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(71) Applicant: **AMS AG** [AT/AT]; Tobelbader Strasse 30,
8141 Premstaetten (AT).

(72) Inventors: **NELSON, Doug**; 6709 Alcove Ln, Plano,
Texas 75024 (US). **HEGDE, Pradeep**; 12483 Waltham dri-

ve, Frisco, Texas 75035 (US). **COGAN, Timothy**; 3608
McClintick Road, McKinney, Texas 75070 (US).

(74) Agent: **MARKS & CLERK LLP**; 62-68 Hills Road, Cam-
bridge Cambridgeshire CB2 1LA (GB).

(81) Designated States (unless otherwise indicated, for every
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CA, CH, CL, CN, CO, CR, CU, CZ, DE, DJ, DK, DM, DO,
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HR, HU, ID, IL, IN, IR, IS, JO, JP, KE, KG, KH, KN, KP,
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(54) Title: HIGH RESOLUTION TIME-OF-FLIGHT MEASUREMENTS

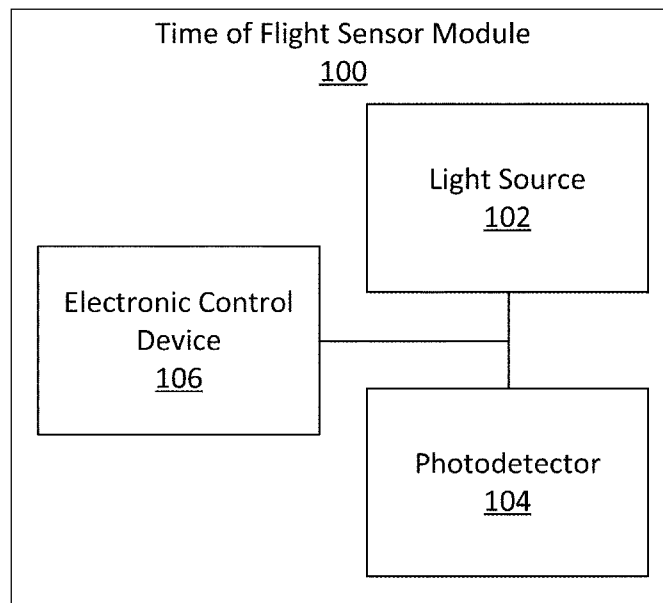


Fig. 1

(57) Abstract: Modulated light is generated using a light source of a sensor module. Using a photodetector of the sensor module, an intensity of modulated light reflected from an object towards the photo detector is measured over a period of time. An electronic control device bins the measured intensity of the reflected modulated light according to a plurality of temporal bins, determines a first temporal bin having the greatest intensity among the plurality of temporal bins, and estimates a distance between the sensor module and the object based on a first temporal bin, and one or more additional temporal bins of the plurality of temporal bins.



TM), European (AL, AT, BE, BG, CH, CY, CZ, DE, DK, EE, ES, FI, FR, GB, GR, HR, HU, IE, IS, IT, LT, LU, LV, MC, MK, MT, NL, NO, PL, PT, RO, RS, SE, SI, SK, SM, TR), OAPI (BF, BJ, CF, CG, CI, CM, GA, GN, GQ, GW, KM, ML, MR, NE, SN, TD, TG).

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- *with international search report (Art. 21(3))*
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INTERNATIONAL SEARCH REPORT

International application No
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A. CLASSIFICATION OF SUBJECT MATTER
 INV. G01S7/4915 G01S7/48 G01S7/497 G01S17/36 G01S17/18
 ADD. G01S17/931

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
 G01S

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)
 EPO-Internal, INSPEC, WPI Data

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	DE 101 38 531 A1 (SIEMENS AG [DE]) 6 March 2003 (2003-03-06) column 1, line 1 - line 18 column 1, line 51 - line 57 column 2, line 38 - column 3, line 58 figures 1-3	1-27
X A	----- EP 3 250 944 B1 (MICROSOFT TECHNOLOGY LICENSING LLC [US]) 6 December 2017 (2017-12-06) page 2, line 5 - line 10 page 3, line 26 - page 4, line 13 page 4, line 51 - line 56 page 7, line 4 - line 40 table at pages 10 and 11 figures 1-3 ----- -/--	1-8, 11-21, 24-27 9,10,22, 23

Further documents are listed in the continuation of Box C.

See patent family annex.

* Special categories of cited documents :

- "A" document defining the general state of the art which is not considered to be of particular relevance
- "E" earlier application or patent but published on or after the international filing date
- "L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)
- "O" document referring to an oral disclosure, use, exhibition or other means
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- "X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone
- "Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art
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Date of the actual completion of the international search 23 March 2020	Date of mailing of the international search report 31/03/2020
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Name and mailing address of the ISA/ European Patent Office, P.B. 5818 Patentlaan 2 NL - 2280 HV Rijswijk Tel. (+31-70) 340-2040, Fax: (+31-70) 340-3016	Authorized officer Köppe, Maro
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INTERNATIONAL SEARCH REPORT

International application No

PCT/EP2019/076895

C(Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT		
Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	HARTZELL PRESTON J ET AL: "Empirical Waveform Decomposition and Radiometric Calibration of a Terrestrial Full-Waveform Laser Scanner", IEEE TRANSACTIONS ON GEOSCIENCE AND REMOTE SENSING, IEEE SERVICE CENTER, PISCATAWAY, NJ, US, vol. 53, no. 1, 1 January 2015 (2015-01-01), pages 162-172, XP011555430, ISSN: 0196-2892, DOI: 10.1109/TGRS.2014.2320134 [retrieved on 2014-08-04]	28-32, 35-43, 46-50
A	page 612, right-hand column, line 1 - line 11 page 164, left-hand column, line 31 - right-hand column, line 25 table I figures 1-3 -----	33,34, 44,45

INTERNATIONAL SEARCH REPORT

International application No.
PCT/EP2019/076895

Box No. II Observations where certain claims were found unsearchable (Continuation of item 2 of first sheet)

This international search report has not been established in respect of certain claims under Article 17(2)(a) for the following reasons:

1. Claims Nos.:
because they relate to subject matter not required to be searched by this Authority, namely:

2. Claims Nos.:
because they relate to parts of the international application that do not comply with the prescribed requirements to such an extent that no meaningful international search can be carried out, specifically:

3. Claims Nos.:
because they are dependent claims and are not drafted in accordance with the second and third sentences of Rule 6.4(a).

Box No. III Observations where unity of invention is lacking (Continuation of item 3 of first sheet)

This International Searching Authority found multiple inventions in this international application, as follows:

see additional sheet

1. As all required additional search fees were timely paid by the applicant, this international search report covers all searchable claims.

2. As all searchable claims could be searched without effort justifying an additional fees, this Authority did not invite payment of additional fees.

3. As only some of the required additional search fees were timely paid by the applicant, this international search report covers only those claims for which fees were paid, specifically claims Nos.:

4. No required additional search fees were timely paid by the applicant. Consequently, this international search report is restricted to the invention first mentioned in the claims; it is covered by claims Nos.:

Remark on Protest

- The additional search fees were accompanied by the applicant's protest and, where applicable, the payment of a protest fee.
- The additional search fees were accompanied by the applicant's protest but the applicable protest fee was not paid within the time limit specified in the invitation.
- No protest accompanied the payment of additional search fees.

FURTHER INFORMATION CONTINUED FROM PCT/ISA/ 210

This International Searching Authority found multiple (groups of) inventions in this international application, as follows:

1. claims: 1-27

method and a system with an (optical) sensor module using at least two temporal bins for determining the distance.

2. claims: 28-50

method and a system with an (optical) sensor module recording a set of measurements for different object distances.

INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No

PCT/EP2019/076895

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
DE 10138531	A1	06-03-2003	NONE

EP 3250944	B1	06-12-2017	CN 107209254 A 26-09-2017
			EP 3250944 A1 06-12-2017
			US 2016223656 A1 04-08-2016
			WO 2016122903 A1 04-08-2016
