LiDAR Technology [UPSC Science & Technology Notes]

LiDAR technology is a remote sensing method which makes use of light in the form of a pulsed laser for measuring variable distances to the subject (Earth).

What is LiDAR?

LiDAR stands for **Li**ght **D**etection **a**nd **R**anging. It is a ranging technology in which the distance of an object is measured by firing beams of light at the object and using the time as well as the wavelength of the reflected beam of light to estimate the distance. These light pulses – when combined with other data help in generating high-resolution, accurate 3D information of the object.

How does a LiDAR system work?

LiDAR follows a simple principle. A laser light is thrown at an object on the Earth's surface and the time it takes for the light to return to the LiDAR source is calculated.

- Mostly, a LiDAR instrument comprises a laser, a scanner, and a specialized GPS (Global Positioning System) receiver.
- Other elements which play an important role in the data collection and analysis are the photodetector and optics.
- Helicopter and airplanes are generally used to acquire LiDAR data over broad areas.
- Considering the speed of light, the process of determining the precise distance using LiDAR is incredibly fast.

Applications of LiDAR Technology

LiDAR Technology has immense applications over wide-ranging areas. Some of the important applications are discussed in this section.

- LiDAR uses light across different wavelengths including ultraviolet, visible, or near infrared light to image objects and it's, as such, able to detect all kind of material compositions, including non-metals, rocks, rain, chemical compounds, aerosols, clouds and even single molecules.
- Airborne LiDAR is installed on a helicopter or drone for data collection.
- Terrestrial LiDAR systems are installed on moving vehicles or tripods on the earth surface for collecting accurate data points. These can be further classified into static LiDAR and mobile LiDAR.
- The technology is mostly used for ground-based surveys and production of high-resolution maps.
- LiDAR technology is used in some applications (Laser Imaging) to create a 3D representation of the object.
- The aerial LiDAR survey technique, for the first time for any railway project in India, was adopted for the Mumbai-Ahmedabad High Speed Rail Corridor owing to its high accuracy.

- The technology is used when the definite depth of the ocean's surface needs to be determined to locate the object in the event of a maritime accident or for other research purposes.
- It is used for calculating phytoplankton fluorescence and biomass in the surface of the ocean.
- Geoscientists use this technology for unearthing secrets related to geomorphology.
- The LiDAR technology is also used in carrying out security operations.

What are the limitations of LiDAR?

Some of the limitations of LiDAR are as under.

- LiDAR systems perform poorly in heavy rain, fog or snow conditions.
- Pulses fired in certain kind of LiDARs become ineffective at certain altitudes. It has a low operating altitude of between 500 meters and 2000 meters.
- It is not suitable to be used in dense forests and thick vegetations.

How is it similar to RADAR and SONAR?

LiDAR technology is quite similar to that of RADAR and SONAR that make use of the principle of reflection of waves for the detection of an object and for estimating the distance. However, while RADAR is based on radio waves and SONAR is based on sounds, LIDAR is based on light beams i.e, Laser.