

What LIDAR Is:

- **L**ight **D**etection **A**nd **R**anging
- Active Sensing System
 - Uses its own energy source, not reflected natural or naturally emitted radiation.
- Day or Night operation.
- Ranging of the reflecting object based on time difference between emission and reflection.
- Direct acquisition of terrain information, whereas photogrammetry is inferential.

LIDAR slides are provided by **Mike Renslow, Spencer B. Gross, Inc.**

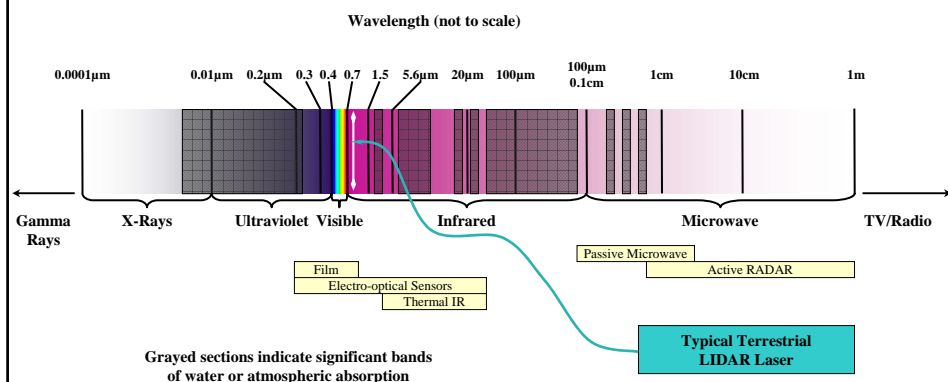
What LIDAR Is Not:

- **NOT** Light/Laser Assisted RADAR
 - RADAR uses electro-magnetic (EM) energy in the radio frequency range; LIDAR does not.
- **NOT** all-weather
 - The target **MUST** be visible. Some haze is manageable, but fog is not.
- **NOT** able to 'see through' trees
 - LIDAR sees around trees, not through them. Fully closed canopies (rain forests) cannot be penetrated.
- **NOT** a Substitute for Photography
 - For **MOST** users, LIDAR intensity images are **NOT** viable replacements for conventional or digital imagery.

LIDAR Characteristics

- Vertical accuracy for commercial applications at 15 cm on discrete points
- Capable of collecting millions of elevation points per hour – much faster than traditional methods
- Produces datasets with much greater density than traditional mapping
- Some systems capable of capturing multiple returns per pulse and/or intensity images
- Supported by rigorous QA/QC – similar to traditional surveying principals

The Electro-Magnetic Spectrum



LIDAR Operational Theory

- A pulse of light is emitted and the precise time is recorded.
- The **reflection** of that pulse is detected and the precise **time** is recorded.
- Using the constant speed of light, the delay can be converted into a “slant range” distance.
- Knowing the position and orientation of the sensor, the XYZ coordinate of the reflective surface can be calculated.

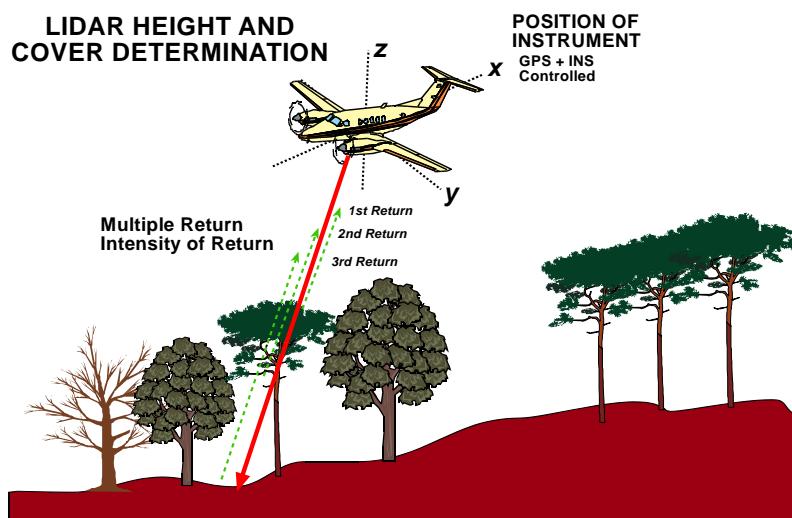
LIDAR Instrumentation

- Laser Source
- Laser Detector
- Scanning mechanism & controller
- Electronics for timing emissions & reflections
- Airborne GPS (position, speed, direction)
- Inertial Measurement Unit (orientation angles)
- High Performance Computer Resources
- High Capacity Data Recorders

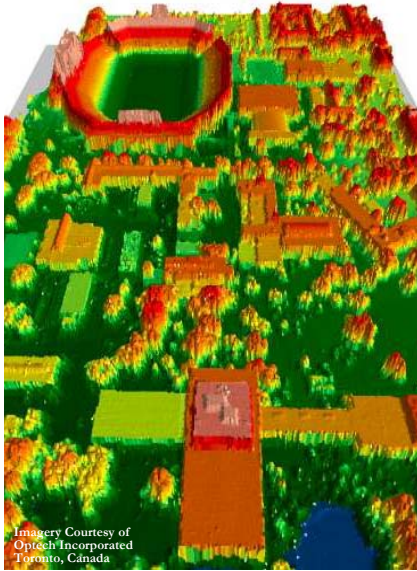
Multiple vs. Single Returns

- Many returns from Single-return systems are from the canopy top and must be discarded during vegetation removal.
- With Multiple-return systems, the 1st returns are also from the canopy top, but successive returns will come from lower surfaces, such as vegetation and the ground.
- Multiple Returns result in more ground points in wooded areas and a more reliable surface model.

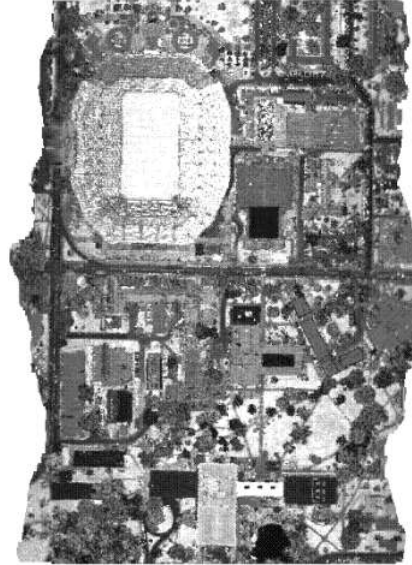
Multiple Returns



LIDAR Return Intensity



Imagery Courtesy of
Optech Incorporated
Toronto, Canada

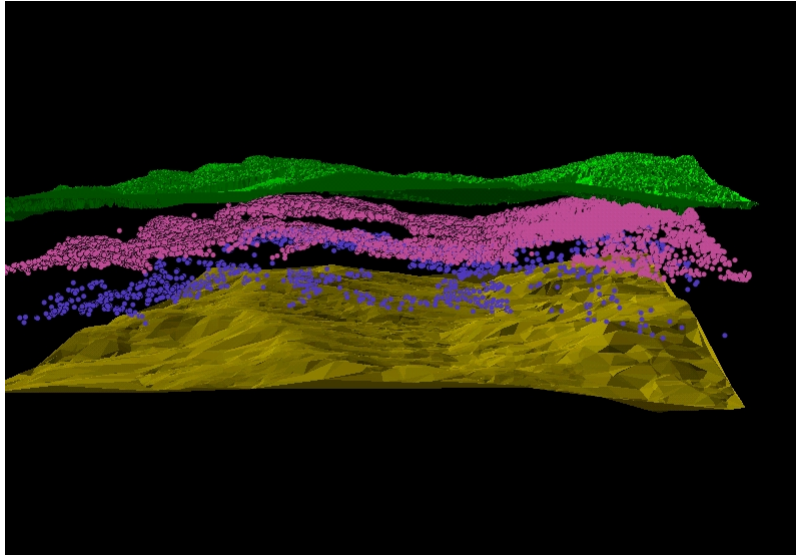


Optech

Canopy “Penetration”

- Multiple-return LIDAR systems will usually provide more points on the ground than either single-return systems (all first or all last) OR conventional photogrammetric collection.
- Surface models for the bare earth in wooded areas are more reliable from Lidar.
- Areas with extremely dense canopy (i.e., dark) which do not have adequate LIDAR penetration can be delineated as “Obscured Areas”, as in conventional mapping.

LIDAR Multiple Returns in 3D



First Surface Model (Primary Returns), Second Returns, Third Returns, and Bare Earth Surface Model

LiDAR Data Analysis – Interpolation & Classification

