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Datasheet for the decision of 7 October 2021

Case Number: T 0228/17 - 3.4.01

Application Number: 12750537.8

Publication Number: 2712426

IPC: G01S7/484, G01S17/10, G05D13/08

Language of the proceedings: EN

Title of invention:
METHOD AND TIME-OF-FLIGHT CAMERA FOR PROVIDING DISTANCE INFORMATION

Patent Proprietor:
Softkinetic Sensors N.V.

Opponent:
Recknagel, Stefan

Headword:
TOF-Camera / SOFTKINETIC SENSORS

Relevant legal provisions:
EPC Art. 56
RPBA Art. 12(4)
RPBA 2020 Art. 13(2)

Keyword:
Inventive step - (no)
Late-filed auxiliary requests - not considered

Decisions cited:
T 1631/15

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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 0228/17 - 3.4.01

D E C I S I O N
of Technical Board of Appeal 3.4.01
of 7 October 2021

Appellant: (Patent Proprietor)	Softkinetic Sensors N.V. Boulevard de la Plaine 15 1050 Bruxelles (BE)
Representative:	MFG Patentanwälte Meyer-Wildhagen Meggle-Freund Gerhard PartG mbB Amalienstraße 62 80799 München (DE)
Respondent: (Opponent)	Recknagel, Stefan Schulstraße 11A 07749 Jena (DE)
Representative:	Behrndt, Klaus LifeTech IP Spies & Behrndt Patentanwälte PartG mbB Elsenheimerstraße 47a 80687 München (DE)
Decision under appeal:	**Decision of the Opposition Division of the European Patent Office posted on 8 November 2016 revoking European patent No. 2712426 pursuant to Article 101(3)(b) EPC.**

Composition of the Board:

Chair	P. Scriven
Members:	B. Noll
	C. Almberg

Summary of Facts and Submissions

I. The opposition against European Patent 2712426 was based on the grounds of lack of novelty and of inventive step (Article 100(a) EPC).

II. The patent was revoked by the Opposition Division, after the proprietor had responded to the notice of opposition and after a subsequent letter submitted by the opponent.

III. The proprietor appealed the Opposition Division's decision. With the statement of grounds of appeal, the proprietor requested that the decision be set aside and the opposition rejected, and filed claims for new auxiliary requests 1 - 9.

IV. The opponent requested the dismissal of the appeal, and that auxiliary requests 1 - 9 not be considered.

V. In a communication accompanying a summons to oral proceedings, the Board gave its preliminary opinion on claim interpretation, novelty and inventive step, and the question of whether the auxiliary requests should be considered in the appeal proceedings.

VI. In response to the summons, the proprietor submitted new auxiliary requests 1 to 10. The previous auxiliary

requests were re-submitted as auxiliary requests 11 to 19.

VII. During oral proceedings before the Board, the proprietor submitted a further auxiliary request, referred to as auxiliary request 0, to be ranked between the main request and auxiliary request 1.

VIII. The parties' final requests were

- in the proprietor's case, that the appealed decision be set aside and that the opposition be rejected, i.e. that the patent be maintained as granted (main request); or that the patent be maintained on the basis of auxiliary request 0 filed during the oral proceedings, or one of ten auxiliary requests filed on 7 September 2021 (auxiliary requests 1 to 10), or nine auxiliary requests, resubmitted on 7 September 2021, but originally filed with the statement of grounds of appeal (auxiliary requests 11 to 19);

- in the opponent's case, that the appeal be dismissed and that the auxiliary requests not be considered.

IX. The parties' arguments, insofar as relevant for this decision, are dealt with in the reasons below.

X. The following document is referred to in this decision:

E2: US 7,609,367 B2.

XI. Claim 1 of the patent (reference sign deleted and feature numbering added by the Board):

(1) A method for providing distance information of a scene with a time-of-flight sensor or camera,

characterized in comprising the steps of

(2) emitting a periodic light signal towards the scene in accordance with a modulation signal

(2.1) based on a clock timing that has a base frequency

(2.2) spread by a periodic perturbation with a perturbation frequency and period,

(3) receiving reflections of the periodic light signal from the scene,

(4) evaluating a time-of-flight information [sic] for the received reflections of the periodic light signal

(4.1) over a set of a plurality of measurement durations in accordance with the modulation signal, and

(5) deriving distance information from the time-of-flight information for the received reflections,

(6) wherein each measurement duration of the set is an integer or half integer multiple of the perturbation period and

(7) over the set of measurement durations the average base frequency is kept constant.

XII. Claim 1 of auxiliary request 0 differs from claim 1 as granted by adding

[... of the perturbation period] and the length of the perturbation period is shorter than the measurement duration, [and over the set ...].

XIII. Claim 1 of auxiliary request 1 differs from claim 1 as granted by omitting *or half integer*.

XIV. Claim 1 of auxiliary request 2 differs from claim 1 of auxiliary request 1 by adding

[... kept constant,] wherein the modulation signal taken over one measurement duration of the set has the same spectral content as the modulation signal taken over any other measurement duration of the set.

XV. Starting from claim 1 of auxiliary request 1, claim of of auxiliary request 3 replaces *periodic perturbation* with *continuous periodic perturbation signal*.

XVI. Starting from claim 1 of auxiliary request 1, claim 1 of auxiliary request 4 replaces *periodic perturbation* with *symmetric and periodic perturbation signal*.

XVII. Claim 1 of auxiliary request 5 differs from claim 1 of auxiliary request 2 by replacing *periodic perturbation* with *continuous, symmetric and periodic perturbation signal*.

XVIII. Claim 1 of auxiliary request 6 differs from claim 1 of auxiliary request 2 by adding

> *[... measurement duration of the set], and wherein the step of evaluating a time-of-flight information for the received reflections of the periodic light signal comprises integrating the received reflections of the periodic light signal over each of the plurality of measurements of the set, and combining the results.*

XIX. Claim 1 of auxiliary request 7 differs from claim 1 of auxiliary request 1 by adding

[... kept constant], further comprising, when lowering the power of the periodic light signal, reducing the perturbation frequency.

XX. Claim 1 of auxiliary request 8 differs from claim 1 of auxiliary request 6 by replacing *periodic perturbation* with *continuous, symmetric and periodic perturbation signal*.

XXI. Claim 1 of auxiliary request 9 differs from claim 1 of auxiliary request 8 by adding

[... and combining the results], further comprising, when lowering the power of the periodic light signal, reducing the perturbation frequency.

XXII. Claim 1 of auxiliary request 10 differs from claim 1 of auxiliary request 9 by adding

[... reducing the perturbation frequency], wherein the periodic light signal is a pulsed signal, and wherein the perturbation frequency is within an interval of the base frequency, preferably within an interval +/-5% or +/-1,5% of the base frequency, or within an interval +/- 0,1% of the base frequency of the modulation signal.

XXIII. Claim 1 of auxiliary requests 11 - 19 corresponds, respectively, to claim 1 of auxiliary requests 2 - 10 except that the alternative "or half integer" is present as in claim 1 as granted.

Reasons for the Decision

The invention, background

1. Time-of-flight (TOF) sensing is for detecting the distance of objects in space. Light pulses from a pulsed light source are emitted towards the object, the reflected portion of light is converted to an electrical signal, and its phase relative to that of the signal driving the light source is obtained, e.g. by homodyne detection. The phase is a measure of the object's distance. Since only a small portion of the emitted light reaches the detector after reflection from the object, the converted electrical signal is integrated over a measuring cycle that consists of a relatively large number of pulses. In the words of the patent, a measuring cycle is called a *measurement duration*. The measuring cycles are continually repeated, so that moving objects can be tracked over time.

2. Generating light pulses periodically would result in a high spectral density within a narrow frequency range. This would cause problems of electromagnetic compatibility within the TOF sensor itself, or with nearby electronic components or devices. Therefore, sensors are not commonly driven by a strictly a periodic pulse sequence, but by one for which the repetition frequency is varied so as to spread the energy over a wider spectrum. However, to obtain the phase of the received light pulses correctly, the modulating signal has to be known to the receiver. Further, its average frequency during a measuring cycle has to be known for deriving the object's distance.

Claim 1 of the patent, interpretation

3. Features 2, 2.1 and 2.2 (*emitting a periodic light signal ...*) are unclear, *inter alia* due to the double occurrence of the word "periodic". The Board has to give the claim some interpretation.

4. The skilled reader would understand that the light signal would be periodic, in the absence of the perturbation, i.e. it would be a sequence of light pulses with a constant repetition rate at the base frequency. When modulated by a periodic perturbation, the instantaneous frequency changes and is different from the base frequency except at singular times. Depending on the relationship between the base frequency and the frequency of the perturbation, the emitted signal may or may not be periodic. In the example in figure 3 of the patent, the light signal is a sequence of pulses, the instantaneous frequency of which goes up and down according to a triangular waveform. The frequency of the emitted signal is the frequency of the triangular waveform.

5. The wording "in accordance with the modulation signal" in feature 4.1 means (in the skilled person's understanding) that the modulation signal is not only applied for generating the emitted light signal but also for evaluating TOF information from the received reflections. This might be by homodyne detection.

6. Feature 6 defines that each measurement duration is an integer or half integer multiple of the perturbation period. By this definition, the duration of a single measurement may be 0.5, 1, 1.5, 2 ... times the duration of one period of the perturbation. The definition does not, as argued by the proprietor, mean

that the measurement cycle is longer than one period of perturbation signal.

7. The claim does not specify whether two successive measuring cycles immediately follow each other or whether they are separated from each other by a time gap, such as a readout period as shown in Figure 2 of the patent. Contrary to the opinion of the proprietor, the claim also does not imply that a readout period is provided between successive measuring cycles and that the period of the perturbation modulation has a specific relationship with the readout period.

8. The claim wording, therefore, includes configurations with an arbitrary frequency pattern within a measuring cycle, this frequency pattern being repeated in each measuring cycle.

Claim 1, inventive step

9. Document E2 discloses a method of measuring the distance of a scene using a TOF sensor. The spectrum of the emitted light signal is spread, in order to reduce electromagnetic interference (E2, column 1, lines 30 to 41 and 58-60). Therefore, E2 addresses the same general technical problem as the patent in suit.

10. E2 discloses the emission of a light signal (Figure 2, 22) towards the scene 24 in accordance with a modulating signal (Figure, 2, the output of illumination driver 16). The modulating signal is based on a clock timing given by numerically controlled oscillator 46. Reflections 26 of the periodic light signal are received from the scene, and TOF-information is evaluated using a demodulation signal 32 which is

derived from the the modulating signal (the output of signal source 12). This evaluation is the same for each measurement cycle.

11. E2 further discloses that distance information is derived from the time-of-flight information for the received reflections, according to the equation of column 2, line 3.

12. E2 further discloses (column 3, line 57 to column 4, line 29) that the light signal is modulated with a predetermined sequence of frequencies for the duration of a measurement cycle. The average frequency, which is required for calculating the distance of a reflecting object, is either obtained according to the equation of column 4, line 22, or takes a predetermined value so that it need not to be determined online but is stored as a constant value (column 2, lines 56 to 60).

13. In E2, the description of how TOF information is obtained is limited to how the modulation frequencies are chosen within a single measurement cycle and how an average frequency is obtained for this cycle. E2 does not explicitly address the selection of modulation frequencies for a plurality of measurement cycles. Therefore, E2 does not directly and unambiguously disclose that the light signal is modulated, for a set of measurement durations, by a base frequency spread by a periodic perturbation modulation having a perturbation frequency and period. In consequence, E2 also fails to disclose a numeric relationship between the period of the perturbation signal and the length of the measuring cycle and does not explicitly disclose that the average base frequency is kept constant over a set of measurement durations.

14. The board does not agree with the opponent's view that it would directly and unambiguously follow from the indication in column 1, lines 58 to 60 (*the modulation frequency is varied over the integration time interval, e.g. according to a predetermined pattern*) that the pattern is the same for all measuring cycles.

15. The proprietor argued that E2 did not disclose an average base frequency in the sense that it was predefined and modulated by a periodic perturbation before being applied to the light signal. According to the proprietor, the average frequency of the modulating signal was only obtained *a posteriori*, either online after completing a measuring cycle or in advance when it was stored in memory. The skilled reader would infer from E2 that the modulating signal had to be freely changeable between measuring cycles. Consequently, an average frequency had necessarily to be determined for each measuring cycle separately.

16. This argument is not persuasive. The claim defines, in features (2) and (6), only the periodicity of the periodic perturbation of the emitted optical signal in relation to the duration of a measuring duration, but not by how this modulation is actually performed. This broad definition, therefore, does not limit the method to a specific implementation of the modulation, where the average base frequency is given as a fixed value and the modulation is performed by periodically changing this value. It is, therefore, irrelevant for the assessment of inventive step whether the average base frequency in E2 is given as a specific value or whether it is determined arithmetically according to the equation of column 4, line 15 by a group of preset modulation frequencies.

17. The technical effect associated with these features is that the average frequency for a measurement cycle does not have to be determined for each integration interval individually, since the modulation of the light signal is the same for each measuring cycle. Thus, the technical problem is to simplify the calculation of average frequency.

18. The skilled person would have understood, from the equation of E2, column 4, line 15, that the sequence of frequency modulations is set for each measuring cycle separately and independently. As there is no necessity for setting the sequence differently for different measuring cycles apparent from E2, a single sequence applied to all intervals would have been apparent to the skilled person as a simple and convenient choice. Consequently, the skilled person would have obtained a method in which the ratio between the measurement duration and the period length of the perturbation modulation was 1, and in which the average frequency was constant for all measuring cycles.

19. The skilled person, starting from E2 and facing the technical problem indicated above, would thus have obtained the method of claim 1. For this reason, claim 1 lacks an inventive step (Article 56 EPC).

The auxiliary requests

20. Auxiliary request 0 was presented for the first time during oral proceedings before the Board. Auxiliary requests 1 to 10 were submitted after notification of the summons to oral proceedings. Auxiliary requests 11 to 19 were first submitted with the statement of grounds of appeal.

21. The Board decided not to consider any of the auxiliary requests in the appeal proceedings, for the reasons set out below.

22. As regards auxiliary requests 11 to 19, the proprietor argued that their admission was justified by a violation of fair proceedings before the Opposition Division, where the opponent had the opportunity to make one more submission than the proprietor, where no term was set for the submission of a response to the opponent's submissions, and where the decision was given unannounced.

23. The Board cannot see any unequal treatment of parties. The Opposition Division had communicated the notice of opposition to the proprietor with an invitation to respond. The Opposition Division equally informed each party about the other's latest submissions (communications of 29 February and 14 July 2016), and both had sufficient time to respond, although neither was invited to. The opponent did respond, whereas the proprietor did not. The procedural irregularity adduced by the proprietor does not correspond to any obligation on the Opposition Division (see, for example, Case Law, 9th ed., IV.C.6.1-2).

24. Instead, and decisively, the Board is of the view that the proprietor could, and should, have presented these auxiliary requests in the opposition proceedings.

25. For these reasons, auxiliary requests 11 to 19 are not taken into account (Article 12(4) RPBA 2007).

26. As regards auxiliary requests 1 to 10, the proprietor argued that the modifications (deleting the alternative "or half integer" multiple from the claims of the the

main request and the auxiliary requests then on file) were made to overcome an objection raised for the first time in the Board's communication, point 19.

27. Even though this modification might have rendered obsolete the additional remark in point 19 of the Board's communication, it would not help to overcome the outstanding objection of lack of inventive step raised in points 13 to 18 of the communication and the Board's view on non-admissibility of the - then pending - auxiliary requests, set out in points 23 and 24 of the communication. In the present case, an amendment addressing only what the Board described as *an additional remark* but none of the other, serious objections is not a cogent reason justifying that these requests be taken into account.

28. For this reason, auxiliary requests 1 to 10 are not taken into account (Article 13(2) RPBA 2020).

29. As regards auxiliary request 0, the proprietor argued that it was taken by surprise, at the oral proceedings, by the view that 1 could be considered an integer multiple and that the reasons for this view were only understandable after a detailed discussion in the oral proceedings.

30. The Board does not accept this argument. The objection was already raised in the notice of opposition, see page 6, fourth paragraph. A more detailed presentation at oral proceedings of arguments relating to an objection in the notice of opposition is not an exceptional circumstance and reason for submitting new requests at the oral proceedings (cf. T 1631/15, *Transcranial magnetic stimulation / University of Texas,* reason 17).

31. Auxiliary request 0 is not taken into account (Article 13(2) RPBA 2020).

Order

For these reasons it is decided that:

The appeal is dismissed.

The Registrar: The Chair:

H. Jenney P. Scriven

Decision electronically authenticated