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Case Number: T 0219/17 - 3.2.02

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Language of the proceedings: EN

Title of invention:
Dental extraoral x-ray imaging system

Patent Proprietor:
Oy Ajat Ltd.

Opponent:
Clara Sattler de Sousa e Brito

Headword:

Relevant legal provisions:
EPC Art. 123(2), 123(3), 56

Keyword:
Added subject-matter (main and eighth auxiliary requests - yes)
Extension of scope of protection (ninth auxiliary request - no)
Inventive step (ninth auxiliary request - yes)

Decisions cited:
T 1400/16

Catchword:

Europäisches Patentamt
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Beschwerdekammern

Boards of Appeal

Chambres de recours

Boards of Appeal of the
European Patent Office
Richard-Reitzner-Allee 8
85540 Haar
GERMANY
Tel. +49 (0)89 2399-0
Fax +49 (0)89 2399-4465

Case Number: T 0219/17 - 3.2.02

D E C I S I O N
of Technical Board of Appeal 3.2.02
of 6 June 2018

Appellant: (Opponent)	Clara Sattler de Sousa e Brito Schönfeldstr. 19 80539 München (DE)
Representative:	Ostertag & Partner Patentanwälte mbB Epplestraße 14 70597 Stuttgart (DE)
Respondent: (Patent Proprietor)	Oy Ajat Ltd. Tekniikantie 4B 02150 Espoo (FI)
Representative:	Seppo Laine Oy Itämerenkatu 3 B 00180 Helsinki (FI)
Decision under appeal:	**Interlocutory decision of the Opposition Division of the European Patent Office posted on 11 November 2016 concerning the maintenance of European Patent No. 2223652 in amended form**

Composition of the Board:

Chairman	E. Dufrasne
Members:	M. Stern
	D. Ceccarelli

Summary of Facts and Submissions

I. The opponent lodged an appeal against the decision, posted on 11 November 2016, concerning the maintenance of European patent No. 2 223 652 in amended form.

II. The following documents are relevant for the present decision:

D14: WO-A-2004/084 728
D21: J.T. Dobbins III et al., "Digital x-ray tomosynthesis: current state of the art and clinical potential", 2003, Phys. Med. Biol. 48, pages R65-R106.

III. Notice of appeal was filed on 20 January 2017, and the fee for appeal was paid the same day. A statement setting out the grounds of appeal was received on 21 March 2017.

IV. Oral proceedings were held on 6 June 2018.

The appellant (opponent) requested that the decision under appeal be set aside and that the patent be revoked.

The respondent (patent proprietor) requested that the appeal be dismissed or, in the alternative, that the decision under appeal be set aside and that the patent be maintained on the basis of one of the eighth to twelfth auxiliary requests filed with letter dated 5 May 2018. The first to seventh auxiliary requests, filed with letter dated 8 August 2017, as well as the request for adaptation of pages 4 and 7 of the description, filed with letter dated 5 May 2018, were withdrawn.

V. Claim 1 of the **main request** (which was held allowable by the Opposition Division) reads as follows:

"An extra-oral dental x-ray imaging system comprising:
(a) an x-ray source (16) exposing x-rays to an object to be imaged (19), which x-ray source (16) is adapted to move for the duration of the exposure;
(b) an x-ray imaging device (14) suitable for producing multiple overlapping frames (40) during at least part of the exposure, wherein the x-ray imaging device (14) has an active area (520) with a long dimension m (530) and a short dimension n (510) and wherein m/n > 1.5;
(c) at least one rotational axis around which at least one of the x-ray source (16) and the imaging device (14) rotates along a predetermined geometric path, the axis being located between a focal point (36) of the x-ray source (16) and the x-ray imaging device (14);
(d) a processing device for inputting the multiple overlapping frames (40) to compose:
an image of a first panoramic layer, and
a limited volumetric 3D image of a volume corresponding to a part of said first panoramic layer,
characterized in that the processing device is adapted to compose said limited volumetric 3D image utilizing an iterative algorithm, wherein said algorithm is adapted to use the location of the x-ray source (16) and the x-ray imaging device (14) during the exposure and the predetermined geometric path to form reprojection data."

VI. Claim 1 of the **eighth auxiliary request** reads as follows (amendments to claim 1 of the main request highlighted by the Board):

"An extra-oral dental x-ray imaging system comprising:
(a) an x-ray source (16) exposing x-rays to an object to be imaged (19), which x-ray source (16) is adapted to move for the duration of the exposure;
(b) an x-ray imaging device (14) suitable for producing multiple overlapping frames (40) during at least part of the exposure, wherein the x-ray imaging device (14) has an active area (520) with a long dimension m (530) and a short dimension n (510) and wherein m/n > 1.5;
(c) at least one rotational axis around which at least one of the x-ray source (16) and the imaging device (14) rotates along a spline along a predetermined geometric path and according to a predefined speed profile, the axis being located between a focal point (36) of the x-ray source (16) and the x-ray imaging device (14);
(d) a processing device for inputting the multiple overlapping frames (40) to compose:
an image of a first panoramic layer, and
a limited volumetric 3D image of a volume corresponding to a part of said first panoramic layer,
characterized in that the processing device is adapted to compose said limited volumetric 3D image utilizing an iterative algorithm, wherein said algorithm is adapted to use the 3D location of the x-ray source (16) and the x-ray imaging device (14) and the related movement profiles during the exposure and the predetermined geometric path to form reprojection data."

VII. Claim 1 of the **ninth auxiliary request** reads as follows (amendments to claim 1 of the main request highlighted by the Board):

"An extra-oral dental x-ray imaging system comprising:

(a) an x-ray source (16) exposing x-rays to an object to be imaged (19), which x-ray source (16) is adapted to move for the duration of the exposure;

(b) an x-ray imaging device (14) suitable for producing multiple overlapping frames (40) during at least part of the exposure, wherein the x-ray imaging device (14) has an active area (520) with a long dimension m (530) and a short dimension n (510) and wherein m/n > 1.5;

(c) at least one rotational axis around which at least one of the x-ray source (16) and the imaging device (14) rotates along a spline along a predetermined geometric path and according to a predefined speed profile, the axis being located between a focal point (36) of the x-ray source (16) and the x-ray imaging device (14);

(d) a processing device for inputting the multiple overlapping frames (40) to compose:

an image of a first panoramic layer, and

a limited volumetric 3D image of a volume corresponding to a part of said first panoramic layer,

characterized in that the processing device is adapted to compose said limited volumetric 3D image utilizing an iterative algorithm, wherein

said algorithm is adapted to use the 3D location of the x-ray source (16) and the x-ray imaging device (14) and the related movement profiles during the exposure and the predetermined geometric path to form reprojection data containing estimates of the projected frames based on a 3D model,

said algorithm is adapted to calculate an error (1200) between the multiple overlapping frames and the estimates of the projected frames and to use the error to update the 3D model (1220), and

said algorithm is adapted to use prior data to set restrictions on the 3D model."

Claims 2 to 9 are dependent claims.

VIII. The arguments of the appellant which are relevant for the present decision may be summarised as follows:

Main and eighth auxiliary requests - Article 123(2) EPC

The arguments regarding Article 123(2) EPC that are relevant for the present decision are essentially those on which the reasons set out below are based.

Ninth auxiliary request

- *Article 123(2), (3) EPC*

Whilst there were no objections against claim 1 concerning Article 123(2) EPC, the claim was said to contravene Article 123(3) EPC. In claim 1 of the patent as granted (feature (d)), the device was defined as composing a first panoramic layer and a limited volumetric 3D image of a volume corresponding to a part of said first panoramic layer. In lieu of said definition, claim 1 of the ninth auxiliary request defined the device as composing *an image of* a first panoramic layer. This amendment created an aliud which shifted the scope of protection, contrary to Article 123(3) EPC.

- *Article 56 EPC*

The closest prior art D14 disclosed a dental x-ray system which composed panoramic-layer and 3D images using cone-beam reconstruction algorithms (page 3,

line 30 to page 5, line 10). Even if D14 did not explicitly disclose that the reconstruction algorithms were iterative, it was the skilled person's common general knowledge that in cone-beam technology, implicitly, or at least in most cases, iterative back-projection reconstruction algorithms were used. The objective technical problem to be solved by the claimed subject-matter was to improve the iterative algorithms of D14. To solve this problem the skilled person would take into account the teaching of the comprehensive review article D21 which summarised the knowledge of the skilled person. The amount of algorithms described was not excessive and could be easily implemented in the system of D14 by a software engineer. D21 described in chapter 3.4 (starting from page R78) iterative reconstruction techniques applicable for cone-beam technologies, as was clear from the lines under Equation (20). The particular iterative algorithm presented under point 3.4.1 bridging pages R78 and R79 contained all the features defined in claim 1. The skilled person could implement this algorithm in the system of D14 without any inventive merit. In particular, it should not be considered to be inventive to recognise that for dental imaging, a reduction of the image quality of a full CT algorithm was sufficient.

IX. The arguments of the respondent which are relevant for the present decision may be summarised as follows:

Main request - Article 123(2) EPC

The summary of the invention on page 8 of the application as filed did not mention that the predetermined geometric path along which the x-ray source and imaging devices were rotated was a spline.

This feature was mentioned in original claim 1 and merely once in the description, on page 17, lines 5 to 7. It was therefore not an essential feature of the invention and it was consequently permissible to omit it from the definition of the invention. Claim 1 was directed to a preferred embodiment of the invention involving the calculation of a limited volumetric 3D image using an iterative algorithm, disclosed on page 22, lines 11 to 15, which did not rely on the specification of the geometric path as a spline. Hence, the preferred embodiment could be defined omitting the feature of a spline.

Eighth auxiliary request - Article 123(2) EPC

Page 22, lines 11 to 15 presented an independent definition of the iterative algorithm, whilst the sentences following thereafter described further preferred embodiments of this algorithm. Hence, claim 1 was not an unallowable generalisation.

Ninth auxiliary request - Articles 123(3) and 56 EPC

The arguments regarding Articles 123(3) and 56 EPC that are relevant for the present decision are essentially those on which the reasons set out below are based.

Reasons for the Decision

1. The appeal is admissible.

2. The invention

The invention concerns a dental panoramic x-ray imaging system. As explained in paragraph [0010] of the patent

and Figure 3, such systems generally comprise an x-ray source and an imaging device which move around the patient's head according to a predetermined geometric path and speed profile. The imaging system of the invention composes an image of a panoramic layer and a limited volumetric 3D image of a volume corresponding to a part of the panoramic layer. The limited volumetric 3D image is composed by utilising an iterative algorithm as disclosed in paragraph 81 and Figure 8f of the patent (page 22, lines 11 to 21).

3. Main request - Article 123(2) EPC

3.1 In the original application, the dental x-ray imaging system of the invention is specified in original claim 1 to rotate the x-ray source and the imaging device "along a spline". According to common general knowledge, a spline is a continuous curve having continuous derivatives, a fact which was not disputed during the procedure (see also T 1400/16, point 2.1.3, decided by the present Board in a related case involving the same patent family).

3.2 In contrast, current claim 1 (feature (c)) specifies that the rotation of the x-ray source and the imaging device is "along a predetermined geometric path", a broader expression that no longer contains the aforementioned limitation of a spline.

3.3 There is no direct and unambiguous disclosure in the original application, explicit or implicit, that the limitation to a spline is an optional one.

3.4 The Board is not convinced by the respondent's argument that since the "Summary of the invention" on page 8 did

not refer to any geometric path, much less to a spline, the latter was therefore not an essential feature of the invention and it was consequently permissible to omit it from the definition of the invention.

The "invention" which is summarised on page 8 is not defined anywhere in the original application but in original claim 1, where it is specified as a system in which the rotation of the x-ray source and the imaging device is along a spline. Instead, the *summary* of the invention (on page 8) has to be understood as being just that, namely a brief account of the main aspects of the invention, which in this case is only defined in original claim 1. That a certain feature of the invention is not mentioned in its summary does not unequivocally convey the information that the feature may be facultative or optional. Moreover, that the feature has been mentioned only once in the description, on page 17, lines 5 to 7, is likewise no reason to consider that the feature has been disclosed as optional.

The respondent argued, moreover, that claim 1 was directed to a preferred embodiment of the invention in which a limited volumetric 3D image was composed using an iterative algorithm (based on page 22, lines 11 to 15), and that this feature did not rely on the specification of the geometric path being a spline, as specified in original claim 1 and described once, on page 17, lines 5 to 7. Hence, the preferred embodiment could be defined omitting the feature of a spline.

The Board disagrees. The preferred embodiment of an originally disclosed invention is, self-evidently, one that includes further technical limitations of that same invention - irrespective of whether or not they

are related to features specified in the original definition of the invention. As indicated above, there is just no definition of the invention other than that of original claim 1, which does include the feature of a spline.

3.5 The Board therefore concludes that the subject-matter of claim 1, specifying that the rotation of the x-ray source and the imaging device is "along a predetermined geometric path", leads to an unallowable generalisation of the content of the application as originally filed, contrary to the requirements of Article 123(2) EPC.

4. Eighth auxiliary request - Article 123(2) EPC

4.1 Claim 1 effectively remedies the aforementioned objection by specifying that the rotation of the x-ray source and the imaging device is along a spline.

4.2 However, the last paragraph of claim 1 defines composing the limited volumetric 3D image utilising an iterative algorithm that contains only some of the steps of the iterative algorithm disclosed on page 22, lines 11 to 21 and presented as a flow diagram in Figure 8f. For example, the calculation of the error between measured and reprojected frames and the update of the current 3D estimate based on that error, as disclosed on page 22, lines 15 to 17 has been omitted in the algorithm claimed. Since further iterative algorithms based on different convergence criteria are clearly conceivable, the mentioned omission leads to an unallowable generalisation of the originally disclosed algorithm. Moreover, the use of prior data to set restrictions on the 3D model, which is disclosed on page 22, lines 18 to 21 as "very important", has been likewise omitted in the algorithm claimed, leading to a

further generalisation of the originally disclosed algorithm.

4.3 The Board does not accept the respondent's argument that page 22, lines 11 to 15 presented an independent definition of the iterative algorithm, whilst the sentences following thereafter described further preferred embodiments of this algorithm. Page 22, lines 11 to 15 refers explicitly to the flow diagram of Figure 8f which contains *all* the algorithm steps disclosed on page 22, lines 11 to 21. Moreover, it is explicitly stated at the beginning of the sentence of lines 15 to 18 that after the steps mentioned in lines 11 to 15 are carried out, *"then"* further steps (which were omitted from the claim) are to follow. This is an explicit and unambiguous indication that the latter steps necessarily follow the preceding ones.

4.4 Hence, as claim 1 defines the system of original claim 1 further limited by merely some of the steps of the iterative algorithm disclosed on page 22, lines 11 to 21 and Figure 8f, its subject-matter is an unallowable intermediate generalisation of the content of the application as filed.

4.5 As a consequence, claim 1 of the eighth auxiliary request does not satisfy the requirements of Article 123(2) EPC.

5. Ninth auxiliary request

5.1 Article 123(2), (3) EPC

5.1.1 Compliance with Article 123(2) EPC is not in dispute regarding claim 1 of the ninth auxiliary request.

However, an objection under Article 123(3) EPC was raised.

5.1.2 In claim 1 of the granted patent (feature (d)), the system is defined as composing a first panoramic layer and a limited volumetric 3D image of a volume corresponding to a part of said first panoramic layer. In lieu of said definition, claim 1 of the ninth auxiliary request defines the system as composing *an image of* a first panoramic layer and a limited volumetric 3D image of a volume corresponding to a part of said first panoramic layer.

The Board considers, however, that the skilled person would naturally understand the "first panoramic layer" as defined in the granted patent as the panoramic *image* of the layer. The Board therefore considers that the explicit definition of the *image* of the layer does not extend the scope of protection of the granted patent. The present Board had reached this conclusion in T 1400/16, point 3.1.4, regarding analogous features in the related case of the same patent family.

Hence, the requirements of Article 123(3) EPC are complied with.

5.2 Article 56 EPC

5.2.1 Whilst novelty was not disputed, the appellant raised the objection that the subject-matter claimed was obvious in view of the closest prior art D14 in combination with D21.

5.2.2 Document D14 discloses a dental x-ray system that composes panoramic-layer images and 3D images using cone-beam reconstruction algorithms (page 3, line 30 to

page 4, line 10). It is undisputed that D14 does not explicitly disclose that the reconstruction algorithms were iterative.

5.2.3 The appellant asserted, however, that from his common general knowledge the skilled person knew that in cone-beam technology, implicitly, or at least in most cases, iterative back-projection reconstruction algorithms were used. The appellant consequently formulated the objective technical problem to be solved by the claimed subject-matter as improving the iterative algorithms of D14. To solve this problem the skilled person would take into account the teaching of the comprehensive review article D21 that summarised the knowledge of the skilled person. The amount of algorithms described was not excessive and could be easily implemented in the system of D14 by a software engineer. D21 described in chapter 3.4 (starting from page R78) iterative reconstruction techniques applicable for cone-beam technologies, as becomes clear from the lines under Equation (20). The particular iterative algorithm presented under point 3.4.1 bridging pages R78 and R79 contained all the features defined in claim 1. Hence, no inventive step was required to implement this algorithm in the system of D14.

5.2.4 The Board finds this line of argument unconvincing for the following reasons.

5.2.5 First, the Board does not accept the appellant's assertion that in cone-beam technology, implicitly, or at least in most cases, iterative back-projection reconstruction algorithms were used. The respondent disputed the correctness of this assertion as, in its opinion, cone-beam reconstruction algorithms were generally filtered back-projection algorithms rather

than iterative ones. The respondent pointed out that cone-beam technologies referred to x-ray beams of conical shape for which, for example, conventional shift-and-add algorithms could be used that were not necessarily iterative, as was explained in D21, on page R78, second paragraph.

In the absence of any evidence from the appellant to underpin its disputed assertion, the Board does not accept it.

5.2.6 Second, since it has not been shown that the reconstruction algorithms of D14 are implicitly or obviously iterative, the objective technical problem formulated by the appellant to improve the *iterative* algorithms of D14 already contains an element of its solution (its iterative nature). Such hindsight knowledge is not permissible in the problem-solution approach.

5.2.7 Third, it has not been shown what reasons the skilled person would have had to choose, among the many x-ray tomosynthesis algorithms described in the comprehensive review article D21, precisely the algorithm under point 3.4.1 on page R78 - which appears to include the features of the claimed algorithm - and to then implement it in the dental x-ray system of D14. Saying that the skilled person *could* choose this algorithm to then implement it in D14 is unconvincing, particularly since it is just one of many algorithms contained in "families of iterative reconstruction techniques that have been described in the literature for the reconstruction of a three-dimensional object from two-dimensional projection images" (page R78, second paragraph, second sentence). For the particular purpose of dental imaging, D21 teaches the use of an algorithm

different from the iterative algorithm disclosed under point 3.4.1 of D21, namely the tuned aperture CT method, or TACT method (page R97, second paragraph). This is a special CT algorithm that D21 only mentions as including an iterative approach in the context of deblurring breast images (page R95, second paragraph).

5.2.8 Regarding the technical effect achieved by the claimed iterative algorithm, the respondent pointed to page 22, lines 22 to 23 of the original application, where it is said that the choice of the specific iterative algorithm of claim 1 for creating 3D images from panoramic layers was deliberate in the sense that although the images were not comparable to full CT images in quality, they were of sufficient quality for dental operations. The technical problem associated with this effect is to simplify a full dental CT imaging apparatus.

Appellant's assertion that it was not inventive to recognise the mentioned technical effect, is irrelevant in the framework of the aforementioned problem-solution-approach starting from D14. As pointed out above, the skilled person would have had no obvious reason to choose the algorithm claimed for the dental x-ray system of D14.

5.2.9 For the aforementioned reasons, the Board is not convinced that the implementation of the claimed iterative algorithm in the dental x-ray system of D14 would have been readily envisioned by the skilled person.

5.2.10 As a consequence, the Board concludes that the subject-matter of claim 1 of the ninth auxiliary request

satisfies the requirements of an inventive step of Article 56 EPC.

Order

For these reasons it is decided that:

1. The decision under appeal is set aside.

2. The case is remitted to the department of first instance with the order to maintain the patent on the basis of:

   - claims 1 to 9 of the ninth auxiliary request, filed with letter dated 5 May 2018; and

   - description and figures of the patent as granted.

The Registrar: The Chairman:

M. Canueto Carbajo E. Dufrasne

Decision electronically authenticated