IOSR Journal of Engineering (IOSRJEN) **www.iosrjen.org**
ISSN (e): 2250-3021, ISSN (p): 2278-8719
PP 31-34

LIDAR : Advanced Method Of Survey And Mapping

Neha N. Pajankar[1] , Yogini Sawale[3] , Prof. Shital A. Navghare[5],
Aachal Harinkhede[2] , Ajinkya Pachare[4]

U.G. Student, Dept. of Civil Engineering TGPCET, Nagpur, India
U.G. Student, Dept. of Civil Engineering TGPCET, Nagpur, India
Asst. Professor, Dept. of Civil Engineering TGPCET, Nagpur, India
U.G. Student, Dept. of Civil Engineering TGPCET, Nagpur, India
U.G. Student, Dept. of Civil Engineering TGPCET, Nagpur, India

Abstract**—**Survey is the basic and major part of civil engineering. It has its own importance in all the sectors of civil works before, in between and also after the Construction works. Surveying of areas which are already situated is a thought task so to overcome this problems the innovative technologies have been introduced and one of them was LIDAR Technology . The time-consuming days of mapping by hand seem numbered, as geographic information system (GIS) , professional land surveyors (PLS) and others within the field of cartography awaken to the advantages of integrating light detecting and ranging (LIDAR) into their mobile mapping systems. This paper deals with the innovative ideas and enhanced property's and applications of LIDAR technology. We have given the reviews on the paper which are in existence on this technology. Our aim is to introduce this technology in today's developing world with our reviews which can help others to get aquented with technology. As in mobile mapping the LIDAR technology is reduced time. The LIDAR head containing 64 semiconductor laser which gives efficiency to making 3D map. In which we can take a minute readings to overcome errors. LIDAR is as like as radar except in LIDAR sensor replaces the radiowaves. Using LIDAR navigation is done by vehicle at 65 Km/h . Which automatically identify a 15 cm sized object at a distance 50m.

Keywords*-LIDAR technology, professional land surveyor, cartography, aquented*

I. Introduction

A LIDAR system combines a single narrow-beam laser with a receiver system. The laser produces an optical pulse that is transmitted, reflected off an object, and returned to the receiver. The receiver accurately measures the travel time of the pulse from its start to its return. With the pulse travelling at the speed of light, the receiver senses the return pulse before the next pulse is sent out. Since the speed of light is known, the travel time can be converted to a range measurement. Combining the laser range, laser scans angle, laser position from GPS, and laser orientation from INS, accurate x, y, z ground coordinates can be calculated for each laser pulse. Laser emission rates can be anywhere from a few pulses per second to tens of thousands of pulses per second. Thus, large volumes of points are collected.

II. Design

The two kinds of LIDAR detection schemes are "incoherent" or direct energy detection which principally measures amplitude changes of the reflected light and coherent detection. Coherent systems generally use optical heterodyne detection. This is more sensitive than direct detection and allows them to operate at much lower power, but requires more complex transceivers. Both types employ pulse models: either micropulse or high energy. Micropulse systems utilize intermittent bursts of energy. They developed as a result of ever-increasing computer power, combined with advances in laser technology. They use considerably less energy in the laser, typically on the order of one microjoule, and are often "eye-safe", meaning they can be used without safety precautions. High-power systems are common in atmospheric research, where they are widely used for measuring atmospheric parameters: the height, layering and densities of clouds, cloud particle properties, temperature, pressure, wind, humidity, and trace gas concentration such as ozone, methane, nitrous oxide, etc.

III. Components

LIDAR systems consist of several major components:

A. Laser

Define abbreviations and acronyms the first time they are used in the text, even after they have been defined in the abstract. Abbreviations such as IEEE, SI, MKS, CGS, sc, dc, and rms do not have to be defined. Do not use abbreviations in the title or heads unless they are unavoidable.

B. Flash LIDAR

The focal plane of a Flash LIDAR camera has rows and columns of pixels with ample "depth" and "intensity" to create 3D landscape models.[20] Each pixel records the time it takes each laser pulse to hit the target and return to the sensor, as well as the depth, location, and reflective intensity of the object being contacted by the laser pulse. Flash uses a single light source that illuminates the field of view in a single pulse. Just like a camera that takes pictures of distance, instead of colors.

C. Phased arrays

A phased array can illuminate any direction by using a microscopic array of individual antennas. Controlling the timing (phase) of each antenna steers a cohesive signal in a specific direction. Phased arrays have been used in radar since the 1950s. The same technique can be used with light. On the order of a million optical antennas are used to see a radiation pattern of a certain size in a certain direction. The system is controlled by timing the precise flash.

D. Microelectromechanical machines

Microelectromechanical mirrors (MEMS) are not entirely solid-state. However, their tiny form factor provides many of the same cost benefits. A single laser is directed to a single mirror that can be reoriented to view any part of the target field. The mirror spins at a rapid rate. However, MEMS systems generally operate in a single plane (left to right). To add a second dimension generally requires a second mirror that moves up and down. Alternatively, another laser can hit the same mirror from another angle.

E. Scanner and optics

Image development speed is affected by the speed at which they are scanned. Options to scan the azimuth and elevation include dual oscillating plane mirrors, a combination with a polygon mirror and a dual axis scanner. Optic choices affect the angular resolution and range that can be detected. A hole mirror or a beam splitter are options to collect a return signal.

F. Photodetector and receiver electronics

Two main photodetector technologies are used in LIDAR: solid state photodetectors, such as silicon avalanche photodiodes, or photomultipliers. The sensitivity of the receiver is another parameter that has to be balanced in a LIDAR design.

G. Position and navigation systems

LIDAR sensors mounted on mobile platforms such as airplanes or satellites require instrumentation to determine the absolute position and orientation of the sensor. Such devices generally include a Global Positioning System receiver and an Inertial Measurement Unit (IMU).

H. Sensor

LIDAR uses active sensors that supply their own illumination source. The energy source hits objects and the reflected energy is detected and measured by sensors. Distance to the object is determined by recording the time between transmitted and backscattered pulses and by using the speed of light to calculate the distance traveled. Flash LIDAR allows for 3D imaging because of the camera's ability to emit a larger flash and sense the spatial relationships and dimensions of area of interest with the returned energy. This allows for more accurate imaging because the captured frames do not need to be stitched together, and the system is not sensitive to platform motion resulting in less distortion.

IV. Applications

There are a wide variety of applications for LIDAR, in addition to the applications listed below, as it is often mentioned in National LIDAR dataset programs.

A. Agriculture

Agricultural robots have been used for a variety of purposes ranging from seed and fertilizer dispersions, sensing techniques as well as crop scouting for the task of weed control. LIDAR can help determine where to apply costly fertilizer. It can create a topographical map of the fields and reveal slopes and sun exposure of the farmland. Researchers at the Agricultural Research Service used this topographical data with the farmland yield results from previous years, to categorize land into zones of high, medium, or low yield. This indicates where to apply fertilizer to maximize yield.

B. Archaeology

LIDAR has many uses in archaeology, including planning of field campaigns, mapping features under forest canopy, and overview of broad, continuous features indistinguishable from the ground. LIDAR can produce high-resolution datasets quickly and cheaply. LIDAR-derived products can be easily integrated into a Geographic Information System (GIS) for analysis and interpretation.

LIDAR can also help to create high-resolution digital elevation models (DEMs) of archaeological sites that can reveal micro-topography that is otherwise hidden by vegetation. The intensity of the returned LIDAR signal can be used to detect features buried under flat vegetated surfaces such as fields, especially when mapping using the infrared spectrum. The presence of these features affects plant growth and thus the amount of infrared light reflected back.

C. Autonomous vehicles

Autonomous vehicles may use LIDAR for obstacle detection and avoidance to navigate safely through environments, using rotating laser beams. Cost map or point cloud outputs from the LIDAR sensor provide the necessary data for robot software to determine where potential obstacles exist in the environment and where the robot is in relation to those potential obstacles. Singapore's Singapore-MIT Alliance for Research and Technology (SMART) is actively developing technologies for autonomous LIDAR vehicles.

Fig. 1: Autonomous LIDAR vehicles

D. Surveying

Airborne LIDAR sensors are used by companies in the remote sensing field. They can be used to create a DTM (Digital Terrain Model) or DEM (Digital Elevation Model); this is quite a common practice for larger areas as a plane can acquire 3–4 km wide swaths in a single flyover. Greater vertical accuracy of below 50 mm can be achieved with a lower flyover, even in forests, where it is able to give the height of the canopy as well as the ground elevation. Typically, a GNSS receiver configured over a georeferenced control point is needed to link the data in with the WGS (World Geodetic System). LIDAR are also in use in hydrographic surveying. Depending upon the clarity of the water LIDAR can measure depths from 0.9m to 40m with a vertical accuracy of 15 cm and horizontal accuracy of 2.5m.

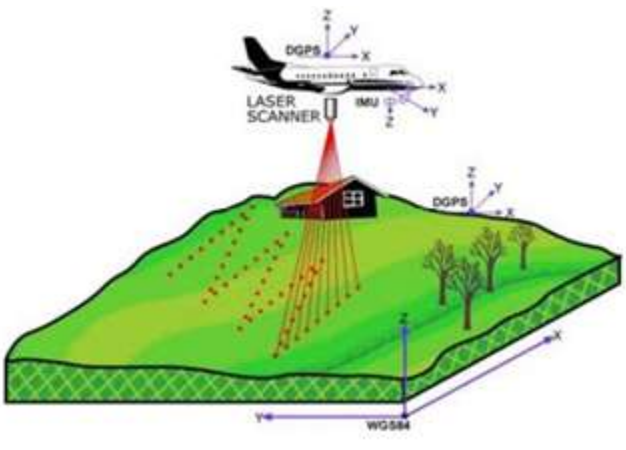

Fig. Airbone-LIDAR System

E. Geology and soil science

High-resolution digital elevation maps generated by airborne and stationary LIDAR have led to significant advances in geomorphology (the branch of geoscience concerned with the origin and evolution of the Earth surface topography). The LIDAR abilities to detect subtle topographic features such as river terraces and river channel banks, to measure the land-surface elevation beneath the vegetation canopy, to better resolve spatial derivatives of elevation, and to detect elevation changes between repeat surveys have enabled many novel studies of the physical and chemical processes that shape landscapes. LIDAR is also used in structural geology and geophysics as a combination between airborne LIDAR and GPS for the detection and study of faults, for measuring uplift.

F. Atmosphere

Initially, based on ruby lasers, LIDAR for meteorological applications was constructed shortly after the invention of the laser and represent one of the first applications of laser technology. LIDAR technology has since expanded vastly in capability and LIDAR systems are used to perform a range of measurements that include profiling clouds, measuring winds, studying aerosols, and quantifying various atmospheric components. Atmospheric components can in turn provide useful information including surface pressure (by measuring the absorption of oxygen or nitrogen), greenhouse gas emissions (carbon dioxide and methane), photosynthesis (carbon dioxide), fires (carbon monoxide), and humidity (water vapor). Atmospheric LIDARs can be either ground-based, airborne or satellite depending on the type of measurement. Atmospheric LIDAR remote sensing works in two ways –

- by measuring backscatter from the atmosphere, and
- by measuring the scattered reflection off the ground (when the LIDAR is airborne) or other hard surface.

G. Mining

For The calculation of ore volumes is accomplished by periodic (monthly) scanning in areas of ore removal, then comparing surface data to the previous scan. LIDAR sensors may also be used for obstacle detection and avoidance for robotic mining vehicles such as in the Komatsu Autonomous Haulage System (AHS) used in Rio Tinto's Mine of the Future.

V. Conclusion

There are many conclusion which can be drawn from this information paper presented here. This deals with various use and research on LIDAR technology itself, specifically the social and economic benefits, the mapping and surveying industry . Thous are listed below not particularly in order but in way to get an ease:

- This technology represent a new source of information related to extracting key surface within urban environment.
- LIDAR technology provided an invaluable tool for fast assessment .
- As mobile mapping system collect hundred of millions of LIDAR points. Velodyne`s. version for LIDAR technology sophisticated 3D understanding or visualization of the environment requirement.
- This technology has also got developed to replace humans with robots.
- LIDAR data have the ability to capture and represent our physical environment which are not possible before. The 3D elevation programme C3DEP Of the USGS for us is an important area where LIDAR data is play an important role.

References

[1]. Nicholas R. Goodwin, Nicholas C. Coops, Thoreau Rory Tooke, Andreas Christen, and James A. Voogt :Can. J. Remote Sensing, Vol. 35, No. 3, pp. 297–309, 2009

[2]. "Elon Musk Calls Out LIDAR Tech as "A Crutch" in Autonomous Vehicles". futurism.com. 2018-02-08. Retrieved 23 June 2018.

[3]. Carter, Jamie; Keil Schmid; Kirk Waters; Lindy Betzhold; Brian Hadley; Rebecca Mataosky; Jennifer Halleran (2012). "LIDAR 101: An Introduction to LIDAR Technology, Data, and Applications." (NOAA) Coastal Services Center" (PDF). Coast.noaaa.gov. p. 14. Retrieved 2017-02-11.

[4]. Philosophical Magazine and Journal of Science, 1930, Series 7, Volume 9, Issue 60, pp. 1014–1020

[5]. 'Experimental Advanced Advanced Research LIDAR', USGS.gov. Retrieved 8 August 2007.

[6]. "LIDAR—Light Detection and Ranging—is a remote sensing method used to examine the surface of the Earth". NOAA. Archived from the original on June 4, 2013. Retrieved June 4, 2013

[7]. M. Young, The Technical Writer's Handbook. Mill Valley, CA: University Science, 1989.

[8]. Cracknell, Arthur P.; Hayes, Ladson (2007) [1991]. Introduction to Remote Sensing (2 ed.). London: Taylor and Francis. ISBN 978-0-8493-9255-9. OCLC 70765252