Lidar: The Journey of a Laser Beam

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Specifications of the Lidar Sensor at the CC GIS lab:
- 100 m Range
- ±3 cm (accuracy)
- 360° view
- 903 nm wavelength lasers
- 5-20 Hz spin rate
- 30° vertical view
- 600,000 points/s

Electromagnetic view*:
Light reflects when it changes from one medium to another that has a different index of refraction. Percent reflectance, \( R \), can be expressed in terms of these two indices of refraction,
\[
R = \left( \frac{n_2}{n_1} \right) \left( \frac{n_1}{n_2} \right)^2
\]

Absorption and Attenuation:
903 nm wavelength light (red line) does not get absorbed much by the components of the earth’s atmosphere. Infrared light is often chosen for above ground Lidar sensors, while green light (not absorbed much by water) is used in Bathymetry.

Lidar Basics:
Speed of light, transmitted times, received times are used to determine distance travelled.

\[
D = v \Delta t
\]
\[
2L = c(t_f - t_i)
\]

Lidar Imaging:
Lidar imaging uses a point cloud of calculated distances to form this image of settlements around an ancient temple in Cambodia, Beng Mealea.

Lidar Mapping Application:
Lidar imaging uses a point cloud of calculated distances to form this image of settlements around an ancient temple in Cambodia, Beng Mealea.

Laser Beam:
Velodyne sensor uses 903 nm wavelength light (Infrared light).

Plane wave reflection: Light wavelets form new wave fronts that form two right triangles that share the same hypotenuse.
\[
\frac{\sin \theta_I}{BD} = \frac{\sin \theta_R}{AC}
\]
\[
\theta_I = \theta_R
\]
Angle of Incidence = Angle of Reflection

The Law of Reflection

Hecht 1974

Roughness of surfaces

903nm wavelength light (red line) does not get absorbed much by the components of the earth’s atmosphere. Infrared light is often chosen for above ground Lidar sensors, while green light (not absorbed much by water) is used in Bathymetry.