**3-D LiDAR Sensing**

Three-dimensional environment sensing enhances the detection and positioning of distant objects. Sensor data is processed and 3D maps are generated by applying various data processing algorithms. Currently, 3-D environment sensing includes usage Light Detection and Ranging (LIDAR), Image Processing using digital camera and Radio Detection and Ranging (RADAR). 3D imaging can be achieved using both scanning and non-scanning systems. "3D gated viewing laser radar" is a non-scanning laser ranging system that applies a pulsed laser and a fast gated camera.

Imaging LIDAR can be constructed using arrays of high speed detectors and modulation sensitive detector arrays typically built on single chips using CMOS and hybrid CMOS/CCD fabrication techniques. In these devices each pixel performs some local processing such as demodulation or gating at high speed, down converting the signals to video rate so that the array may be read like a camera. Using this technique many thousands of pixels / channels may be acquired simultaneously.[[1]](https://en.wikipedia.org/wiki/Lidar#cite_note-13) High resolution 3D LIDAR cameras use homodyne detection with an electronic CCD or CMOS [shutter](https://en.wikipedia.org/wiki/Shutter_(photography)).[[2]](https://en.wikipedia.org/wiki/Lidar#cite_note-Medina_A.2C_Gay.C3.A1_F.2C_and_Pozo_F_800.E2.80.93805_http:.2F.2Fwww.opticsinfobase.org.2Fjosaa.2Fabstract.cfm.3FURI.3Djosaa-23-4-800-14)” A coherent imaging LIDAR uses [synthetic array heterodyne detection](https://en.wikipedia.org/wiki/Synthetic_array_heterodyne_detection) to enable a staring single element receiver to act as though it were an imaging array[3].

There are a few 3D sensing techniques which include scanning imaging LIDAR and pulsed floodlight- illumination imaging LIDAR. Detection range is the limitation of these techniques. LIDAR is used to emit laser on distant object and measure the distance between LiDAR and the object. 3D images are generated on basis of the data collected by the LiDAR.

### There are many 3D LiDAR manufacturers with different scanning range. Top searches over the internet list them as Ocular Robotics, Konica Minolta's 3-D LiDAR, [Velodyne LiDAR](http://velodynelidar.com/), Quanergy, Structure and many more.

**Reference**

1. *Medina, Antonio. "Three Dimensional Camera and Rangefinder". January 1992. United States Patent 5081530.*
2. *Medina A, Gayá F, Pozo F (2006).*[*"Compact laser radar and three-dimensional camera"*](http://www.opticsinfobase.org/josaa/abstract.cfm?URI=josaa-23%E2%80%934%E2%80%93800)*. J. Opt. Soc. Am. A.****23****: 800–805.*[*Bibcode*](https://en.wikipedia.org/wiki/Bibcode)*:[2006JOSAA..23..800M](http://adsabs.harvard.edu/abs/2006JOSAA..23..800M).*[*doi*](https://en.wikipedia.org/wiki/Digital_object_identifier)*:*[*10.1364/josaa.23.000800*](https://dx.doi.org/10.1364%2Fjosaa.23.000800)*.*
3. *Strauss, C. E. M. (1994).*[*"Synthetic-array heterodyne detection: a single-element detector acts as an array"*](http://www.opticsinfobase.org/ol/abstract.cfm?id=12612)*. Opt. Lett.****19****: 1609–1611.*[*Bibcode*](https://en.wikipedia.org/wiki/Bibcode)*:[1994OptL...19.1609S](http://adsabs.harvard.edu/abs/1994OptL...19.1609S).*[*doi*](https://en.wikipedia.org/wiki/Digital_object_identifier)*:*[*10.1364/ol.19.001609*](https://dx.doi.org/10.1364%2Fol.19.001609)*.*