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Datasheet for the decision of 20 November 2024

Case Number: T 1318/22 - 3.5.06

Application Number: 17717924.9

Publication Number: 3430569

IPC: G06K9/20, G06K9/62

Language of the proceedings: EN

Title of invention:
OPTICAL IMPLEMENTATION OF MACHINE LEARNING FOR REAL TIME INCREASED CONTRAST VIA MULTIPLE WAVELENGTH lLLUMINATION WITH TUNABLE POWER

Applicant:
Verily Life Sciences LLC

Headword:
Optimised contrast/VERILY

Relevant legal provisions:
EPC Art. 54, 56
RPBA 2020 Art. 12(6)

Keyword:
Novelty - main request (no)
Inventive step - first auxiliary request (no) - obvious solution
Second auxiliary request - admitted in first-instance proceedings (no)

Decisions cited:

Catchword:

Europäisches Patentamt
European Patent Office
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Beschwerdekammern

Boards of Appeal

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Case Number: T 1318/22 - 3.5.06

D E C I S I O N
of Technical Board of Appeal 3.5.06
of 20 November 2024

Appellant: (Applicant)	Verily Life Sciences LLC 2999 Olympus Blvd 10th Floor / Ste 1000 Dallas, TX 75019 (US)
Representative:	Mewburn Ellis LLP Aurora Building Counterslip Bristol BS1 6BX (GB)
Decision under appeal:	**Decision of the Examining Division of the European Patent Office posted on 10 December 2021 refusing European patent application No. 17717924.9 pursuant to Article 97(2) EPC.**

Composition of the Board:

Chairman	M. Müller
Members:	T. Alecu
	K. Kerber-Zubrzycka

Summary of Facts and Submissions

I. The appeal lies from the decision of the Examining Division to refuse the application. The Examining Division refused the main and the first auxiliary request underlying the decision for lack of compliance with Articles 83 and 84 EPC, and also for lack of novelty (main request) and lack of inventive step (first auxiliary request) in view of document

D1: LIU CHAO ET AL: "Discriminative Illumination: Per-Pixel Classification of Raw Materials Based on Optimal Projections of Spectral BRDF".

The second auxiliary request was not admitted into the proceedings (Rule 137(3) EPC).

II. With the statement of grounds of appeal the Appellant requested that the decision of the Examining Division be set aside and that a patent be granted on the basis of the main request or one of two auxiliary requests, which are the same as those underlying the decision under appeal (filed on 11 October 2021).

III. In a communication accompanying a summons to oral proceedings the Board provided its preliminary opinion, which was that it

(a) disagreed with the Examining Division regarding Articles 83 and 84 EPC, but
(b) agreed with it regarding novelty (main request) and inventive step (first auxiliary request), and
(c) saw no reason to overturn the decision not to admit the second auxiliary request.

IV. In reply the Appellant withdrew the request for oral proceedings, which were subsequently cancelled. The Appellant did not provide any substantive arguments.

V. *Claim 1 of the main request defines:*

A method comprising:
receiving an indication to generate an image for comparing a first object and a second object with an imaging system;
accessing an extracted classification vector for the first object and the second object;
determining, from the extracted classification vector, an optimized set of illumination intensities to apply to one or more spectral illumination sources of the imaging system, each of the one or more spectral illumination sources configured to provide illumination to the first object and the second object with one or more spectral bands of light having the optimized set of illumination intensities, wherein the illumination intensities are determined by scaling elements of the classification vector by a first constant, or by translating the elements of the classification vector by a second constant, and wherein the optimized set of illumination intensities is configured to produce an image where a pixel intensity difference between an image portion of the first object and an image portion of the second object is greater compared to an un-optimised set of illumination intensities; and
either:
providing to the imaging system the optimized set of illumination intensities for illuminating the first object and the second object with the one or more spectral bands of light having the optimized set of illumination intensities;
or:

illuminating the first object and the second object with the one or more spectral bands of light having the optimized set of illumination intensities;

generating, with the imaging system, an image comprising an array of image pixels based on reflected intensities of the one or more spectral bands of light, wherein an intensity of each of the image pixels is determined according to the optimized set of illumination intensities; and

providing the image for display with the imaging system;

wherein the method further comprises extracting the classification vector by:

collecting multiple instances of the first object and multiple instances of the second object;

sequentially illuminating each instance of the first object and each instance of the second object with each individual spectral band of light from the one or more spectral bands of light;

generating one or more maps corresponding to the one or more spectral bands of light for each instance of the first object and each instance of the second object, each map comprising an array of pixels based on reflected intensities of the corresponding spectral band of light;

identifying a subset of pixels corresponding to an instance of the first object or an instance of the second object in each map;

extracting a plurality of reflectance values for the first object and a plurality of reflectance values for the second object from the subset of pixels identified in each map; and

extracting the classification vector by separating the plurality of reflectance values for the first object and the plurality of reflectance values for the second object, wherein the classification vector points

along a direction separating the plurality of reflectance values for the first object and the plurality of reflectance values for the second object.

VI. Claim 1 of the first auxiliary request differs from that of the main request by specifying that "*the first object and the second object are two human or animal organs*".

VII. Claim 1 of the second auxiliary request differs from that of the main request in the steps pertaining to the extraction of the classification vector, which are now defined as follows:

collecting multiple instances of the first object and multiple instances of the second object;

collecting a plurality of reflectance values for the first object and a plurality of reflectance values for the second object by performing integrating sphere measurements, comprising:

sequentially illuminating each instance of the first object and each instance of the second object with each individual spectral band of light from the one or more spectral bands of light;

generating one or more maps corresponding to the one or more spectral bands of light for each instance of the first object and each instance of the second object, each map comprising an array of pixels based on reflected intensities of the corresponding spectral band of light;

identifying a subset of pixels corresponding to an instance of the first object or an instance of the second object in each map; and

extracting a plurality of reflectance values for the first object and a plurality of reflectance values for the second object from the subset of pixels identified

in each map, wherein the plurality of reflectance values for the first object and the second object are diffused reflectance values; and

extracting the classification vector by separating the plurality of reflectance values for the first object and the plurality of reflectance values for the second object, wherein the classification vector points along a direction separating the plurality of reflectance values for the first object and the plurality of reflectance values for the second object.

Reasons for the Decision

The application

2. The application relates to generating images with optimized contrast between two objects using imaging systems with multiple spectral illumination sources, e.g. a hyperspectral imaging system (paragraphs 2, 5). It proposes to optimise the intensities of the illumination wavelengths using a discriminative learning approach (see figure 3). The optimized illumination system may be used in a surgical setting to increase the contrast between human organs, thereby aiding the surgeon in its work (paragraph 3).

3. Images of multiple instances of the two objects are taken at various wavelengths and the system collects for each instance object reflectance values at different wavelengths to form feature vectors for classification (paragraphs 34 to 38). These are (linearly) separated in feature space, using e.g. a support vector machine classifier (SVM) or a clustering approach (paragraphs 39 to 51). The classification vector, indicating the direction in which the sets are

separated (see figure 5), is used to provide an optimized illumination setting, in which the intensities for the different wavelengths mimic the values of the classification vector (paragraph 52).

4. Regarding the measurement of reflectance values the application provides theoretical considerations of the relationship between the illumination intensity, the object reflectance, the camera or eye sensitivity to wavelengths and the received intensity at a camera or at the human eye (paragraphs 24 to 29). The measurements may be collected (paragraph 38) by using "*any one or a combination of integrating sphere measurements, Fourier transform infrared spectroscopy (FT-IR), or hyperspectral imaging*".

Main request: novelty

5. Document D1 teaches a method for classifying materials using discriminative illumination. It measures, for training purposes, the bidirectional reflectance distribution function (BRDF) for the different materials at different wavelengths and employs a linear discrimination technique (e.g. LDA or SVM) to separate the material classes. The obtained classification vector is used to modulate the light intensities during use so as to obtain images "*that directly measure discriminative features from spectral BRDFs*" (see sections 3 and 3.1). The obtained images are also said to provide a better signal-to-noise ratio (SNR) (section 3.2).

6. The Examining Division considered that this document disclosed all features of claim 1 (decision, points 3 and 4).

7. The Appellant argued (statement of grounds of appeal, section 1.2) that D1 did not disclose the following features (numbering from the decision):

f51) *collecting multiple instances of the first object and multiple instances of the second object;*

f52) *sequentially illuminating each instance of the first object and each instance of the second object with each individual spectral band of light from the one or more spectral bands of light;*

f53) *generating one or more maps corresponding to the one or more spectral bands of light for each instance of the first object and each instance of the second object, each map comprising an array of pixels based on reflected intensities of the corresponding spectral band of light;*

f54) *identifying a subset of pixels corresponding to an instance of the first object or an instance of the second object in each map;*

f55) *extracting a plurality of reflectance values for the first object and a plurality of reflectance values for the second object from the subset of pixels identified in each map.*

7.1 In particular, D1 did not indicate what the training data consisted of. Figure 2, as referenced by the Examining Division, did not show multiple instances of the objects (feature f51)), but only one instance of each. There was no disclosure of sequential illumination, and no disclosure of illumination with individual spectral bands (feature f52)). Therefore, features f53) and f54) were not disclosed either. Feature f55) was

also not disclosed, because the spectral BRDF in D1 did not correspond to reflectance values.

8. The Board understands D1 as follows.

8.1 First, the spectral BRDF is a vector of reflectance values, comprising reflectance values depending on wavelength, incidence angle and reflection angle (D1, section 3). So D1 does measure reflectance values (feature f55)).

8.2 Regarding training, D1 states the following (page 88, right column, bottom, description of figure 2a): "*In the training stage, raw images of the training samples, i.e., the BRDF feature vectors x of the training samples, are measured".* In the Board's understanding the "training samples" are those shown in figure 1, so they comprise multiple instances of each type of material. Feature f51) is thereby disclosed.

8.3 D1 continues by stating: "*The raw images can be measured either in a straightforward way, in which each image is captured when a single LED is turned on, or with multiplexing illumination ..*". In the Board's view each of the LEDs, whether broadband or narrowband (see page 88, left column, last paragraph), define one "*individual spectral band of light*" as claimed. So feature f52) is also disclosed.

8.4 Because the system of D1 takes images of the materials to be discriminated (figures 2b, 2h), features f53) and f54) are also disclosed.

9. Thus the Board agrees with the Examining Division that claim 1 of the main request lacks novelty in view of D1, Article 54 EPC.

First auxiliary request

10. This request differs from the main request in that claim 1 specifies that the objects to be compared are "*two human or animal organs*". The Appellant argues (statement of grounds of appeal 2.2) that the invention enables optimised contrast between anatomical structures, so that a medical practitioner can readily distinguish them in a surgical procedure or other medical setting. A technical problem solved by the invention is improving the safety of a medical procedure. D1 is not in the field of medical imaging, but in a quite remote field, that of classifying raw materials. The person skilled in the art would find no teaching in D1 leading them to implement its teaching in a medical context.

11. The Examining Division was of the opinion (point 5) that "*from D1, the skilled person would consider applying the discriminative illumination to distinguish other objects in other application domains (see D1 sect.1 par. 1-2)*". It saw no specific adaptation claimed which would make the claim non-obvious.

12. The Board remarks first that the Appellant mischaracterises the claimed invention. There is no surgical, or, more broadly, safety-related medical setting claimed, implicitly or explicitly. The claim simply defines comparing two human or animal organs. So the problem the person skilled in the art is trying to solve is how to compare or discriminate two such organs, for any possible purpose.

13. Second, the person skilled in the art is aware that image processing methods, although developed for specific applications, may be general enough to be

applied to other, similar, applications, possibly with some adaptation. In the Board's view, the skilled person would recognize that the principle taught in D1 of optimizing illuminations for different materials can be applied to other type of objects, such as the claimed organs. Therefore, even though D1 does not expressly specify organ discrimination, the person skilled in the art would recognise in D1 a possible solution to the posed problem.

14. Hence the Board agrees with the Examining Division that claim 1 of the first auxiliary request lacks inventive step, Article 56 EPC.

Second auxiliary request

15. This request does not define the objects to be human or animal organs, but specifies instead that the reflectance measurements are collected using integrating spheres.

16. The Examining Division did not admit this request because (decision, point 6)

- it did not help overcoming the objections as to a lack of disclosure raised by the Examining Division,

- the Appellant did not "*build on*" the previous request but "*trie[d] out this feature as a different direction for specifying what the invention is*", which direction was not compatible with the previous one,

- an integrating sphere was not claimed in the original set of claims and was not considered to be a likely fallback position, and

- an integrating sphere was commonly known for measuring material reflectance so that its use in D1 was, "*prima facie, not based on an inventive step*".

17. The Appellant argued (statement of grounds of appeal, section 3.1) that this request was made in response to and addressed the objections of sufficiency of disclosure by the Examining Division.

17.1 More specifically, because an integrating sphere was well known for measuring reflectance, this amendment clearly addressed the objections of the Examining Division.

17.2 Moreover, the subject-matter of claim according to the second auxiliary request related to the same invention as the main request, and the amendment had basis in the description.

17.3 Hence, the amendment should have been admitted.

18. The Board notes that even if the Appellant is right that this request addressed the objection of the Examining Division as to sufficiency, the points made by the Examining Division to justify their non-admittance are correct.

18.1 The specification of an integrating sphere measuring instrument may address the said objections, but it is true, as the Examining Division indicated, that the use of integrating spheres is prima facie incompatible with measuring reflectance of human organs, which is the main application indicated in the description and claimed in the previous auxiliary request.

18.2 Further, while this request may be a limitation of the main request, it shifts the focus of the invention from a method of optimizing illumination to details related to measurements. This, in principle, constitutes a new perspective in the examination of novelty and inventive step, which the Examining Division did not consider up to that point, i.e. it was not an anticipated fallback position.

18.3 That given, the fact that the amendment has basis in the description is immaterial.

18.4 Ultimately, it is within the discretion of the Examining Division to admit amendments, and the Board does not see that it exercised its discretion in an unreasonable manner or using the wrong principles. Therefore, the Board does not admit this request (see Article 12(6) RPBA).

Order

For these reasons it is decided that:

The appeal is dismissed.

The Registrar: The Chairman:

L. Stridde Martin Müller

Decision electronically authenticated