reflected light from the measurement region to be received from the planar measurement region and diverted along a vertical path to a photoreceiver arrangement.

US 7,746,449 discloses a light detection and ranging system, comprising a collimated laser beam, a mirror unit rotating around a scan axis, the mirror unit including a receiving portion and a transmitting portion offset by an angle about the scan axis relative to a surface plane of the receiving portion, respective centroids of the receiving and transmitting portions being positioned at a common point on the scan axis.

US 7,969,558 discloses a lidar-based 3-D point cloud system comprising a support structure, a plurality of laser emitters supported by the support structure, a plurality of avalanche photodiode detectors supported by the support structure, and a rotary component configured to rotate the plurality of laser emitters and the plurality of avalanche photodiode detectors at a speed of at least 200 RPM (rotations per minute).

US application 2011/0216304 discloses a LiDAR-based sensor system comprising a base, head assembly, a rotary component configured to rotate the head assembly with respect to the base, the rotation of the head assembly defining an axis of rotation; an electrical motherboard carried in the head assembly, the motherboard defining a plane and being positioned substantially parallel to the axis of rotation, a plurality of photon transmitters mounted to a plurality of emitter circuit boards, the plurality of emitter circuit boards being mounted directly to the motherboard, and a plurality of detectors mounted to a plurality of detector circuit boards, the plurality of detector circuit boards being mounted directly to the motherboard.

SUMMARY OF THE INVENTION

According to a first aspect of the present invention, there is provided a time-of-flight lidar apparatus comprising: a single optical emitter sensing in one dimension; at least one photodetector; a spinning turret rotating said emitter and at least one photodetector; and an external case that is static to encase the spinning turret, wherein the entire body of the external case is a window that is visually opaque and essentially transparent to infrared radiation emitted by the emitter on the spinning turret.

As disclosed, there is provided a method for three-dimensional sensing utilizing a time-of-flight lidar apparatus comprising: a single optical emitter sensing in one dimension; at least one photodetector; a mechanical means of scanning in two dimensions said emitter and at least one photodetector.

An apparatus and method are used for three-dimensional sensing with a time-of-flight lidar sensor having a single emitter and at least one photodetector. Said single emitter can comprise a single laser, a single laser bar, or multiple lasers (preferably in the form of an integrated multi-laser chip, or co-packaged laser chips, or a multi-chip module in a single package), and in all three cases the emitter output is imaged to form a radiation pattern whose envelope is elongated to provide one-dimensional sensing. Said single emitter can also comprise a single laser coupled to

What is Claimed is:

1. A time-of-flight lidar apparatus comprising:

a) a single optical emitter sensing in one dimension;

b) at least one photodetector;

c) a spinning turret rotating said emitter and at least one photodetector; and

d) an external case that is static to encase the spinning turret, wherein the entire body of the external case is a window that is visually opaque and essentially transparent to infrared radiation emitted by the emitter on the spinning turret.

2. The apparatus of claim 1 wherein said single emitter comprises one of a set of elements including but not limited to:

a) a single laser imaged to form a radiation pattern whose envelope is elongated to provide one-dimensional sensing;

b) a single laser bar imaged to form a radiation pattern whose envelope is elongated to provide one-dimensional sensing;

c) a plurality of lasers integrated on one substrate and imaged to form a continuous radiation pattern whose envelope is elongated to provide one-dimensional sensing;

d) a plurality of lasers co-packaged and imaged to form a continuous radiation pattern whose envelope is elongated to provide one-dimensional sensing;

e) a single laser coupled to an optical phased array that images a beamformed radiation pattern whose envelope is elongated to provide one-dimensional sensing;

f) a single laser coupled to an optical phased array that sweeps a beamformed radiation pattern in one dimension to provide one-dimensional sensing;

g) a single laser coupled to a diffractive optical element to form a radiation pattern whose envelope is elongated to provide one-dimensional sensing;

h) a single laser coupled to a holographic optical element to form a radiation pattern whose envelope is elongated to provide one-dimensional sensing;

i) a single laser coupled to a lens to form a radiation pattern whose envelope is elongated to provide one-dimensional sensing.

3. The apparatus of claim 1 wherein said at least one photodetector comprises one of a set of elements including but not limited to:

a) single-photon avalanche diode arrays;

b) avalanche photodiodes;

c) positive-intrinsic-negative diodes.

4. The apparatus of claim 1 comprising a plurality of photodetectors in a form selected from a set comprising but not limited to:

a) integrated multi-photodetector chip;

b) co-packaged photodetector chips;

c) photodetection multi-chip module.

5. The apparatus of claim 1 wherein said mechanical means of scanning in two dimensions said emitter and said at least one photodetector is selected from a set comprising but not limited to:

a) spinning

b) mirror scanning

c) prism scanning

d) lens scanning

e) DOE scanning

f) HOE scanning

g) grating scanning