paragraph [0033–page 14, paragraph [0050] for a more technical discussion. Very briefly, when parameters are highly correlated, a certain n × n H matrix ("Hessian") of second order partial

Claim 1 is representative and reads:

A method for optical metrology testing of a microelectronic structure comprising:

determining a model of a first microelectronic structure on a substrate, the model of the first microelectronic structure including a set of model parameters, the set of model parameters including

geometric parameters, material parameters, or both;

performing optical metrology measurement of the first microelectronic structure utilizing

an optical metrology system to determine a value of at least one parameter of the first microelectronic structure,

including collecting measured spectra data for the first microelectronic structure on a hardware element,

the hardware element being a reflectometer or ellipsometer;

during the optical metrology measurement of the first microelectronic structure,

dynamically removing correlation of two or more parameters of the set of model parameters,

wherein the dynamic removal of correlation of parameters during the optical metrology measurement does not change the model of the microelectronic structure,

each iteration of the dynamic removal of correlation during the optical metrology measurement including:

---

derivatives is said to be often close to singular—i.e., without an inverse—leading to large errors and failure to converge on a global minimum. Under certain conditions (Spec. 13 [0046]–14 [0050]), the complexity of the mathematical problem may be reduced by applying constraints to reduce the size of the parameter set (*id.* at 13 [0045]), thereby "eliminating (throwing away) certain search directions that do not significantly change the objective function values when change is along one or combination of those directions" (*id.* at 16 [0061]).

generating a Jacobian matrix of the set of model parameters, wherein generating the matrix includes inputting the measured spectra data for the microelectronic structure collected by the hardware element,

applying a singular value decomposition of the Jacobian matrix, wherein

the application of the singular value decomposition results in a set of singular vectors,

selecting a subset of the set of singular vectors, wherein selecting the subset of vectors includes

applying a threshold, the threshold being adaptively selected based on the number of iterations of the dynamic removal of correlation that are performed, and

computing a direction of the parameter search based on the subset of vectors;

if the model of the first microelectronic structure does not converge following an iteration of the dynamic removal of correlation,

performing one or more additional iterations of the dynamic removal of correlation until the model converges; and

if the model of the first microelectronic structure does converge, *reporting out results of the optical metrology measurement* of the first microelectronic structure including

the value of the at least one parameter of the first microelectronic structure based on comparison of the measured spectra data for the first microelectronic structure with a simulated diffraction signal for the model of the first microelectronic structure.

(Claims App., Br. 27–28; some indentation, paragraphing, and emphasis added.)

Independent claim 15 is directed to a "non-transitory tangible machine-accessible storage medium having instructions" that cause the method to be carried out. (*Id.* at 29–30.) Remaining independent claim 29 is directed to a system for optical metrology testing of microelectronic structures for carrying out the method. (*Id.* at 32–33.)

B. Discussion

The Board's findings of fact throughout this Opinion are supported by a preponderance of the evidence of record.

Initially, we find that Lee's arguments for the patentability of claim 15 (Br. 14–20) and for the patentability of claim 29 (*id.* at 20–26) are substantially the same as the arguments for patentability of claim 1 (*id.* at 10–14). Moreover, Lee expressly limits arguments for patentability of the corresponding dependent claims to those raised for the independent claims. (*Id.* at 26.) We therefore focus our attention on claim 1, with which the remaining claims stand or fall. 37 C.F.R. § 41.37(c)(1)(iv) (2017).

Lee (Br. 10, ll. 15–20) urges that the Examiner erred harmfully in step 1 of the *Alice* analytical framework by concluding that the claimed invention is "directed to an abstract idea of a method for dynamic removal of correlation of parameters" (FR 5, ll. 3–4), more specifically, "to an algorithm for performing a series of mathematical operations/functions to a model that includes a set of parameters" (*id.* at 24–25). Rather than being analogous to the patent-ineligible inventions at issue in *Maucorps*[8] (algorithm for determining an optimum number or value) and *Flook*[9] (formula for computing an alarm limit) (Br. 10), Lee urges that the claimed

---

[8] *In re Maucorps*, 609 F.2d 481 (CCPA 1979).

[9] *Parker v. Flook*, 437 U.S. 584 (1978).

invention is analogous to the patent-eligible claim at issue in *Diehr*[10] because the steps of the claimed process "impose meaningful limits that apply the formula to improve an existing technological process" (*id.* at 11). Moreover, Lee argues, "the claim is inextricably tied to optical metrology." (*Id.*) In Lee's view, as in *McRO*[11], "claim 1 provides for specific rules in a process for automated optical metrology testing of microelectronic structure to achieve an improved technological result, and specifically for determining and presenting a value of at least one parameter of the first microelectronic structure." (*Id.* at 13, ll. 14–17.)

These arguments are not persuasive of harmful error. That the claimed process involves performing optical measurements on a first microelectronic structure is not dispositive. As the Court held in *Flook*, "a claim for an improved method of calculation, even when tied to a specific end use, is unpatentable subject matter under § 101." 437 U.S. at 595 n.18; *cf. Bancorp Servs., L.L.C. v. Sun Life Assur. Co. of Canada (US)*, 687 F.3d 1266, 1277 (Fed. Cir. 2012) ("a machine, system, medium, or the like may in some cases be equivalent to an abstract mental process for purposes of patent ineligibility. As the Supreme Court has explained, the form of the claims should not trump basic issues of patentability" (citing, *inter alia*, *Flook*, 437 U.S. at 593)). As for the steps of processing the measured data, although an allegedly novel combination of analytical steps is recited, our reviewing court has explained that "we have treated analyzing information

---

[10] *Diamond v. Diehr*, 450 U.S. 175 (1981).

[11] *McRO, Inc. v. Bandai Namco Games Am. Inc.*, 837 F.3d 1299 (Fed. Cir. 2016).

by steps people go through in their minds, or by mathematical algorithms, without more, as essentially mental processes within the abstract-idea category." *Elec. Power Grp., LLC v. Alstom S.A.*, 830 F.3d 1350, 1353–54 (Fed. Cir. 2016). As the court explained recently, "[i]t is clear from *Mayo* that the 'inventive concept' cannot be the abstract idea itself, and *Berkheimer* and *Aatrix* leave untouched the numerous cases from this court which have held claims ineligible because the only alleged 'inventive concept' is the abstract idea." *Berkheimer v. HP Inc.*, 890 F.3d 1369, 1374 (Fed. Cir. 2018) (denying reh'g en banc) (citation omitted). Finally, the result of the claimed process, upon convergence of the model, is "reporting out results of the optical metrology measurement . . . including the value of . . . at least one parameter . . . ." Again, our reviewing court has explained that "merely presenting the results of abstract processes of collecting and analyzing information, without more (such as identifying a particular tool for presentation), is abstract as an ancillary part of such collection and analysis." *Elec. Power Grp.*, 830 F.3d at 1354. Thus, the final step of the claim is not enough by itself to bring the claim into the realm of patent eligibility.

In *McRO*, the Federal Circuit determined that the rules incorporated into the claimed process prevented the claim from being directed to an abstract idea. The "rules with specific characteristics" at issue in *McRO* involve "a first set of rules that define output morph weight set stream as a function of phoneme sequence and time of said phoneme sequence." *McRO*, 837 F.3d at 1307–08, 1313. Broad as these rules are, they nonetheless establish relations between physical events, namely, the facial expressions people make when making a phoneme, i.e., a specific sound, the visual representation of a character's face (a "viseme"), and a timed transcript of the phonemes pronounced during an utterance. The result of the application of these rules is a final stream of output morph weight sets at a desired frame rate to produce lip synchronization and facial expression control of the animated character speaking the utterance. As a result, the claims do not "preempt approaches that use rules of a different structure or different techniques." *Id.* at 1316. In contrast, the rules of the present claims involve dynamically removing correlation of two or more parameters by generating a Jacobean matrix, applying a singular value decomposition, and selecting, by applying a threshold condition, a subset of the singular vectors until the model converges. These purely mathematical operations are abstract ideas applied to data (optical measurements) obtained by ellipsometry or reflectometry. The result of the calculations is the value of at least one parameter of the structure. It cannot be said, fairly, that that value is an improved technological result in an industrial practice, conventional or otherwise.

We conclude that harmful error has not been demonstrated in the Examiner's *Alice* step 1 analysis. We therefore turn to step 2 of the *Alice* framework, in which we look for something in the claims, other than and in addition to the abstract ideas, that transforms the abstract idea into patent-eligible subject matter.

Lee urges that "the claim elements recite an improvement to the technology of optical metrology testing of a microelectronic structure." (Br. 14, ll. 12–14.) The improvement is said to be "dynamically removing the correlation of model parameters during an optical metrology measurement without changing the model of the structure itself." (*Id.* at ll. 19–20.) The dynamic removal process, however, is disclosed to be a series of mathematical manipulations, and thus is a "mental process[] within the abstract–idea category." *Elec. Power Grp.*, 830 F.3d at 1354.

There is, moreover, neither in the claim nor in the supporting disclosure, any indication that nonstandard processing hardware, or nonstandard software (aside from the specific coding for solving the sets of equations) is presented as part of the claimed invention. Thus, there are no additional elements which serve to transform the abstract idea into patent-eligible subject matter.

We conclude that harmful error has not been demonstrated in the appealed rejection.

C. Order

It is ORDERED that the rejection of claims 1–6, 8–10, 12–20, 22–24, 26, and 28–30 is affirmed.

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

AFFIRMED