PATENT COOPERATION TREATY

From the
INTERNATIONAL SEARCHING AUTHORITY

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PCT

WRITTEN OPINION OF THE
INTERNATIONAL SEARCHING AUTHORITY

(PCT Rule 43*bis*.1)

Date of mailing *(day/month/year)*	26 JUN 2020	
Applicant's or agent's file reference 35703-45842/WO	FOR FURTHER ACTION See paragraph 2 below	
International application No. PCT/US20/25042	International filing date *(day/month/year)* 26 March 2020 (26.03.2020)	Priority date *(day/month/year)* 29 March 2019 (29.03.2019)

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

IPC - G01S 13/34, 17/34, 17/06, 13/58,17/58; G02B 6/35; G01N 21/27 (2020.01)

CPC - G01S 13/343, 17/34, 17/42, 13/584, 13/583, 17/58; G02B 6/3548, 6/354, 6/356, 6/3556, 6/3558, 6/3534, 6/351, 6/35; G01S 17/93; G01N 21/39, 21/276, 21/27

Applicant

OURS Technology Inc.

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

- [x] 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
- [x] Box No. V Reasoned statement under Rule 43*bis*.1(a)(i) with regard to novelty, inventive step and industrial applicability; citations and explanations supporting such statement
- [ ] Box No. VI Certain documents cited
- [x] Box No. VII Certain defects in the international application
- [x] Box No. VIII Certain observations on the international application

2. **FURTHER ACTION**

If a demand for international preliminary examination is made, this opinion will 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 66.1*bis*(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/ISA/220 or before the expiration of 22 months from the priority date, whichever expires later.

For further options, see Form PCT/ISA/220.

Name and mailing address of the ISA/US	Date of completion of this opinion	Authorized officer
Mail Stop PCT, Attn: ISA/US Commissioner for Patents P.O. Box 1450, Alexandria, Virginia 22313-1450 Facsimile No. 571-273-8300	28 May 2020 (28.05.2020)	Shane Thomas PCT Help Desk Telephone No. 571-272-4300

WRITTEN OPINION OF THE INTERNATIONAL SEARCHING AUTHORITY

International application No.
PCT/US20/25042

Box No. I Basis of this opinion

1. With regard to the **language**, this opinion has been established on the basis of:

[X] 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 43*bis*.1(b)).

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 13*ter*.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 13*ter*.1(a)).

  [ ] on paper or in the form of an image file (Rule 13*ter*.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:

WRITTEN OPINION OF THE
INTERNATIONAL SEARCHING AUTHORITY

International application No.
PCT/US20/25042

Box No. V Reasoned statement under Rule 43*bis*.1(a)(i) with regard to novelty, inventive step and industrial applicability; citations and explanations supporting such statement

1. Statement

Novelty (N)	Claims	1-20	YES
	Claims	NONE	NO
Inventive step (IS)	Claims	NONE	YES
	Claims	1-20	NO
Industrial applicability (IA)	Claims	1-20	YES
	Claims	NONE	NO

2. Citations and explanations:

Claims 1, 3-5, 7-11, 14-16 lack an inventive step under PCT Article 33(3) as being obvious over US 2018/0267250 A1 to ANALOG PHOTONICS LLC (ANALOG PHOTONICS) in view of US 2019/0064358 A1 to MEZMERIZ INC. (MEZMERIZ).

As per claim 1, ANALOG PHOTONICS discloses a frequency modulated continuous wave FMCW LiDAR transceiver implemented on a photonic integrated circuit (frequency-modulated continuous wave laser detection and ranging FMCW LiDAR system operates to transmit and receive components of LIDAR integrated onto a silicon photonic substrate; paragraphs [0031] & [0049]), the photonic integrated circuit comprising: an input port configured to receive a frequency modulated laser signal (an input port of optical circulator receives a frequency modulated laser signal; figure 7B; paragraph [0052]); a plurality of optical antennas (as shown in figure 7B, a plurality of optical antennas, pairs of emitter/receiver pairs; figure 7B; paragraph [0069]; claim 16); an optical switch configured to switchably couple the input port to the optical antennas, thereby forming optical paths between the input port and the optical antennas (as shown in figure 7B, an optical switch switchably couples the input port to the optical antennas, thereby forming optical paths between the input port and the optical antennas; figure 7B; paragraphs [0052] & [0057]); for the optical path from the input port to one of the optical antennas, a splitter coupled along the optical path and configured to: split a received portion of the laser signal into a local oscillator signal and a transmitted signal (as shown in figure 7B, laser signal gets split along optical path to form a local oscillator signal and transmitted/emitted signal; figure 7B; paragraphs [0052] & [0072]), wherein the transmitted signal is emitted via the optical antenna and a reflection of the transmitted signal is received via the optical antenna as a reflected signal (as shown in figure 7B, wherein the transmitted signal is emitted/sent via the optical antenna and a reflection of the transmitted signal is received via the optical antenna as a reflected signal; figure 7B; paragraph [0055]); output a return signal that is a portion of the reflected signal, and for the splitter, a mixer coupled to receive the return signal and the local oscillator signal from the splitter (as shown in figure 7B, output a return signal that is a portion of the reflected signal, and for the splitter, a photodetector (mixer) connected to receive the return signal and the local oscillator signal from the splitter; figure 7B), the mixer configured to mix the return signal and the local oscillator signal to generate one or more output signals used to determine depth information for a field of view of the transceiver (as shown in figure 7B, photodetector mixes the return signal and the local oscillator signal to generate one output signal used to determine distance information for a field of view of the transceiver; figure 7B; paragraph [0060]; claim 25). ANALOG PHOTONICS fails to disclose for each optical path from the input port to one of the optical antennas, a splitter coupled along the optical path and configured to: split a received portion of the laser signal into a local oscillator signal and a transmitted signal. However, MEZMERIZ discloses for each optical path from the input port to one of the optical antennas, a splitter coupled along the optical path and configured to: split a received portion of the laser signal into a local oscillator signal and a transmitted signal (each optical path from input port 242 to output port 264 of directional coupler a splitter splits a received portion of the light/laser beam 240 into a local oscillator LO signal 272 and transmitted signal at output 246; figure 2; paragraphs [0024] & [0027]). It would have been obvious to one of ordinary skill in the art, at the time the invention was made, to modify the FMCW LiDAR transceiver of ANALOG PHOTONICS to include the for each optical path from the input port to one of the optical antennas, a splitter coupled along the optical path and configured to: split a received portion of the laser signal into a local oscillator signal and a transmitted signal, as taught by MEZMERIZ, in order to provide multiple beat frequencies 288 which provides additionally information of the distance to the remote object and improving signal-to-noise SNR ratio (MEZMERIZ; paragraph [0027]).

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WRITTEN OPINION OF THE
INTERNATIONAL SEARCHING AUTHORITY

International application No.
PCT/US20/25042

Box No. VII Certain defects in the international application

The following defects in the form or contents of the international application have been noted:

Claim 11 is objected to under PCT Rule 66.2(a)(iii) as containing the following defect in the form or contents thereof: in line 29 of the claim 11, the term "and and" is interpreted as a typographical error and for the purposes of this opinion will be interpreted as the term "and".

WRITTEN OPINION OF THE INTERNATIONAL SEARCHING AUTHORITY

International application No. PCT/US20/25042

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:

Claim 18 is objected to under PCT Rule 66.2(a)(v) as lacking clarity under PCT Article 6 because claim 18 is indefinite for the following reason(s): Claim 18 refers to "the FMCW", in line 1. There is a lack of antecedent basis for these limitations in the claim. For the purpose of this opinion, as best understood, the claim is interpreted to read "the FMCW LiDAR transceiver".

WRITTEN OPINION OF THE
INTERNATIONAL SEARCHING AUTHORITY

International application No.
PCT/US20/25042

Supplemental Box

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-***-Continued from Box V: Citations and Explanations-***-

As per claim 11, ANALOG PHOTONICS discloses a frequency modulated continuous wave FMCW LiDAR system (frequency-modulated continuous wave laser detection and ranging FMCW LiDAR system operates to transmit and receive components of LIDAR integrated onto a silicon photonic substrate; paragraphs [0031] & [0049]) comprising: a LiDAR chip including a FMCW LiDAR transceiver implemented on a photonic integrated circuit (components of LIDAR integrated onto a silicon photonic substrate; paragraphs [0031] & [0049]), the photonic integrated circuit comprising: an input port configured to receive a frequency modulated laser signal (an input port of optical circulator receives a frequency modulated laser signal; figure 7B; paragraph [0052]); a plurality of optical antennas (as shown in figure 7B, a plurality of optical antennas, pairs of emitter/receiver pairs; figure 7B; paragraph [0069]; claim 16]); an optical switch configured to switchably couple the input port to the optical antennas, thereby forming optical paths between the input port and the optical antennas (as shown in figure 7B, an optical switch switchably couples the input port to the optical antennas, thereby forming optical paths between the input port and the optical antennas; figure 7B; paragraphs [0052] & [0057]); for the optical path from the input port to one of the optical antennas, a splitter coupled along the optical path and configured to: split a received portion of the laser signal into a local oscillator signal and a transmitted signal (as shown in figure 7B, laser signal gets split along optical path to form a local oscillator signal and transmitted/emitted signal; figure 7B; paragraphs [0052] & [0072]), wherein the transmitted signal is emitted via the optical antenna and a reflection of the transmitted signal is received via the optical antenna as a reflected signal (as shown in figure 7B, wherein the transmitted signal is emitted/sent via the optical antenna and a reflection of the transmitted signal is received via the optical antenna as a reflected signal; figure 7B; paragraph [0055]), output a return signal that is a portion of the reflected signal, and for the splitter, a mixer coupled to receive the return signal and the local oscillator signal from the splitter (as shown in figure 7B, output a return signal that is a portion of the reflected signal, and for the splitter, a photodetector (mixer) connected to receive the return signal and the local oscillator signal from the splitter; figure 7B), the mixer configured to mix the return signal and the local oscillator signal to generate one or more output signals used to determine depth information for a field of view of FMCW LiDAR (as shown in figure 7B, photodetector mixes the return signal and the local oscillator signal to generate one output signal used to determine distance information for a field of view of the transceiver; figure 7B; paragraph [0060]; claim 25); and a lens positioned to collimate the transmitted signals emitted via the plurality of antennas (as shown in figure 7B, lens positioned to collimate the transmitted/sent signal emitted via the plurality of antennas; figure 7B; paragraphs [0029] & [0055]); and wherein the lens is also positioned to receive the reflected signals and couple the reflected signals to the emitting optical antennas (as shown in figure 7B, lens positioned to receive the reflected/received signal and couple the received signals to the optical antennas; figure 7B; paragraphs [0029] & [0055]). ANALOG PHOTONICS fails to disclose for each optical path from the input port to one of the optical antennas, a splitter coupled along the optical path and configured to: split a received portion of the laser signal into a local oscillator signal and a transmitted signal. However, MEZMERIZ discloses for each optical path from the input port to one of the optical antennas, a splitter coupled along the optical path and configured to: split a received portion of the laser signal into a local oscillator signal and a transmitted signal (each optical path from input port 242 to output port 264 of directional coupler a splitter splits a received portion of the light/laser beam 240 into a local oscillator LO signal 272 and transmitted signal at output 246; figure 2; paragraphs [0024] & [0027]). It would have been obvious to one of ordinary skill in the art, at the time the invention was made, to modify the FMCW LiDAR transceiver of ANALOG PHOTONICS to include the for each optical path from the input port to one of the optical antennas, a splitter coupled along the optical path and configured to: split a received portion of the laser signal into a local oscillator signal and a transmitted signal, as taught by MEZMERIZ, in order to provide multiple beat frequencies 288 which provides additionally information of the distance to the remote object and improving signal-to-noise SNR ratio (MEZMERIZ; paragraph [0027]).

As per claim 3, ANALOG PHOTONICS in view of MEZMERIZ discloses the FMCW transceiver of claim 1. Modified ANALOG PHOTONICS further discloses wherein the FMCW transceiver comprises a separate splitter for each of the plurality of antennas, each splitter coupled along the optical path between the optical switch and the corresponding antenna (as shown in figure 7B, FMCW transceiver includes an optical circulator for each of the plurality of optical antennas, the optical circulator coupled along the optical path between the optical switch and the corresponding antenna; figure 7B; paragraphs [0048] & [0052]).

As per claim 4, ANALOG PHOTONICS in view of MEZMERIZ discloses the FMCW transceiver of claim 1. Modified ANALOG PHOTONICS further discloses wherein the FMCW transceiver contains only one splitter coupled between the input port and the optical switch (as shown in figure 7B, FMCW transceiver contains only one splitter coupled between the input port and the optical switch; figure 7B; paragraph [0052]).

As per claim 5, ANALOG PHOTONICS in view of MEZMERIZ discloses the FMCW transceiver of claim 1. Modified ANALOG PHOTONICS further discloses wherein an arrangement of the plurality of antennas is selected from a group comprising: a regular array, a linear array, and a rectangular array (optical antennas/emitters positioned along a line that is not curved; paragraph [0056]).

As per claim 7, ANALOG PHOTONICS in view of MEZMERIZ discloses the FMCW transceiver of claim 1. Modified ANALOG PHOTONICS further discloses wherein the optical switch comprises: a passive optical splitter that splits the frequency modulated laser signal between at least two optical paths (as shown in figure 7B, passive optical splitter that splits the frequency modulated laser signal between at least two optical paths; figure 7B).

As per claim 8, ANALOG PHOTONICS in view of MEZMERIZ discloses the FMCW transceiver of claim 1. Modified ANALOG PHOTONICS further discloses wherein the optical switch comprises: an active optical splitter that switchably couples the frequency modulated laser signal to only one of at least two optical paths (as shown in figure 7B, optical switch includes an active optical splitter that switchably couples the frequency modulated laser signal to only one of at least two optical paths; figure 7B).

As per claim 9, ANALOG PHOTONICS in view of MEZMERIZ discloses the FMCW transceiver of claim 8. Modified ANALOG PHOTONICS further discloses wherein the optical switch comprises a plurality of active optical splitters (as shown in figure 7B, optical switch comprises a plurality of active optical splitters; figure 7B).

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WRITTEN OPINION OF THE
INTERNATIONAL SEARCHING AUTHORITY

International application No.
PCT/US20/25042

Supplemental Box

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As per claim 10, ANALOG PHOTONICS in view of MEZMERIZ discloses the FMCW transceiver of claim 1. Modified ANALOG PHOTONICS further discloses wherein the optical switch optically couples the frequency modulated laser signal to each of the optical antennas one at time over a scanning period of the FMCW transceiver (optical switch optically couples the frequency modulated laser signal to each of the optical antennas one at time over a scanning period of the FMCW transceiver; paragraph [0047]).

As per claim 14, ANALOG PHOTONICS in view of MEZMERIZ discloses the FMCW LiDAR system of claim 11. Modified ANALOG PHOTONICS further discloses wherein the lens is configured to: project a transmitted signal emitted from a first antenna of the plurality of antennas into a corresponding portion of the field of view of the FMCW LiDAR system (as shown in figure 7B, lens projects a transmitted signal emitted from a first antenna of the plurality of antennas into a corresponding portion of the field of view of the FMCW LiDAR system; figure 7B; paragraph [0055]); and provide a reflection of the transmitted signal to the first antenna (as shown in figure 7B, provide a reflection of the transmitted signal to the first antenna; figure 7B; paragraph [0055]).

As per claim 15, ANALOG PHOTONICS in view of MEZMERIZ discloses the FMCW LiDAR system of claim 11. Modified ANALOG PHOTONICS further discloses wherein the plurality of optical antennas are arranged in a linear array (optical antennas/emitters positioned along a line that is not curved; paragraph [0056]), and the lens produces collimated transmitted signals that scan the transceiver field of view along one angular dimension (as shown in figure 7B, lens positioned to collimate the transmitted/sent signal emitted via the plurality of antennas that scan the field of view along an angular dimension; figure 7B; paragraphs [0029], [0055] & [0074]).

As per claim 16, ANALOG PHOTONICS in view of MEZMERIZ discloses the FMCW LiDAR system of claim 15. Modified ANALOG PHOTONICS further discloses wherein the FMCW LiDAR system has a field of view of 5 degrees or better along the one angular dimension (wherein the FMCW LiDAR system has a field of view of 360 degrees along the one angular dimension; paragraph [0063]).

Claims 2, 12 & 13 lack an inventive step under PCT Article 33(3) as being obvious over ANALOG PHOTONICS in view of MEZMERIZ in further view of US 2010/0103084 A1 to OTO, M (OTO).

As per claims 2 & 12, ANALOG PHOTONICS in view of MEZMERIZ discloses the FMCW transceiver and the FMCW LIDAR system of claims 1 & 11. ANALOG PHOTONICS and MEZMERIZ fail to disclose for each splitter, a polarization assembly coupled along the optical path between the splitter and the optical antenna, the polarization assembly configured to: couple an optical signal from a first waveguide to form the transmitted signal, and polarize the transmitted signal to have a first polarization, and couple the return signal into a second waveguide for optical detection. However, OTO discloses for each splitter, a polarization assembly coupled along the optical path between the splitter and the optical antenna, the polarization assembly configured to: couple an optical signal from a first waveguide to form the transmitted signal (for each beam splitter, a quarter wave plate 67 coupled along the optical path between splitter and emitter, quarter wave plate converts light into polarized light so as to be emitted; paragraph [0092]); and polarize the transmitted signal to have a first polarization (polarize the transmitted signal to have p-polarized component; paragraph [0092]; abstract); and polarize the reflected signal based on a second polarization that is orthogonal to the first polarization to form a return signal (polarize the reflected signal based on a s-polarized component that is orthogonal to the p-polarized component to form a return signal; paragraphs [0092] & [0252]; abstract); and couple the return signal into a second waveguide for optical detection (light detector 69 detects reflected laser light in optical disk 65; paragraph [0252]). It would have been obvious to one of ordinary skill in the art, at the time the invention was made, to modify the FMCW transceiver and the FMCW LIDAR system of ANALOG PHOTONICS to include the for each splitter, a polarization assembly coupled along the optical path between the splitter and the optical antenna, the polarization assembly configured to: couple an optical signal from a first waveguide to form the transmitted signal, and polarize the transmitted signal to have a first polarization, and couple the return signal into a second waveguide for optical detection, as taught by OTO, in order to provide sufficient light resistance to blue-violet laser, high reliability, and improve optical characteristic (OTO; paragraph [0092]).

As per claim 13, ANALOG PHOTONICS in view of MEZMERIZ discloses the FMCW LiDAR system of claim 12. ANALOG PHOTONICS and MEZMERIZ fail to disclose a quarter wave plate positioned along an optical path of the emitted transmitted signals, to convert the transmitted signals from a first linear polarization to a circular polarization and is configured to convert the reflected signals from circular polarization to a second linear polarization that is orthogonal to the first linear polarization. However, OTO further discloses a quarter wave plate positioned along an optical path of the emitted transmitted signals, to convert the transmitted signals from a first linear polarization to a circular polarization and is configured to convert the reflected signals from circular polarization to a second linear polarization that is orthogonal to the first linear polarization (a quarter wave plate positioned along an optical path of the emitted transmitted signals, to convert the transmitted signals from a linear polarization to a circular polarization and converts the reflected signals from circular polarization to a second linear polarization that is orthogonal, 90 degrees, to the first linear polarization; figure 16-1C; paragraph [0092]; abstract). It would have been obvious to one of ordinary skill in the art, at the time the invention was made, to modify the FMCW LiDAR system of ANALOG PHOTONICS to include the quarter wave plate positioned along an optical path of the emitted transmitted signals, to convert the transmitted signals from a first linear polarization to a circular polarization and is configured to convert the reflected signals from circular polarization to a second linear polarization that is orthogonal to the first linear polarization, as taught by OTO, in order to provide sufficient light resistance to blue-violet laser, high reliability, and improve optical characteristic (OTO; paragraph [0092]).

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WRITTEN OPINION OF THE INTERNATIONAL SEARCHING AUTHORITY

International application No. PCT/US20/25042

Supplemental Box

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Claim 6 lack an inventive step under PCT Article 33(3) as being obvious over ANALOG PHOTONICS in view of MEZMERIZ in further view of US 2018/0224547 A1 to BLACKMORE SENSORS AND ANALYTICS INC. (BLACKMORE).

As per claim 6, ANALOG PHOTONICS in view of MEZMERIZ discloses the FMCW transceiver of claim 1. ANALOG PHOTONICS and MEZMERIZ fail to disclose wherein the one or more output signals includes a quadrature output signal and an in-phase output signal for each return signal. However, BLACKMORE discloses wherein the one or more output signals includes a quadrature output signal and an in-phase output signal for each return signal (cross spectrum made of different output signals includes a quadrature component signal and an in-phase component signal; paragraph [0051]). It would have been obvious to one of ordinary skill in the art, at the time the invention was made, to modify the FMCW transceiver of ANALOG PHOTONICS to include the one or more output signals includes a quadrature output signal and an in-phase output signal for each return signal, as taught by BLACKMORE, in order to provide an efficient process to calculate the Doppler shift to reduce problems during range measurements (BLACKMORE; paragraph [0051]).

Claims 17-19 lack an inventive step under PCT Article 33(3) as being obvious over ANALOG PHOTONICS in view of MEZMERIZ in further view of US 2014/0078491 A1 to EISELE, A et al. (EISELE).

As per claim 17, ANALOG PHOTONICS in view of MEZMERIZ discloses the FMCW LiDAR system of claim 15. ANALOG PHOTONICS and MEZMERIZ fail to disclose a scanning mirror configured to scan the transmitted signals in a second dimension within the field of view of the FMCW LiDAR system, the second dimension orthogonal to the one angular dimension. However, EISELE discloses a scanning mirror configured to scan the transmitted signals in a second dimension within the field of view of the FMCW LiDAR system, the second dimension orthogonal to the one angular dimension (controlled mirror to used to scan the emitted signals in a second dimension within the field of view of the FMCW LIDAR system; figure 1A; paragraphs [0059]-[0060]). It would have been obvious to one of ordinary skill in the art, at the time the invention was made, to modify the FMCW LiDAR system of ANALOG PHOTONICS to include the scanning mirror configured to scan the transmitted signals in a second dimension within the field of view of the FMCW LiDAR system, the second dimension orthogonal to the one angular dimension, as taught by EISELE, in order to provide two-dimensional scanning to measure a two-dimensional or three-dimensional object and correct for angle-dependent distance variation (EISELE; paragraphs [0059] & [0062]).

As per claim 18, ANALOG PHOTONICS in view of MEZMERIZ discloses the FMCW LiDAR system of claim 11. Modified ANALOG PHOTONICS further discloses wherein the FMCW LiDAR transceiver is configured to emit a plurality of transmitted signals from the plurality of antennas (as shown in figure 7B, FMCW LiDAR system emits a plurality of transmitted signals from the plurality of antennas; figure 7B; paragraph [0069]; claim 16). ANALOG PHOTONICS and MEZMERIZ fail to disclose such that the plurality of transmitted signals scan in two dimensions a portion of the field of view of the FMCW LiDAR system. However, EISELE discloses such that the plurality of transmitted signals scan in two dimensions a portion of the field of view of the FMCW LiDAR system (such that the plurality of transmitted signals scan in two dimensions a portion of the field of view of the FMCW LiDAR system; paragraphs [0059] & [0062]). It would have been obvious to one of ordinary skill in the art, at the time the invention was made, to modify the FMCW LiDAR system of ANALOG PHOTONICS to include wherein the FMCW LiDAR transceiver is configured to emit a plurality of transmitted signals from the plurality of antennas such that the plurality of transmitted signals scan in two dimensions a portion of the field of view of the FMCW LiDAR system, as taught by EISELE, in order to provide two-dimensional scanning to measure a two-dimensional or three-dimensional object and correct for angle-dependent distance variation (EISELE; paragraphs [0059] & [0062]).

As per claim 19, ANALOG PHOTONICS in view of MEZMERIZ discloses the FMCW LiDAR system of claim 18. Modified ANALOG PHOTONICS discloses wherein the scan module field of view is at 5 degrees or better along the first dimension (field of view is 360 degrees along first dimension; paragraph [0071]). ANALOG PHOTONICS and MEZMERIZ fail to disclose wherein the two dimensions are a first dimension and a second dimension, and the scan module field of view is at 5 degrees or better along the first dimension and is 5 degrees or better along the second dimension. However, EISELE discloses wherein the two dimensions are a first dimension and a second dimension, and the scan module field of view is at 5 degrees or better along the first dimension and is 5 degrees or better along the second dimension (two dimensions make up the field of view during scanning to have a large field of view; paragraphs [0012] & [0071]). It would have been obvious to one of ordinary skill in the art, at the time the invention was made, to modify the FMCW LiDAR system of ANALOG PHOTONICS to include the two dimensions are a first dimension and a second dimension, and the scan module field of view is at 5 degrees or better along the first dimension and is 5 degrees or better along the second dimension, as taught by EISELE, in order to provide two-dimensional scanning to measure a two-dimensional or three-dimensional object and correct for angle-dependent distance variation (EISELE; paragraphs [0059] & [0062]).

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WRITTEN OPINION OF THE
INTERNATIONAL SEARCHING AUTHORITY

International application No.
PCT/US20/25042

Supplemental Box

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Claim 20 lacks an inventive step under PCT Article 33(3) as being obvious over ANALOG PHOTONICS in view of MEZMERIZ in further view of "Suitable Combination of Direct Intensity Modulation and Spreading Sequence for LIDAR with Pulse Coding" by to KIM, G et al. (KIM).

As per claim 20, ANALOG PHOTONICS in view of MEZMERIZ discloses the FMCW LiDAR system of claim 11. Modified ANALOG PHOTONICS further discloses wherein the FMCW LiDAR system is configured to target at least 100K points over the field of view of the FMCW LiDAR system (FMCW LiDAR system collects at least 1 billion data points over the field of view of the FMCW LiDAR system; paragraph [0061]). ANALOG PHOTONICS and MEZMERIZ fail to disclose wherein the FMCW LiDAR system is configured to target at least 100K points per second over the field of view of the FMCW LiDAR system. However, KIM discloses wherein the FMCW LiDAR system is configured to target at least 100K points per second over the field of view of the FMCW LiDAR system (pulsed scanning FMCW LiDAR system collects at least 1.5 billion data points per second over the field of view of the FMCW LiDAR system; page 2). It would have been obvious to one of ordinary skill in the art, at the time the invention was made, to modify the FMCW LiDAR system of ANALOG PHOTONICS to include the FMCW LiDAR system is configured to target at least 100K points per second over the field of view of the FMCW LiDAR system, as taught by KIM, in order to provide an increase in range resolution to distinguish the reflections from two targets that are very close in range, reduce range ambiguity, achieve longer maximum distance, high measurement point, high frame refresh rate, and high angular resolution per second at the same time (KIM; page 2).

Claims 1-20 have industrial applicability as defined by PCT Article 33(4) because the subject matter can be made or used in industry.