PATENT COOPERATION TREATY

From the
INTERNATIONAL SEARCHING AUTHORITY

To:

see form PCT/ISA220

PCT

WRITTEN OPINION OF THE
INTERNATIONAL SEARCHING AUTHORITY
(PCT Rule 43bis.1)

Date of mailing
(day/month/year) see form PCT/ISA210 (second sheet)

FOR FURTHER ACTION
See paragraph 2 below

Applicant's or agent's file reference
see form PCT/ISA220

International application No.
PCT/US2019/016584
International filing date (day/month/year) 05.02.2019
Priority date (day/month/year) 07.02.2018

International Patent Classification (IPC) or both national classification and IPC
INV. G06F17/50 B33Y50/00

Applicant
SIEMENS CORPORATION

1. This opinion contains indications relating to the following items:

☑ Box No. I  Basis of the opinion
☑ Box No. II  Priority
☐ Box No. III  Non-establishment of opinion with regard to novelty, inventive step and industrial applicability
☐ Box No. IV  Lack of unity of invention
☑ Box No. V  Reasoned statement under Rule 43bis.1(a)(i) with regard to novelty, inventive step and industrial applicability; citations and explanations supporting such statement
☐ Box No. VI  Certain documents cited
☐ Box No. VII  Certain defects in the international application
☒ Box No. VIII  Certain observations on the international application

2. FURTHER ACTION

If a demand for international preliminary examination is made, this opinion will usually be considered to be a written opinion of the International Preliminary Examining Authority ("IPEA") except that this does not apply where the applicant chooses an Authority other than this one to be the IPEA and the chosen IPEA has notified the International Bureau under Rule 66.1bis(b) that written opinions of this International Searching Authority will not be so considered.

If this opinion is, as provided above, considered to be a written opinion of the IPEA, the applicant is invited to submit to the IPEA a written reply together, where appropriate, with amendments, before the expiration of 3 months from the date of mailing of Form PCT/ISA220 or before the expiration of 22 months from the priority date, whichever expires later.

For further options, see Form PCT/ISA220.

Name and mailing address of the ISA:

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Date of completion of this opinion
see form PCT/ISA210

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Form PCT/ISA237 (Cover Sheet) (January 2015)
Box No. I  Basis of the opinion

1. With regard to the language, this opinion has been established on the basis of:
   ☑ the international application in the language in which it was filed.
   ☐ a translation of the international application into , which is the language of a translation furnished for the purposes of international search (Rules 12.3(a) and 23.1 (b)).

2. ☐ This opinion has been established taking into account the rectification of an obvious mistake authorized by or notified to this Authority under Rule 91 (Rule 43bis.1(a))

3. ☐ With regard to any nucleotide and/or amino acid sequence disclosed in the international application, this opinion has been established on the basis of a sequence listing:
   a. ☐ forming part of the international application as filed:
      ☐ in the form of an Annex C:ST.25 text file.
      ☐ on paper or in the form of an image file.
   b. ☐ furnished together with the international application under PCT Rule 13ter.1(a) for the purposes of international search only in the form of an Annex C:ST.25 text file.
   c. ☐ furnished subsequent to the international filing date for the purposes of international search only:
      ☐ in the form of an Annex C:ST.25 text file (Rule 13ter.1(a)).
      ☐ on paper or in the form of an image file (Rule 13ter.1(b) and Administrative Instructions, Section 713).

4. ☐ In addition, in the case that more than one version or copy of a sequence listing has been filed or furnished, the required statements that the information in the subsequent or additional copies is identical to that forming part of the application as filed or does not go beyond the application as filed, as appropriate, were furnished.

5. Additional comments:

Box No. II  Priority

1. ☑ The validity of the priority claim has not been considered because the International Searching Authority does not have in its possession a copy of the earlier application whose priority has been claimed or, where required, a translation of that earlier application. This opinion has nevertheless been established on the assumption that the relevant date (Rules 43bis.1 and 64.1) is the claimed priority date.

2. ☐ This opinion has been established as if no priority had been claimed due to the fact that the priority claim has been found invalid (Rules 43bis.1 and 64.1). Thus for the purposes of this opinion, the international filing date indicated above is considered to be the relevant date.

3. Additional observations, if necessary:
Box No. V  Reasoned statement under Rule 43bis.1(a)(i) with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement

1. Statement

<table>
<thead>
<tr>
<th></th>
<th>Yes</th>
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<td><strong>Novelty (N)</strong></td>
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2. Citations and explanations

*see separate sheet*

Box No. VI  Certain documents cited

1. Certain published documents (Rules 43bis.1 and 70.10)
   
   *and / or*

2. Non-written disclosures (Rules 43bis.1 and 70.9)

*see form 210*

Box No. VIII  Certain observations on the international application

The following observations on the clarity of the claims, description, and drawings or on the question whether the claims are fully supported by the description, are made:

*see separate sheet*
Re Item V

Reasoned statement with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement

1  Article 33(2) PCT

1.1 Reference is made to the following document:

D1  WO 2017/088134 A1 (SIEMENS PRODUCT LIFECYCLE MAN
SOFTWARE INC [US] ET AL.) 1 June 2017 (2017-06-01)

1.2 The present application does not meet the criteria of Article 33(1) PCT,
because the subject-matter of claim 1 is not new in the sense of Article 33(2)
PCT.

1.3 D1 discloses (where references in parentheses apply to this document D1):

A method, comprising:
receiving part data for a part to be manufactured;

(figure 2, item 205: "Receive model".

paragraph 31: "The system receives a model of an object to be manufactured
(205) . In most cases, the object is to be manufactured using additive
manufacturing techniques.")

creating a set of balls and beams in a computer-aided design (CAD)
model, in a patterning structure and based on the part data;

constructing a steady lattice structure in the CAD model; and

(figure 2, item 210: "Create a lattice".

paragraph 32: " The system can create the lattice as a rod lattice
representation defined by an arrangement of generalized cylindrical rods with
optional spherical balls at the rod junctions.")

displaying the CAD model including the steady lattice structure.

(figure 2, item 220: "Render model")

1.4 Since all features of claim 1 are disclosed in D1, claim 1 is not new (Article
33(2) PCT).

1.5 Claim 2 is also not new (Article 33(2) PCT), since D1 also discloses the
further features of claim 2
The method of claim 1, further comprising computing integral properties of at least one of the steady lattice structure, each of a plurality of rows in the steady lattice structure, or a plurality of hubs in the steady lattice structure.

(figure 2, item 225: "Analyse mass properties"
see also paragraphs 38, 40-42)

1.6 Claim 3 is also not new (Article 33(2) PCT), since D1 also discloses the further features of claim 3

The method of any of claims 1-2, wherein the steady lattice structure is created by connecting adjacent balls in the set of balls with respective ones of the beams, wherein each beam is divided into half-beams, and the union of each ball and its connected half-beams defines a hub.

(paragraph 32: "The system can create the lattice as a rod lattice representation defined by an arrangement of generalized cylindrical rods with optional spherical balls at the rod junctions.")

1.7 Claim 4 is also not new (Article 33(2) PCT), since D1 also discloses the further features of claim 4

The method of any of claims 1-3, wherein the steady lattice structure includes repeating patterns of hubs.

(figure 3B)

1.8 Claim 5 is also not new (Article 33(2) PCT), since D1 also discloses the further features of claim 5

The method of any of claims 1-4, further comprising computing integral properties using closed-form expressions.

(paragraph 41: "When the rod has a variable cross-section, then the volume is computed by numerically executing the integral \( \int A(l) \, dl \) where \( A(l) \) is the cross section at position \( l \) and \( 0 \leq l \leq L \), \( L \) is the length of the rod segment.")

1.9 Claim 6 is also not new (Article 33(2) PCT), since D1 also discloses the further features of claim 6

The method of any of claims 1-5, wherein the steady lattice structure is displayed using swirling curves.

(figures 3a, 3b and 3e)
1.10 Claim 7 is also not new (Article 33(2) PCT), since D1 also discloses the further features of claim 7

The method of any of claims 1-6, wherein each ball is created by applying a same similarity transform.

(figure 3b)

1.11 Claim 8 is also not new (Article 33(2) PCT), since D1 also discloses the further features of claim 8

The method of any of claims 1-7, further comprising manufacturing the part according to the CAD model.

(paragraph 36: "For example, the trimming operation can be used in core design functions including but not limited to visualization, mass property evaluation, finite element analysis, and manufacturing.")

1.12 Claim 9 is also not new (Article 33(2) PCT), since D1 also discloses the further features of claim 9

A data processing system comprising at least a processor and accessible memory, configured to perform a method as in any of claims 1-8.

(claim 11: "a data processing system comprising...")

1.13 Claim 10 is also not new (Article 33(2) PCT), since D1 also discloses the further features of claim 10

A non-transitory computer-readable medium encoded with executable instructions that, when executed, cause a data processing system to perform a method as in any of claims 1-8.

(claim 20: "20. A non-transitory computer-readable medium encoded with executable instructions that, when executed, cause one or more data processing systems to...")

2 Article 33(3) PCT

2.1 Independently of the above objection, the present application also does not meet the requirements of Article 33(1) PCT because the subject-matter of claim 1 does not involve an inventive step within the meaning of Article 33(3) PCT, for the following reasons.
2.2 Claim 1 comprises mathematical features (the reception of abstract data, the creation of geometric entities (balls, beams, lattice) in a geometrical construct (the CAD model), and the display of said geometric entities and constructs), therefore these features fall under the scope of Rule 67.1(i) PCT.

2.3 The International Search Authorities have divergent practice concerning the examination of such claims. The EPO considers that non-technical features, i.e., features which do not contribute to the technical character of the invention as claimed, cannot support the presence of an inventive step. Consequently, it will be first examined whether the mathematical features of the claim contribute to the technical character of the invention.

2.4 Mathematical features contribute to the technical character of the invention if they form part of the solution to a technical problem in a field of technology.

2.5 This is however not the case here.

2.5.1 First, no field of technology can be identified here, since the terms used (part, balls, beams, lattice, model...) are broad and abstract to the point that no clear field of technology can be derived from them.

2.5.2 Second, these features do not contribute to the solution of a technical problem, since the claim amounts in performing geometric operations on abstract data and in displaying the result. Performing geometric operations on abstract data is seen as an abstract mathematical task, and not a technical one.

2.6 As a consequence of the above, the mathematical steps of the claim cannot be seen to form part of the solution to a technical problem in a field of technology. Consequently, the mathematical features do not contribute to the technical character of the invention, and cannot support the presence of an inventive step (Article 33(3) PCT).

2.7 To identify the features of claim 1 that lack technical character, we reproduce the text of claim 1 below, with the technical features crossed out:

   A method, comprising:
   receiving part data for a part to be manufactured;
   creating a set of balls and beams in a computer-aided design (CAD) model, in a patterning structure and based on the part data;
   constructing a steady lattice structure in the CAD model; and
   displaying the CAD model including the steady lattice structure.

2.8 The features contributing to the technical character of the invention are that:
a. the method is **assumed to be computer-implemented** (see item VIII below)

b. the model is **a computer-aided-design model**

2.9 When employing the problem solution approach in this kind of mixed type claims involving technical and non-technical features, the technical problem has to be formulated in such a way that there is no possibility of an inventive step being derived from the non-technical features. Accordingly, the skilled person is provided with a requirement specification corresponding to the non-technical concepts, as part of the problem to be solved.

2.10 Given the above, the technical problem to be solved can be seen as how to automate the above mathematical method.

2.11 When trying to solve the above-mentioned problem, the skilled person would, as a normal design option, and using only basic programming skills, implement the above method above on a general purpose computer well-known in the art, thus leading to a computer implemented method, and to a computer-aided-design model.

2.12 Therefore, the technical features a and b above do not justify the presence of an inventive step (Article 33(3) PCT).

2.13 Consequently, the subject-matter of claim 1 does not involve an inventive step (Article 33(3) PCT).

2.14 The subject-matter of the dependent claims 2-8 also does not involve an inventive step (Article 33(3) PCT).

2.15 The further features of claims 2 and 5 claim the computation of mathematical quantities, hence there are also mathematical features and do not contribute to technical character of the invention.

2.16 The further features of claims 3, 4 and 7 claim the execution of geometrical operations on geometrical entities, hence there are also mathematical features and do not contribute to technical character of the invention.

2.17 The further features of claim 6 claim an alternative display of the geometrical entities, further display which is not technical and therefore does not contribute to technical character of the invention.

2.18 The further features of claim 8 do not justify the presence of an inventive step since, if given a (CAD) model of part, the skilled person can be expected to know how to manufacture it.
2.19 Claims 9 and 10 comprise features which, in essence, correspond to the features of claim 1, which was shown to lack an inventive step above. The additional features of claims 9 and 10 relate to standard computing technology, and are merely reciting generic elements of general purpose computing technology which are notoriously known to the skilled person. Hence, these features do not support the presence of an inventive step within the meaning of Article 33(3) PCT, and the objection relating to claim 1 above also applies, mutatis mutandis, to the subject-matter of claims 9 and 10. Consequently, the subject-matter of claims 9 and 10 does not involve an inventive step (Article 33(3) PCT).

Re Item VI

Certain documents cited

3 Reference is made to the following document:
   D4 Ashish Gupta ET AL: “Designing and processing parametric models of steady lattices”,

3.1 The inventors have published D4 on the 30.06.2018, which is after the claimed priority 07.02.18, but before the filing date of the present application 05.02.2019.

3.2 The validity of the priority claim could not as yet be established, because the International Searching Authority is not in possession of a copy of the priority document.

3.3 Should the priority claimed be invalid, D4 would then be prejudicial to the novelty of all claims (see in particular sections 5-5.3, 6-6.6, 7-7.2).

Re Item VIII

Certain observations on the international application

4 Article 6 PCT

4.1 The application does not meet the requirements of Article 6 PCT, because claim 1 is not clear.

4.2 Concerning the preamble
4.2.1 The method claimed by claim 1 does not explicitly claim the use of technical means (i.e. that the method is *computer-implemented*). However, independent claims 9 and 10 do claim the use of technical means to execute the method of claim 1. This introduces doubt as to whether the technical means are essential features of the invention, thus rendering the set of claims unclear (Article 6 PCT). It was considered in box V above that the method of claim 1 is *computer-implemented*.

4.3 Concerning the feature "receiving"

4.3.1 The term "part data" is vague and unclear. All that can be understood from this wording, and from the corresponding feature, is that "data, which in some way is associated to a part to be manufactured, is received". It is however not clear what this data should represent.

4.4 Concerning the feature "creating"

4.4.1 The term "patterning structure" is neither defined nor clear in its own right. It is therefore not clear what are the restrictions associated with the wording "in a patterning structure".

4.4.2 The wording "based on the part data" is vague and unclear, since the claim does not clearly specify, in terms of technical features, how the "part data" is used in order to create the set of balls and beams.

4.4.3 The term "in a computer-aided design model" is not clear.

4.4.3.1 It is indeed not clear what are the potential relationships between the "part data" and this "computer-aided-design model", i.e. do these represent the same entity or not.

4.4.3.2 It is also not clear whether the "CAD model" is supposed to represent the "part to be manufactured" or not.

4.4.4 The term "creating" is not clear. As a consequence of the above, the claim does not comprise any feature which would explain what considerations must be taken into account when creating this set of balls and beams (such as where, in the CAD model, the balls and beams are created; how are these balls and beams associated with the "part data"; or what is the "pattern" that these balls and beams are supposed to form).

4.5 Concerning the feature "constructing"
4.5.1 The term "steady lattice structure" is neither well-known in the field nor clear in its own right. Hence, it is not clear what are the properties of a "steady lattice structure" in view of a "non-steady lattice structure".

4.5.2 The term "constructing" is vague and unclear, since the claim does not specify any considerations which are to be taken into account when constructing the lattice. Consequently, it is not clear where the lattice is constructed, what is its form, or how it interacts with the "part data" or with the "set of balls and beams". Claim 3 clarifies this unclear term.

4.6 The application does not meet the requirements of Article 6 PCT, because claim 2 is not clear.

4.6.1 The term "integral properties" is vague and unclear.

4.6.2 The term "hub" is vague and unclear.

4.7 The application does not meet the requirements of Article 6 PCT, because claim 5 is not clear.

4.7.1 The term "computing" is vague and unclear, in that it is not specified how these integrals are computed, i.e. which closed forms expressions are used.

4.8 The application does not meet the requirements of Article 6 PCT, because claim 6 is not clear.

4.8.1 It is not clear how a steady lattice structure can be converted into swirling curves.

4.9 The application does not meet the requirements of Article 6 PCT, because claim 7 is not clear.

4.9.1 The term "same similarity transform is not clear".

4.9.2 This further feature does not help in clarifying how the balls are created.