PATENT COOPERATION TREATY

From the
INTERNATIONAL SEARCHING AUTHORITY

To: JUDITH SZEPESI
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PCT

WRITTEN OPINION OF THE
INTERNATIONAL SEARCHING AUTHORITY

(PCT Rule 43*bis*.1)

Date of mailing *(day/month/year)*	08 APR 2020
Applicant's or agent's file reference 14100P0048PCT	**FOR FURTHER ACTION** See paragraph 2 below

International application No.	International filing date *(day/month/year)*	Priority date *(day/month/year)*
PCT/US 19/65101	06 December 2019 (06.12.2019)	07 December 2018 (07.12.2018)

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

IPC - G02B 26/08; G02B 27/00; G02B 27/01; G06F 3/01; H04N 13/365 (2020.01)

CPC - G02B 26/08; G02B 27/00; G02B 27/01; G03B 21/142; H04N 13/30; G06 F3/011; G06 F3/013; H04N 13/365

Applicant AVEGANT CORP.

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

- ☒ 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
- ☒ 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
- ☐ Box No. VII Certain defects in the international application
- ☒ 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	16 March 2020	Lee Young PCT Help Desk Telephone No. 571-272-4300

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Box No. I Basis of this opinion

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

☒ 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:

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Box No. IV Lack of unity of invention

1. ☒ In response to the invitation (Form PCT/ISA/206) to pay additional fees the applicant has, within the applicable time limit:

   ☐ paid additional fees.

   ☐ paid additional fees under protest and, where applicable, the protest fee.

   ☐ paid additional fees under protest but the applicable protest fee was not paid.

   ☒ not paid additional fees.

2. ☐ This Authority found that the requirement of unity of invention is not complied with and chose not to invite the applicant to pay additional fees.

3. This Authority considers that the requirement of unity of invention in accordance with Rule 13.1, 13.2 and 13.3 is

   ☐ complied with.

   ☒ not complied with for the following reasons:

This application contains the following inventions or groups of inventions which are not so linked as to form a single general inventive concept under PCT Rule 13.1. In order for all inventions to be searched, the appropriate additional search fees must be paid.

Group I: Claims 1-18 are directed to an image steering system.

Group II: Claims 19 are directed to a magnetic counter-balancer for piezoelectric display.

The inventions listed as Groups I-II do not relate to a single general inventive concept under PCT Rule 13.1 because, under PCT Rule 13.2, they lack the same or corresponding special technical features for the following reasons:

Special Technical Features
Group I includes the special technical feature of a position element to position an image generated by the display element the position element comprising: steerable element; an X-axis controller to pivot the steerable element around an Xaxis; a Y-axis controller to pivot the steerable element around a Yaxis; flexible arms supporting the moveable display element; a controller to pivot the steerable element around the axis-using the flexible arm, wherein a movement of the steerable element is such that a user does not perceive motion; such that the steerable element has a range of motion that enables the steerable display to be positioned and repositioned at a plurality of locations within a field of view of the user, not included in the other Groups.

Group II includes the special technical feature of two pivots around which the display element can move in all directions; piezo-electric elements to drive the pivots, to move the display element; magnets and associated magnetic sensors to determine a position of the display element; wherein a position of the magnets counterbalances the piezo electric elements, such that the display element is balanced in weight, not included in the other groups.

COMMON TECHNICAL FEATURES
The only technical feature shared by Groups I-II that would otherwise unify the groups, is a steerable display system comprising: a moveable display element. However, this shared technical feature does not represent a contribution over prior art, because the shared technical feature is disclosed by WO 2018/019831 A1 to Optotune AG (hereinafter Optotune).

Optotune discloses a steerable display system (Pg. 37, ln 1-3- Furthermore, according to an embodiment of the optical device according to the present invention, the plate member can be a rigid prism for steering of a light beam and particularly changing an angle of incoming light; Pg. 101, ln 4-8- Typical applications include... head-up displays, head-mounted displays, digital cameras, mobile phone cameras, virtual reality displays, augmented reality displays...) comprising: a moveable display element (Pg. 45, ln 9-11- Fig. 2 shows in conjunction with the schematic representation of Fig. 1 an embodiment of an optical device 1 according to the invention that allows to tilt a transparent member 55 in 2D between a first and a second position...; Pg. 45, 24-25- Of course, in all embodiments of the present invention one may also use a plate member 55 that is not transparent, but forms a mirror).

As the common features were known in the art at the time of the invention, they cannot be considered special technical features that would otherwise unify the groups.

Therefore, Groups I-II lack unity under PCT Rule 13.

4. Consequently, this opinion has been established in respect of the following parts of the international application:

   ☐ all parts.

   ☒ the parts relating to claims Nos. 1-18

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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	1-18	YES
	Claims	None	NO
Inventive step (IS)	Claims	None	YES
	Claims	1-18	NO
Industrial applicability (IA)	Claims	1-18	YES
	Claims	None	NO

2. Citations and explanations:

Claims 1, 5, 6, 8, 9, 10, 14, 15, 17, and 18 lack an inventive step under PCT Article 33(3) as being obvious over WO 2018/019831 A1 to Optotune AG (hereinafter Optotune).

Regarding claim 1, Optotune discloses, a steerable display system (Pg. 37, ln 1-3- Furthermore, according to an embodiment of the optical device according to the present invention, the plate member can be a rigid prism for steering of a light beam and particularly changing an angle of incoming light; Pg. 101, ln 4-8- Typical applications include... head-up displays, head-mounted displays, digital cameras, mobile phone cameras, virtual reality displays, augmented reality displays...) comprising: a display element (Pg. 45, ln 9-11- Fig. 2 shows in conjunction with the schematic representation of Fig. 1 an embodiment of an optical device 1 according to the invention that allows to tilt a transparent member 55 in 2D between a first and a second position...; Pg. 45, 24-25- Of course, in all embodiments of the present invention one may also use a plate member 55 that is not transparent, but forms a mirror); a position element to position an image generated by the display element (Fig. 2, element 33; Pg. 45, 28-33- In detail, the optical device 1 comprises, besides said transparent plate member 55 configured for refracting a light beam L passing through the plate member 55, wherein the light beam L projects an image IM comprised of rows and columns of pixels P, a carrier 33 to which said transparent plate member 55 is rigidly mounted, wherein the carrier 33 is configured to be moved between a first and a second state, whereby said projected image IM is shifted by said fraction DELTAP of a pixel...) the position element comprising: a steerable element (Fig. 2C, element 66; Pg. 46, ln 23-28- In order to achieve a transition between said stable states 1A, 1 B, the optical device 1 comprises an actuator means 66 that is configured to force a transition of the carrier 33, e.g. of the first part 33A and the second part 33B, from its first stable state 1A to its second stable state 1 B and vice versa; Pg. 46, ln 31-34- Particularly, the actuator means 66 comprises a plurality of electrically conducting coils 31A and a corresponding plurality of magnets 32B, wherein the coils 31A are arranged on the support frame 51, and wherein the magnets 32B are arranged on the carrier 33); an X-axis controller to pivot the steerable element around an X-axis (First direction/axis; Pg. 80, ln 32- Pg. 81, ln 1-2- ...a carrier 33 that is connected via two springs 30A to a support frame 51 comprising four arms 51 a, 51 aa, 51 b, 51 bb so that the carrier 33 can be tilted about a first axis 700 that is aligned with said springs 30A between said first and said second state with respect to said support frame 51. This causes the light beam L (or an image IM) to be shifted in a first direction...); a Y-axis controller to pivot the steerable element around a Yaxis; (second direction/axis; Pg. 81, ln 28-33- ...a second part 33B that is connected via springs 30B to the first part 33A, so that the second part 33B can be tilted about a second axis 701 that runs perpendicular to the first axis 700 with respect to the first part 33A between a first and a second state of the second part 33B whereby particularly said light beam L (or a projected image IM) is shifted, particularly by a fraction DELTAP' of a pixel, particularly by a half of a pixel, along a second direction); such that the steerable element has a range of motion that enables the steerable display to be positioned and repositioned at a plurality of locations (Pg. 45, ln 2-8- The present invention relates to optical devices that allow to shift an image IM projected by a light beam L by a fraction of a pixel (e.g. one-half pixel) DELTAP in either 1 D (e.g. horizontally) along a first direction x (e.g. corresponding to pixel rows of the image) or 2D (e.g. horizontally and vertically, or even diagonally) along a first direction x and a second direction y (e.g. corresponding to pixel columns of the image), wherein the shift in y-direction is denoted DELTAP'; Pg. 47, ln 11-15- Generally, in all embodiments described herein, the actuator means 66, 660 (e.g. coils 31A) maybe controlled by means of an electronic control unit which is not shown and which may control e.g. a defined tilting movement of the carrier 33 / plate member 55 in order to achieve a resolution enhancement / shift of the light beam L (or change in angle of reflection) of the optical device 1 as described herein). Optotune fails to specifically disclose, the plurality of locations within a field of view of the user. However, it would have been obvious to a person having ordinary skill in the art, the plurality of locations within a field of view of the user, to improve the display image resolution for a user based on routine experimentation (Pg. 101, ln 1-6- Besides the applications already mentioned above, the optical device 1 according to the invention can be used for super resolution imaging but also super resolution projection and is then integrated in an optical assembly, particularly with multiple optical elements. Typical applications include microprojectors, home projectors, business projectors, cinema projectors, entertainment projectors, pico-projectors, head-up displays, head-mounted displays...). Optotune fails to specifically disclose, wherein a movement of the steerable element is such that a user does not perceive motion. However, it would have been obvious to a person having ordinary skill in the art, to have provided a movement of the steerable element is such that a user does not perceive motion, based on routine experimentation in view of the teachings or Optotune, to improve the resolution and user experience (Pg. 1, ln 23-27- The sub-frames are projected in a sufficiently fast manner so that they appear to the human eye as if they are being projected simultaneously and superimposed. For instance, in case the sub-frames are aligned such that the corners of the pixels in one sub-frame are projected on the centers of the next sub-frame and so on, the illusion of a resolution can be achieved that seems twice as high; Pg. 1, ln 32- Pg. 2, ln 1- Based on the above the problem underlying the invention is to provide an improved optical device for generating such a super resolution image which requires only a relatively small amount of energy for pixel shifting; Pg. 2, ln 2-3- According thereto, an optical device for enhancing the resolution of an image is disclosed...).

--see supplemental box

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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 10 was originally written as "position element", for the purposes of this opinion it has been interpreted as "a position element"

Claim 10 was originally written as "the steerable element", however the claim provides no antecedent bases, therefore "the steerable element" has been interpreted as referencing "a steerable display system" as found in the preamble.

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Supplemental Box

In case **the space in any of the preceding boxes is not sufficient.**
Continuation of:
----Continuation of Box No. V----

Regarding claim 5, Optotune discloses the steerable display system of claim 1. Optotune further discloses, further comprising: an actuator to move the steerable element, the actuator comprising one of a piezo-electric element, a magnetic element, a nanomotor (Pg. 46, ln 31-34- Particularly, the actuator means 66 comprises a plurality of electrically conducting coils 31A and a corresponding plurality of magnets 32B, wherein the coils 31A are arranged on the support frame 51, and wherein the magnets 32B are arranged on the carrier 33).

Regarding claim 6, Optotune discloses the steerable display system of claim 5. Optotune fails to specifically disclose, wherein the actuator has an absolute precision of+/- 0.75 arc minute, and a relative precision of 0.06 arc minute. However, it would have been obvious to a person having ordinary skill in the art, to provide the actuator having an absolute precision of +/- 0.75 arc minute, and a relative precision of 0.06 arc minute, to improve the resolution performance based on routine experimentation (see Optotune, Pg. 1, ln 5-6- The present invention relates to an optical device for enhancing resolution of an image according to claim 1; Pg. 2, ln 8-12- ...a carrier to which said transparent plate member is rigidly mounted, wherein the carrier is configured to be moved between at least a first and a second state, whereby said light beam is shifted e.g. along a first direction (e.g. said projected image is shifted by a fraction of a pixel, particularly by a half of a pixel along the first direction)...).

Regarding claim 8, Optotune discloses the steerable display system of claim 1. Optotune fails to specifically disclose, wherein the steerable element is a mirror having a diameter between 5mm and 15mm. However, it would have been obvious to a person having ordinary skill in the art, to have provided the steerable element as a mirror having a diameter between 5mm and 15mm, to improve the resolution performance based on routine experimentation (Pg. 26, ln 7-8- Further, particularly, plate member / glass member can comprise a thickness that is smaller than or equal to 5 mm...; Pg. 37, ln 6-9- Particularly, the optical device can be used in a wide variety of technical applications, particularly for increasing resolution in 3D scanning of an object or space. Here, the optical device can be used in addition to a mirror to scan smaller areas in more detail).

Regarding claim 9, Optotune discloses the steerable display system of claim 1. Optotune fails to specifically disclose, wherein the position element is smaller than 5 mm x 12 mm x 12 mm. However, it would have been obvious to a person having ordinary skill in the art, to have provided the position element to be smaller than 5 mm x 12 mm x 12 mm, to improve the design size and stability performance based on routine experimentation (Pg. 31, ln 4-6- ...at least one separate mass body is mounted on the support frame for increasing the mass and thus the moment of inertia of the support frame and therewith stability of the optical device...; Pg. 52, ln 17-20- This spring/carrier 30 is therefore particularly configured to periodically provide, store, and absorb the energy required to accelerate and decelerate a moving mass (inertial forces), particularly the carrier 33 (or components thereof, e.g. first and/or second part 30A, 30B) and the plate member 55; Pg. 37, ln 6-9- Particularly, the optical device can be used in a wide variety of technical applications, particularly for increasing resolution in 3D scanning of an object or space. Here, the optical device can be used in addition to a mirror to scan smaller areas in more detail).

Regarding claim 10, Optotune discloses a steerable display system (Pg. 37, ln 1-3- Furthermore, according to an embodiment of the optical device according to the present invention, the plate member can be a rigid prism for steering of a light beam and particularly changing an angle of incoming light; Pg. 101, ln 4-8- Typical applications include... head-up displays, head-mounted displays, digital cameras, mobile phone cameras, virtual reality displays, augmented reality displays...) comprising: a moveable display element (Pg. 45, ln 9-11- Fig. 2 shows in conjunction with the schematic representation of Fig. 1 an embodiment of an optical device 1 according to the invention that allows to tilt a transparent member 55 in 2D between a first and a second position...; Pg. 45, 24-25- Of course, in all embodiments of the present invention one may also use a plate member 55 that is not transparent, but forms a mirror); a position element to move the display element, to position an image generated by the display element (Fig. 2, element 33; Pg. 45, 28-33- In detail, the optical device 1 comprises, besides said transparent plate member 55 configured for refracting a light beam L passing through the plate member 55, wherein the light beam L projects an image IM comprised of rows and columns of pixels P, a carrier 33 to which said transparent plate member 55 is rigidly mounted, wherein the carrier 33 is configured to be moved between a first and a second state, whereby said projected image IM is shifted by said fraction DELTAP of a pixel...), the position elements comprising: flexible arms supporting the moveable display element (Pg. 80, ln 30- Pg. Pg. 81, ln 1- As before, the optical device 1 comprises a transparent plate member 55 configured for refracting a light beam L passing through the plate member 55 (see also above), a carrier 33 that is connected via two springs 30A to a support frame 51 comprising four arms 51 a, 51 aa, 51 b, 51 bb so that the carrier 33 can be tilted about a first axis 700 that is aligned with said springs 30A between said first and said second state with respect to said support frame 51); a controller to pivot the steerable element around the axis-using the flexible arm (Pg. 47, ln 11-15- Generally, in all embodiments described herein, the actuator means 66, 660 (e.g. coils 31A) maybe controlled by means of an electronic control unit which is not shown and which may control e.g. a defined tilting movement of the carrier 33 / plate member 55 in order to achieve a resolution enhancement / shift of the light beam L (or change in angle of reflection) of the optical device 1 as described herein); such that the steerable element has a range of motion that enables the steerable display to be positioned and repositioned at a plurality of locations (Pg. 45, ln 2-8- The present invention relates to optical devices that allow to shift an image IM projected by a light beam L by a fraction of a pixel (e.g. one-half pixel) DELTAP in either 1 D (e.g. horizontally) along a first direction x (e.g. corresponding to pixel rows of the image) or 2D (e.g. horizontally and vertically, or even diagonally) along a first direction x and a second direction y (e.g. corresponding to pixel columns of the image), wherein the shift in y-direction is denoted DELTAP'; Pg. 47, ln 11-15- Generally, in all embodiments described herein, the actuator means 66, 660 (e.g. coils 31A) maybe controlled by means of an electronic control unit which is not shown and which may control e.g. a defined tilting movement of the carrier 33 / plate member 55 in order to achieve a resolution enhancement / shift of the light beam L (or change in angle of reflection) of the optical device 1 as described herein; Pg. 101, ln 4-8- Typical applications include... head-up displays, head-mounted displays, digital cameras, mobile phone cameras, virtual reality displays, augmented reality displays...). Optotune fails to specifically disclose, the plurality of locations within a field of view of the user. However, it would have been obvious to a person having ordinary skill in the art, the plurality of locations within a field of view of the user, to improve the display image resolution for a user based on routine experimentation (Pg. 101, ln 1-6- Besides the applications already mentioned above, the optical device 1 according to the invention can be used for super resolution imaging but also super resolution projection and is then integrated in an optical assembly, particularly with multiple optical elements. Typical applications include microprojectors, home projectors, business projectors, cinema projectors, entertainment projectors, pico-projectors, head-up displays, head-mounted displays...). (claim 10 continued)

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Supplemental Box

In case **the space in any of the preceding boxes is not sufficient.**
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(claim 10 continued) Optotune fails to specifically disclose, wherein a movement of the steerable element is such that a user does not perceive motion. However, it would have been obvious to a person having ordinary skill in the art, to have provided a movement of the steerable element is such that a user does not perceive motion, based on routine experimentation, in view of the teachings or Optotune, to improve the resolution and user experience (Pg. 1, ln 23-27- The sub-frames are projected in a sufficiently fast manner so that they appear to the human eye as if they are being projected simultaneously and superimposed. For instance, in case the sub-frames are aligned such that the corners of the pixels in one sub-frame are projected on the centers of the next sub-frame and so on, the illusion of a resolution can be achieved that seems twice as high; Pg. 1, ln 32- Pg. 2, ln 1- Based on the above the problem underlying the invention is to provide an improved optical device for generating such a super resolution image which requires only a relatively small amount of energy for pixel shifting; Pg. 2, ln 2-3- According thereto, an optical device for enhancing the resolution of an image is disclosed...).

Regarding claim 14, Optotune discloses the steerable display system of claim 10. Optotune further discloses, further comprising: an actuator to move the steerable element, the actuator comprising one of a piezo-electric element, a magnetic element, a nanomotor (Pg. 46, ln 31-34- Particularly, the actuator means 66 comprises a plurality of electrically conducting coils 31A and a corresponding plurality of magnets 32B, wherein the coils 31A are arranged on the support frame 51, and wherein the magnets 32B are arranged on the carrier 33).

Regarding claim 15, Optotune discloses the steerable display system of claim 14. Optotune fails to specifically disclose, wherein the actuator has an absolute precision of+/- 0.75 arc minute, and a relative precision of 0.06 arc minute. However, it would have been obvious to a person having ordinary skill in the art, wherein the actuator has an absolute precision of+/- 0.75 arc minute, and a relative precision of 0.06 arc minute, to improve the resolution performance based on routine experimentation (see Optotune, Pg. 1, ln 5-6- The present invention relates to an optical device for enhancing resolution of an image according to claim 1; Pg. 2, ln 8-12- ...a carrier to which said transparent plate member is rigidly mounted, wherein the carrier is configured to be moved between at least a first and a second state, whereby said light beam is shifted e.g. along a first direction (e.g. said projected image is shifted by a fraction of a pixel, particularly by a half of a pixel along the first direction)...).

Regarding claim 17, Optotune discloses the steerable display system of claim 10. Optotune fails to specifically disclose, wherein the steerable element is a mirror having a diameter between 5mm and 15mm. However, it would have been obvious to a person having ordinary skill in the art, wherein the steerable element is a mirror having a diameter between 5mm and 15mm, to improve the resolution based on routine experimentation (Pg. 26, ln 7-8- Further, particularly, plate member / glass member can comprise a thickness that is smaller than or equal to 5 mm...; Pg. 37, ln 6-9- Particularly, the optical device can be used in a wide variety of technical applications, particularly for increasing resolution in 3D scanning of an object or space. Here, the optical device can be used in addition to a mirror to scan smaller areas in more detail).

Regarding claim 18, Optotune discloses the steerable display system of claim 10. Optotune fails to specifically disclose, wherein the position element is smaller than 5 mm x 12mm x 12 mm. However, it would have been obvious to a person having ordinary skill in the art, to have provided the position element to be smaller than 5 mm x 12mm x 12 mm, to improve the design size and stability performance based on routine experimentation (Pg. 31, ln 4-6- ...at least one separate mass body is mounted on the support frame for increasing the mass and thus the moment of inertia of the support frame and therewith stability of the optical device...; Pg. 52, ln 17-20- This spring/carrier 30 is therefore particularly configured to periodically provide, store, and absorb the energy required to accelerate and decelerate a moving mass (inertial forces), particularly the carrier 33 (or components thereof, e.g. first and/or second part 30A, 30B) and the plate member 55; Pg. 37, ln 6-9- Particularly, the optical device can be used in a wide variety of technical applications, particularly for increasing resolution in 3D scanning of an object or space. Here, the optical device can be used in addition to a mirror to scan smaller areas in more detail).

Claims 2-4 and 11-13 lack an inventive step under PCT Article 33(3) as being obvious over Optotune in view of US 2018/0284451 A1 to Avegant Corp. (hereinafter Avegant).

Regarding claim 2, Optotune discloses the steerable display system of claim 1. Optotune fails to disclose, further comprising: a position validator, to verify an actual position of the steerable element and to adjust steerable display image data when the actual position is not an intended position. Avegant, drawn to steerable displays, discloses, further comprising: a position validator (para [0070]- The processing system 238 in one embodiment further includes foveal position validator 247 which validates the positioning of the position elements 226, 236, to ensure that the displays 220, 230 are properly positioned), to verify an actual position of the steerable element and to adjust steerable display image data when the actual position is not an intended position (para [0061]- In one embodiment, the foveal display image is projected directly onto the user's eye using a set of one or more totally or partially transparent positioning elements 226. In one embodiment, the positioning elements 226 include a steerable mirror; para [0070]- The processing system 238 in one embodiment further includes foveal position validator 247 which validates the positioning of the position elements 226, 236, to ensure that the displays 220, 230 are properly positioned). It would have been obvious to a person having ordinary skill in the art to combine the position validator of Avegant,with the display of Optotune to improve the resolution performance (see Avegant, para [0002]- Achieving such resolutions is challenging at the level of the panel, the drive electronics, and the rendering pipeline; para [0040]- The present application discloses a steerable foveal display, referred to as a foveal display. The foveal display in one embodiment is positioned to provide the high resolution area where the user's fovea is located).

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In case **the space in any of the preceding boxes is not sufficient.**
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Regarding claim 3, Optotune discloses the steerable display system of claim 1. Optotune fails to disclose, wherein the steerable element comprises one or more of: adjustable mirror, tunable prism, acousto-optical modulator, adjustable display panel, a curved mirror, a diffractive element, and a Fresnel reflector. However, Avegant, drawn to steerable displays, discloses, wherein the steerable element comprises one or more of: adjustable mirror, tunable prism, acousto-optical modulator, adjustable display panel, a curved mirror, a diffractive element, and a Fresnel reflector (para [0061]- In one embodiment, the positioning elements 226 include a Fresnel reflector). It would have been obvious to a person having ordinary skill in the art to combine the fresnel reflector of Avegant,with the display of Optotune to improve the resolution performance (see Avegant, para [0002]- Achieving such resolutions is challenging at the level of the panel, the drive electronics, and the rendering pipeline; para [0040]- The present application discloses a steerable foveal display, referred to as a foveal display. The foveal display in one embodiment is positioned to provide the high resolution area where the user's fovea is located).

Regarding claim 4, Optotune discloses the steerable display system of claim 1. Optotune fails to disclose, wherein: the steerable display has a monocular field of view of at least 1 degree, positioned within a scannable field of view of at least 20 degrees. However, Avegant, drawn to steerable displays, discloses, wherein: the steerable display has a monocular field of view of at least 1 degree, positioned within a scannable field of view of at least 20 degrees (Abstract- A display system comprising a foveal display having a monocular field of view of at least 1 degree is positioned within a scannable field of view of at least 20 degrees...). It would have been obvious to a person having ordinary skill in the art to combine the monocular field of view of Avegant,with the display of Optotune to improve the resolution performance (see Avegant, para [0002]- Achieving such resolutions is challenging at the level of the panel, the drive electronics, and the rendering pipeline; para [0040]- The present application discloses a steerable foveal display, referred to as a foveal display. The foveal display in one embodiment is positioned to provide the high resolution area where the user's fovea is located).

Regarding claim 11, Optotune discloses the steerable display system of claim 10. Optotune fails to disclose, further comprising: a position validator, to verify an actual position of the steerable element and to adjust steerable display image data when the actual position is not an intended position. However, Avegant, drawn to steerable displays, discloses, further comprising: a position validator (para [0070]- The processing system 238 in one embodiment further includes foveal position validator 247 which validates the positioning of the position elements 226, 236, to ensure that the displays 220, 230 are properly positioned), to verify an actual position of the steerable element and to adjust steerable display image data when the actual position is not an intended position (para [0061]- In one embodiment, the foveal display image is projected directly onto the user's eye using a set of one or more totally or partially transparent positioning elements 226. In one embodiment, the positioning elements 226 include a steerable mirror; para [0070]- The processing system 238 in one embodiment further includes foveal position validator 247 which validates the positioning of the position elements 226, 236, to ensure that the displays 220, 230 are properly positioned). It would have been obvious to a person having ordinary skill in the art to combine the position validator of Avegant,with the display of Optotune to improve the resolution performance (see Avegant, para [0002]- Achieving such resolutions is challenging at the level of the panel, the drive electronics, and the rendering pipeline; para [0040]- The present application discloses a steerable foveal display, referred to as a foveal display. The foveal display in one embodiment is positioned to provide the high resolution area where the user's fovea is located).

Regarding claim 12, Optotune discloses the steerable display system of claim 10. Optotune fails to disclose, wherein the steerable element comprises one or more of: adjustable mirror, tunable prism, acousto-optical modulator, adjustable display panel, a curved mirror, a diffractive element, and a Fresnel reflector. However, Avegant, drawn to steerable displays, discloses, wherein the steerable element comprises one or more of: adjustable mirror, tunable prism, acousto-optical modulator, adjustable display panel, a curved mirror, a diffractive element, and a Fresnel reflector (para [0061]- In one embodiment, the positioning elements 226 include a Fresnel reflector). It would have been obvious to a person having ordinary skill in the art to combine the fresnel reflector of Avegant,with the display of Optotune to improve the resolution performance (see Avegant, para [0002]- Achieving such resolutions is challenging at the level of the panel, the drive electronics, and the rendering pipeline; para [0040]- The present application discloses a steerable foveal display, referred to as a foveal display. The foveal display in one embodiment is positioned to provide the high resolution area where the user's fovea is located).

Regarding claim 13, Optotune discloses the steerable display system of claim 10. Optotune fails to disclose, wherein: the steerable display has a monocular field of view of at least 1 degree, positioned within a scannable field of view of at least 20 degrees. However, Avegant, drawn to steerable displays, discloses, wherein: the steerable display has a monocular field of view of at least 1 degree, positioned within a scannable field of view of at least 20 degrees (Abstract- A display system comprising a foveal display having a monocular field of view of at least 1 degree is positioned within a scannable field of view of at least 20 degrees...). It would have been obvious to a person having ordinary skill in the art to combine the monocular field of view of Avegant,with the display of Optotune to improve the resolution performance (see Avegant, para [0002]- Achieving such resolutions is challenging at the level of the panel, the drive electronics, and the rendering pipeline; para [0040]- The present application discloses a steerable foveal display, referred to as a foveal display. The foveal display in one embodiment is positioned to provide the high resolution area where the user's fovea is located).

----Continuation of Box No. V----

WRITTEN OPINION OF THE
INTERNATIONAL SEARCHING AUTHORITY

International application No.
PCT/US 19/65101

Supplemental Box

In case **the space in any of the preceding boxes is not sufficient.**
Continuation of:
----Continuation of Box No. V----

Claims 7 and 16 lack an inventive step under PCT Article 33(3) as being obvious over Optotune in view of US 2008/0015553 A1 (Zacharias).

Regarding claim 7, Optotune discloses the steerable display system of claim 5. Optotune fails to disclose, wherein a settling time is less than 2 ms. However, Zacharias, drawn to beam steering, discloses, wherein a settling time is less than 2 ms (para [0087]- Beam steering mechanism 128 is selected to provide dual axis steering capabilities and a high speed of operation. Step settling times below 2 milliseconds for steps above 400 microns at the retinal plane are preferred for practicing this invention to its full potential...). It would have been obvious to a person having ordinary skill in the art to combine the settling time of Zacharias with the steerable display of Optotune to improve the change of speed of operation performance (see Zacharias, para [0193]- Adding all treatment times, settling times and re-aiming times gives a total best case scenario pan-photocoagulation treatment duration of under 2 minutes...; para [0022]- Another object is the provision of such apparatus and method which significantly reduces the time required for such procedures being more efficient and well tolerated; para [0087]- Beam steering mechanism 128 is selected to provide dual axis steering capabilities and a high speed of operation. Step settling times below 2 milliseconds for steps above 400 microns at the retinal plane are preferred for practicing this invention to its full potential).

Regarding claim 16, Optotune discloses the steerable display system of claim 14. Optotune fails to disclose, wherein a settling time is less than 2 ms. However, Zacharias, drawn to beam steering, discloses, wherein a settling time is less than 2 ms (para [0087]- Beam steering mechanism 128 is selected to provide dual axis steering capabilities and a high speed of operation. Step settling times below 2 milliseconds for steps above 400 microns at the retinal plane are preferred for practicing this invention to its full potential...). It would have been obvious to a person having ordinary skill in the art to combine the settling time of Zacharias with the steerable display of Optotune to improve the change of speed of operation performance (see Zacharias, para [0193]- Adding all treatment times, settling times and re-aiming times gives a total best case scenario pan-photocoagulation treatment duration of under 2 minutes...; para [0022]- Another object is the provision of such apparatus and method which significantly reduces the time required for such procedures being more efficient and well tolerated; para [0087]- Beam steering mechanism 128 is selected to provide dual axis steering capabilities and a high speed of operation. Step settling times below 2 milliseconds for steps above 400 microns at the retinal plane are preferred for practicing this invention to its full potential).

Claims 1-18 have industrial applicability as defined by PCT Article 33(4) because the subject matter can be made or used by industry.