

LIDAR Laser Beam Returns

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Range and Reflectance

- LIDAR pulse beams are short-wavelength
 - Ultraviolet
 - Visible
 - Near-infrared
- Can image objects nearly the same wavelength, or larger
- Returns data on 3D range and reflectance

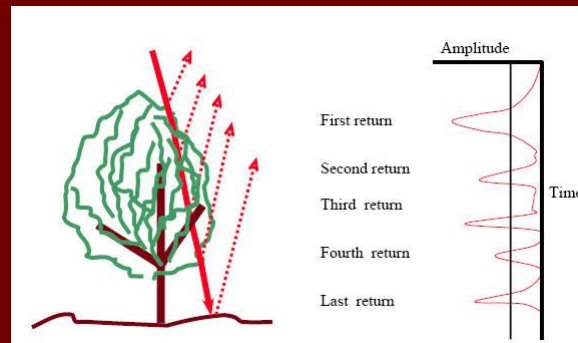
LIDAR Advantages

- Dielectric properties of objects determine reflectivity
- Radar misses objects with weak reflectivity
- Certain materials reflect stronger in visible wavelengths than microwave
- LIDAR pulses produce backscattering reflections that can detect very small objects
 - 10 microns in visible
 - 250 μm in UV

Reflection Intensity

- Intensity of reflection useful ancillary data
- Pulse size, frequency and wavelength is varied to image different compounds
- 600-1064 μm lasers most common for scientific applications
- 532 μm laser for bathymetry: less attenuation through water
- 1.064 μm near-infrared pulse for topography:
 - Snow – 70-90%
 - Mixed Forest – 50-60%
 - Black Asphalt – 5%

Multiple Return LIDAR



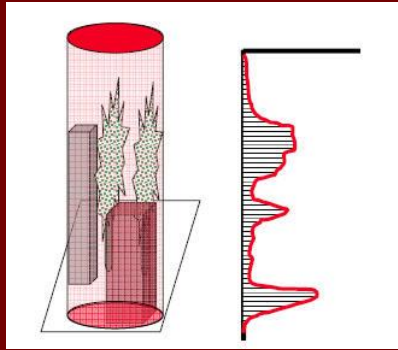
Source: Lohani, Bharat.

Airborne Altimetric LiDAR: Principle, Data Collection, Processing and Applications.

Multiple Return LIDAR

- Radar beam splits as it hits objects
- Can collect up to four returns
- Options:
 - First
 - First/last
 - All four
- First-return/last return data can show object height
 - Last return doesn't always reach the ground

Full Wave Form LIDAR



*Source: Lohani, Bharat.
Airborne Altimetric LIDAR: Principle, Data Collection, Processing and Applications.*

Full Wave Form LIDAR

- Echoes are sampled at small regular intervals
- Sampling starts before first echo and ends after last echo
- Returns data stream rather than discrete time-stamped points
- Optimal for intricate surfaces, such as forest canopy

Discussion Questions

- What radar size/electromagnetic spectrum range is most typically used on topographic LIDAR imaging?
- What is the difference between multiple return and full wave form LIDAR?
- Which is more suited to forest canopy imaging?
- What is the primary drawback of first/last multiple return analysis?

References

- Lohani, Bharat. Airborne Altimetric LiDAR: Principle, Data Collection, Processing and Applications.
http://home.iitk.ac.in/~blohani/LiDAR_Tutorial/Airborne_AltimetricLidar_Tutorial.htm
- Lillesand, T. M., Kiefer, R. W., and Chipman, J. W. 2004. Remote Sensing and Image Interpretation, 5th edition. John Wiley & Sons.
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