



LANDPRO

Make the most of your land

LiDAR and Spectral Reflectance for Advanced Vegetation Monitoring

1

Company & Speaker Background









ANDY BURRELL
Aerial Systems Manager

Freephone: 0800 023 318
Mobile: 027 223 5753

Landpro Limited
Cromwell
13 Pines Hill Drive
PO Box 402
Cromwell 9302
New Zealand
New Plymouth
Cromwell
Gore
www.landpro.co.nz

Surveying

Aerial Survey & Mapping

Environmental & Technical

Planning & Resource Management

2

Presentation Overview

- Remote Sensing Basics
- What is LiDAR
- LiDAR Vegetation Metrics
- Multi and Hyperspectral imagery
- Vegetation Analytics
- Bringing the data together for meaningful analytics
- Questions and Discussions

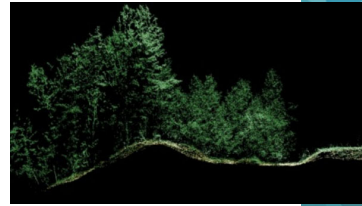
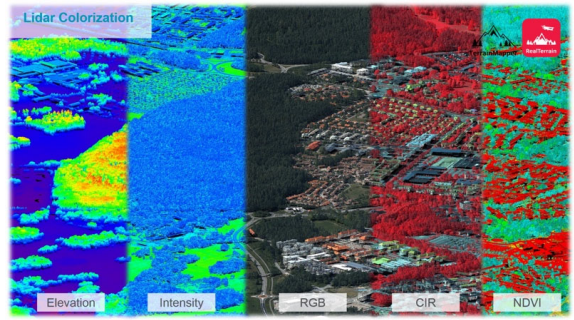
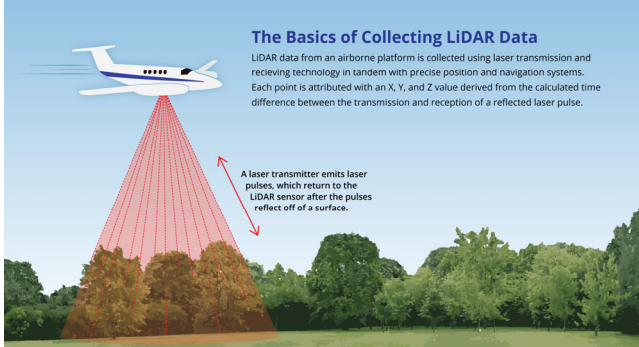
3

What is LiDAR

neon

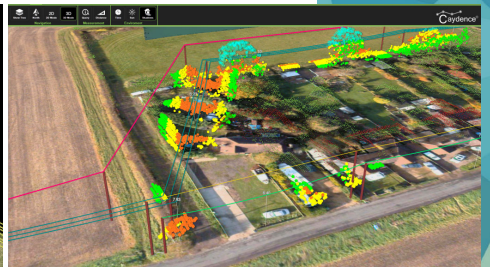
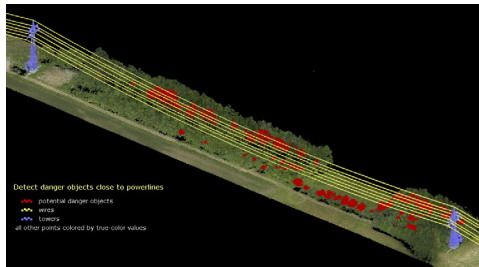
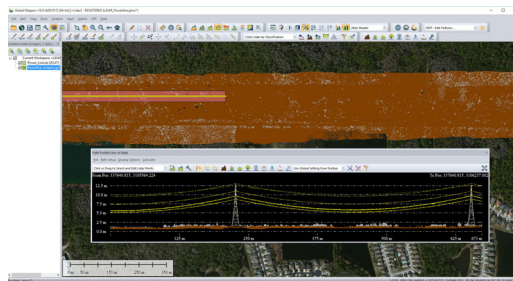
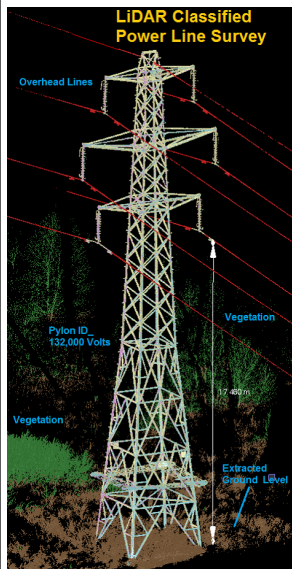
4

Active LiDAR Sensors



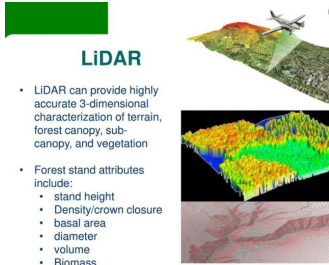
5

Typical LiDAR for Powerline Industry



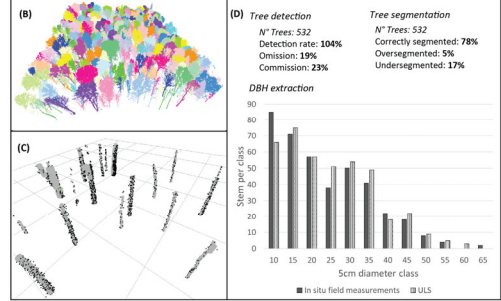
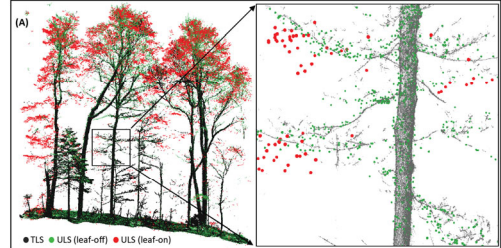
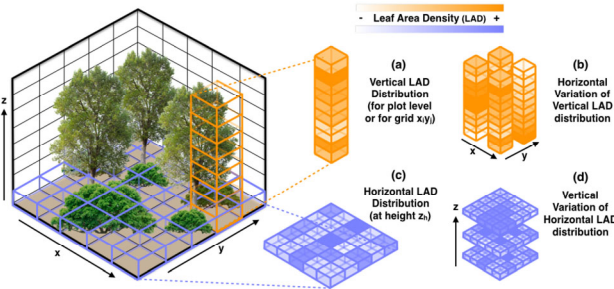
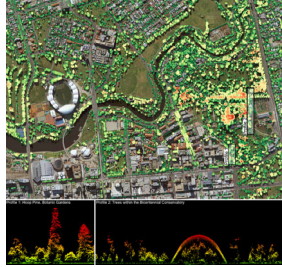
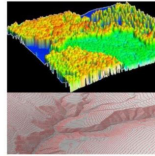
6

LiDAR Vegetation Metrics



LiDAR

- LiDAR can provide highly accurate 3-dimensional characterization of terrain, forest canopy, sub-canopy, and vegetation
- Forest stand attributes include:
 - stand height
 - Density/crown closure
 - basal area
 - diameter
 - volume
 - Biomass
 - Other



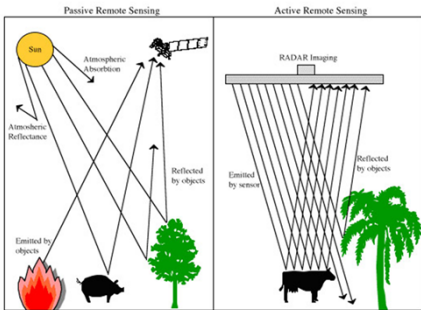
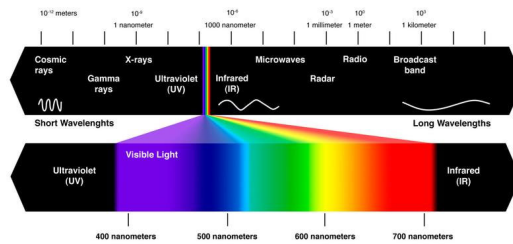
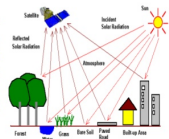
7

So what is remote sensing?

INTRODUCTION TO REMOTE SENSING

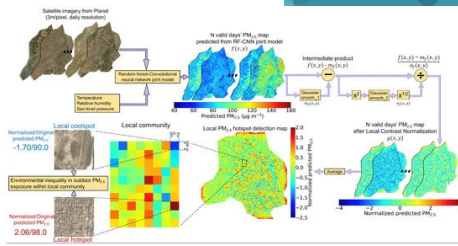
Definition :

Remote sensing is an art and science of obtaining information about an object or feature without physically coming in contact with that object or feature




Active sensors emit energy in order to scan objects and areas whereupon a sensor then detects and measures the radiation that is reflected or backscattered from the target. RADAR and LiDAR are examples of active remote sensing where the time delay between emission and return is measured, establishing the location, speed and direction of an object.

Passive sensors gather radiation that is emitted or reflected by the object or surrounding areas. Reflected sunlight is the most common source of radiation measured by passive sensors. Examples of passive remote sensors include film photography, infrared, charge-coupled devices, and radiometers.



8


Multispectral and Hyperspectral Imaging Sensors



Leica ADS100 Digital Pushroom Sensor

- Full colour RGBN in forward, backward and nadir
- Swept width of 20,000 pixels
- Highest data acquisition efficiency
- More flexible stereo interpretation
- Embedded Novatel SPAN GNSS/IMU system
- End-to-end workflow from mission planning to orthophoto
- Highest level processing performance

... when it has to be right **Leica Geosystems**



Broadband

Visible	SWIR	LWIR
---------	------	------

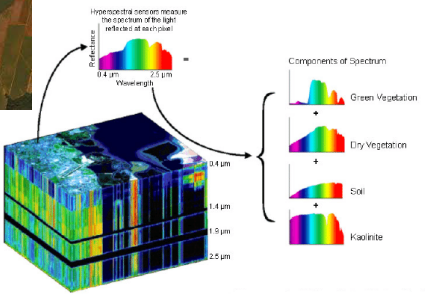
Multispectral

Band	Band	Band	Band	Band	Band	Band
1	2	3	4	5	7	6
45-52	52-60	63-69	79-90	1.55-1.75	2.08-2.35	10.4-12.4

Hyperspectral

100s of Bands

Hyperspectral Imaging



Hyperspectral imaging means in the spectrum of the light reflected at each pixel.

Components of Spectrum:


- Green Vegetation
- Dry Vegetation
- Soil
- Kadiolite

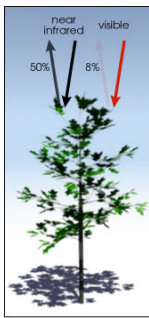
9

Normalized difference vegetation index

$$NDVI = \frac{(NIR - Red)}{(NIR + Red)}$$


NDVI always ranges from -1 to +1.





near infrared: 50%
visible: 8%

$$\frac{(0.50 - 0.08)}{(0.50 + 0.08)} = 0.72$$



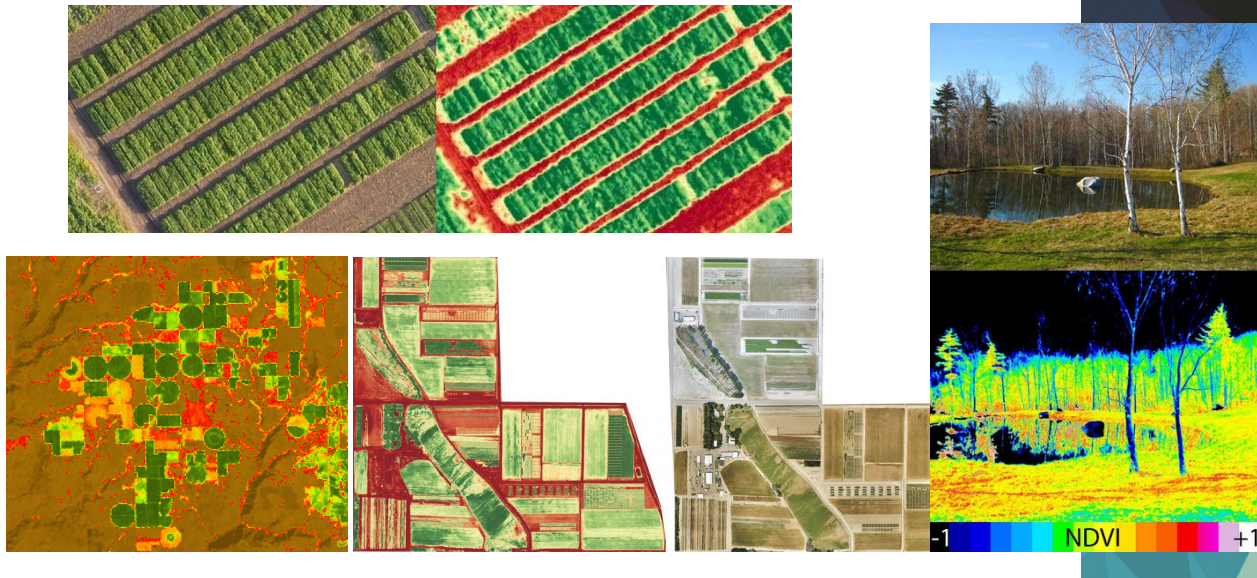
near infrared: 40%
visible: 30%

$$\frac{(0.4 - 0.30)}{(0.4 + 0.30)} = 0.14$$

Normalized Difference Vegetation Index (NDVI) quantifies vegetation by measuring the difference between near-infrared (which vegetation strongly reflects) and red light (which vegetation absorbs).

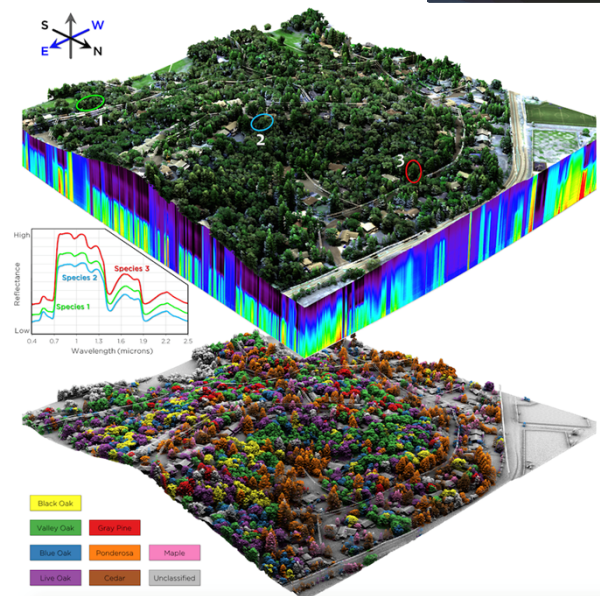
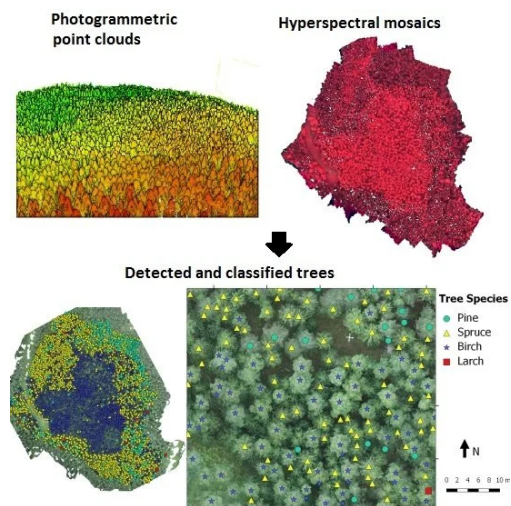
10

NDVI Examples from Multispectral



11

Species Analysis from Hyperspectral



12

Growth and AI predictions

Determine the associations between phenotypes and spectral information

(a) $R^2=0.82$ Branching height (m) vs Tree height (m)

(b) $R^2=0.88$ Crown length (m) vs Tree height (m)

(c) $R^2=0.79$ Crown area (m²) vs Tree height (m)

(d) 3D point cloud of a tree (50m x 50m)

(e) 3D model of a tree (70m)

Water stress

- Stem water potential
- Stomatal conductance
- Canopy temperature

Architecture parameters

- Canopy volume
- Crown diameter
- Tree height
- Leaf area
- Leaf area index

Pigments and nutrients

- Chlorophyll content
- Anthocyanin content
- Nutritional content

Degree of disease

Biochemical parameters

- Fruit dry weight
- Soluble solids
- Titrate acidity

13

Bringing it back to your networks

Automated Complex 3D Shapes
using AI & Cloud Compute

Automated Linking of New & Old Data

Compression of Complex Big Data
for utility use cases

Assigning Costs, Urgency and Resourcing

Classified LiDAR & 3D Model & Measurements

Classified LiDAR (by-product)

Full Digital Twin - assets & veg

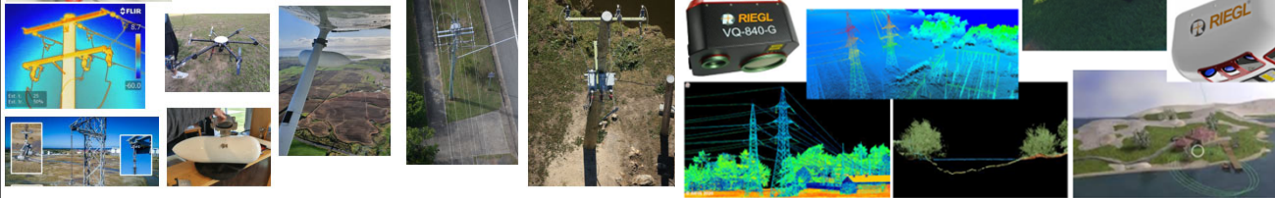
Image of Pole

14

Landpro Powerline Systems




Landpro VUX 840G LiDAR sensor



15

Questions and Discussion



ANDY BURRELL
Aerial Systems Manager

Freephone 0800 023 318
Mobile 027 223 5753

Landpro Limited
Cromwell
13 Pinot Noir Drive
PO Box 302
Cromwell 9342
New Zealand
New Plymouth
Cromwell
Gore
www.landpro.co.nz

16