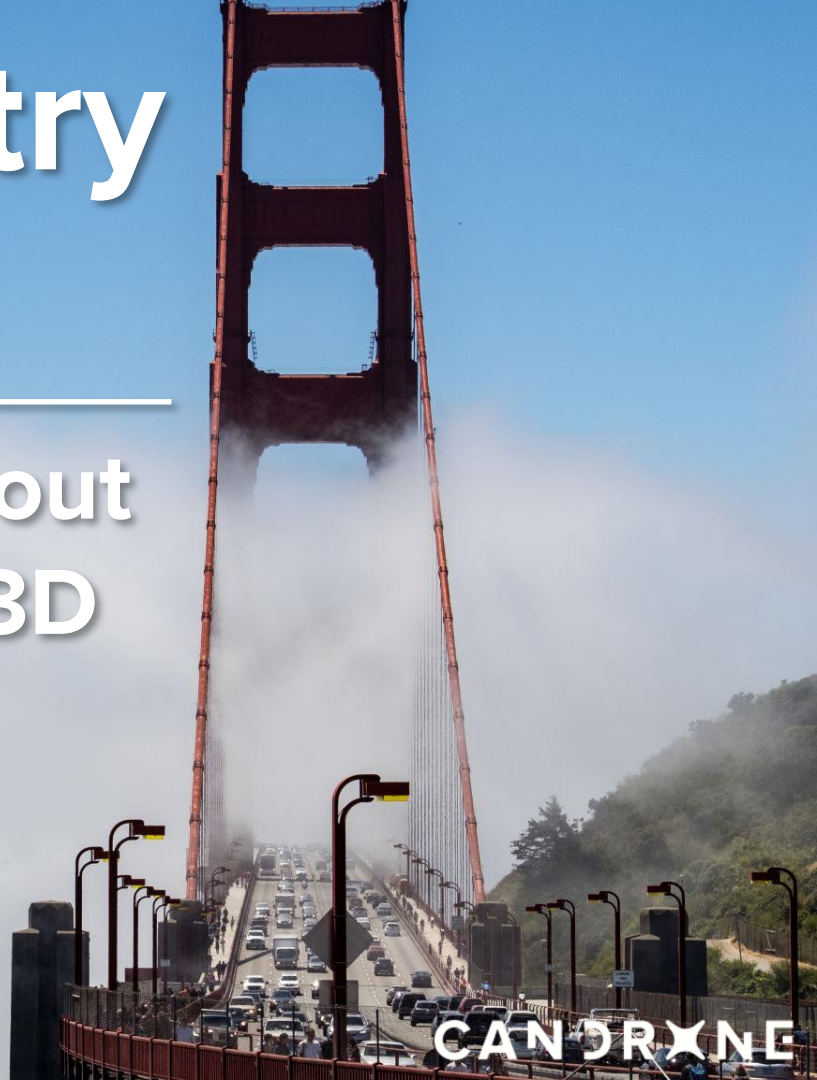
Photogrammetry + LiDAR

The Facts and Myths About Modelling Our World in 3D via UAV



Who Am I?

- Zane White
- Geospatial Data Technician
- Data Processing, Training
- Candrone
- BSc Environmental Geoscience and Geomatics at the University of Guelph
- GIS, Geosciences, Surface Water Detection

Who Is Candrone?

- Founded in 2009
- End-to-end solutions for numerous industries
- Data collection and processing
- Field work
- Training and certification programs
- Client-support
- Rentals and sales

OUR CLIENTS

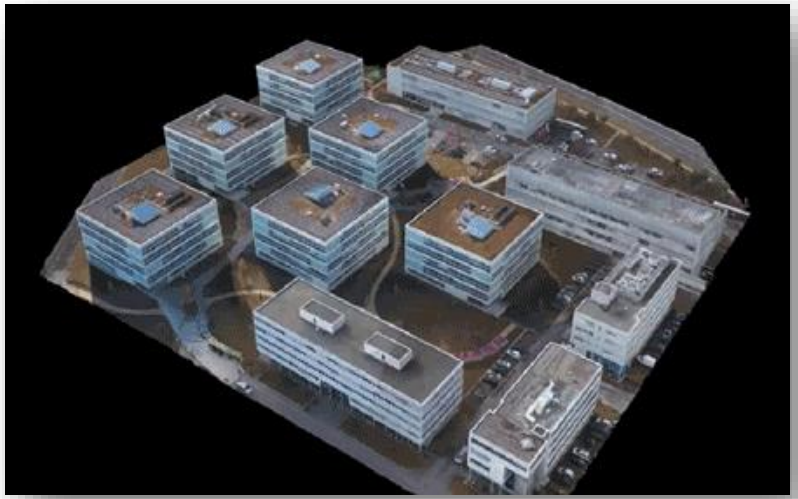
- Candrone services over 18,000 clients
- Clients span government, university, mining, surveying, forestry, among other industries

1. Photogrammetry
2. LiDAR
3. Topics and Terms
4. Common Errors
5. How Are Drones Involved?
6. How to Integrate

WHAT IS PHOTOGRAMMETRY?

Photogrammetry is the science of obtaining reliable information about the properties of surfaces and objects through images, without physically touching the objects. It is a form of remote sensing, a science of analyzing our world without needing to physically touch it.

Photogrammetry produces maps & precise three-dimensional positions of points.



History of Photogrammetry

In 1855: **Mr. Nadir** obtained the **first oblique aerial photo**, from a hot air balloon!

In 1888 Roll Film was invented and Kodak revolutionized the **accessibility** of photogrammetry (and photography).

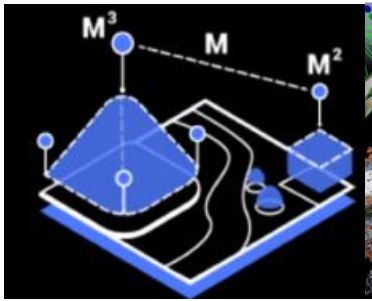
The U.S. Geological Survey began to use photogrammetry for **topographic mapping** in 1904.

In 1924 Earl church & Otto von Gruber established Projective Equations: This equation takes into account 3 pairs of points on each image to **line up 2 images.**

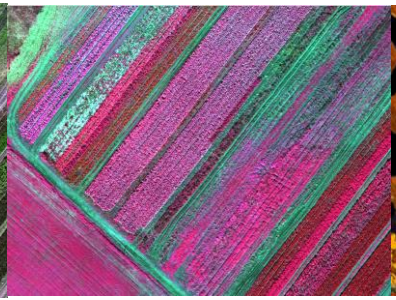
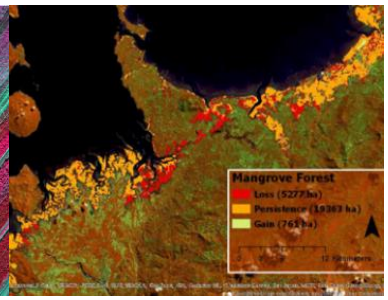
Photograph via Mansell/The LIFE Picture Collection/Getty

Overview of Photogrammetry Applications and its Value:

Construction and Surveying: Photogrammetry is great for project planning, cut fill volumes, stockpile management, progression report monitoring, etc.
Engineering Inspections: Linear distance measuring from remote locations + Site surveys help project management
Agricultural & Forestry : NDVI (vegetation health) mapping, pest identification, soil analysis site selection, vegetation damage analysis.
Environmental Sciences: Floodplain mapping, erosion mapping, landslide mapping, land cover change analysis
Additional application areas: Mining, real estate, roof inspections, insurance inspections, video games, medical sciences, urban planning.





What is a 3D Point Cloud?

- 3D point clouds are thousands of georeferenced 3D points produced by using an **algorithm** called Structure from Motion (SfM) to **overlap images.**
- SfM uses a **pixel based reconstruction** technique to generate image based point clouds.
- These 3D point clouds are then very powerful for making highly accurate Orthophoto, DSM and DEM models.

What is Image Overlap and How Much Overlap Do I Need?

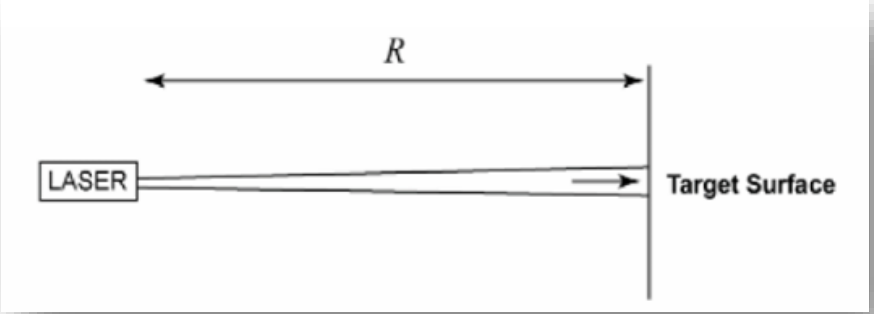
- Overlap allows us to compare the same point in several images and improves accuracy of triangulation.
- Image overlap helps to eliminate ellipsoid error.
- Image overlap is required if you want to stitch images together into an orthomosaic map or 3 dimensional model. In mapping software (such as Pix4D or Agrisoft), overlapping images makes tie points with those neighbouring images to tie them together.
- 2 types of overlap: frontal and side

Overlap for different types of projects

	Minimum overlap (not good for forests, snow or lakes and fields)	Double grid mission: for facade mapping and more detail	Forestry Vegetation Flat terrain/fields Snow/Sand	Survey Grade	Corridors: Roads, railway, rivers
Frontal	75%	80%	85%	80%	85%
Side	60%	70%	70%	80%	60%

What is LiDAR?

- LiDAR = Light Detection And Ranging
- Active form of remote sensing
- Measures the distance to target surfaces using narrow beams of near-infrared light (e.g.1064 nanometers).
- Near infrared is used because vegetation highly reflects near infrared light.
- 30-50% overlap in data collection



How Does LiDAR Work?

LASER

Laser ranging for accurate distance measurement

GPS

Geographic position and the height of the sensor

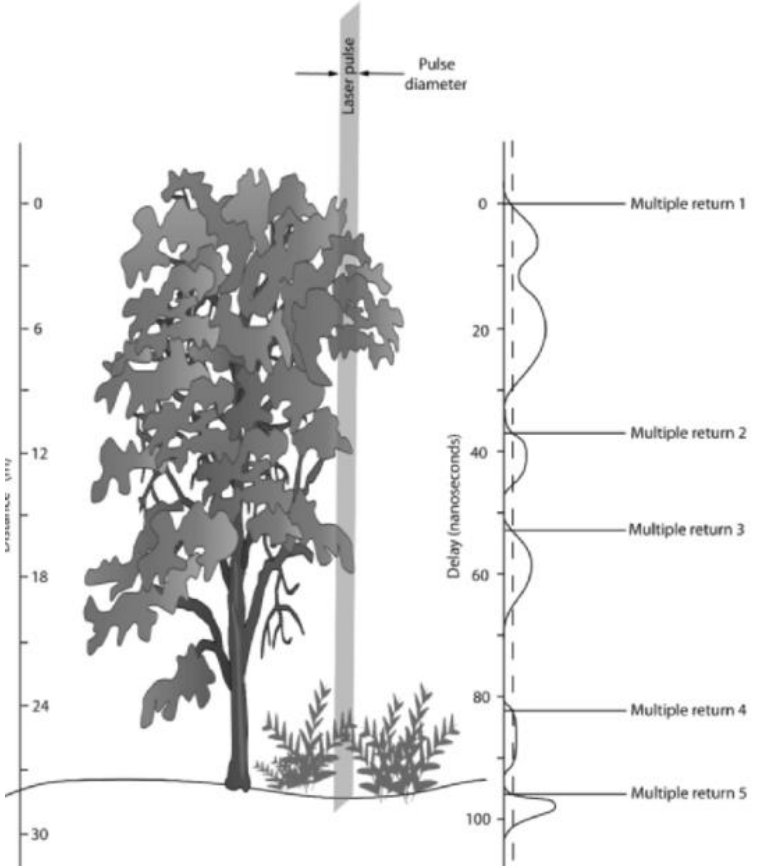
IMU

Aircraft attitude measurements using an inertial measurement unit (IMU) to record the precise orientation of the sensor

What Are Returns?

Lidar sensors started out having single return capability, but now lidar sensors are capable of recording up to 5 measurements from one outgoing laser pulse. The L1 and V70 are capable of 3 returns! So you are able to get some foliage and ground at once!

What's the difference between a pulse and a return? Pulse is what goes out of the LiDAR sensor and the ‘return’ is what comes back.



SCANNING MODES

NON-REPETITIVE CIRCULAR SCANNING

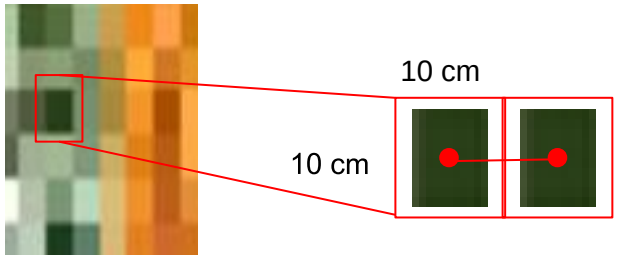
- Better coverage
- Traditional mapping
- 70.4° * 77.2°

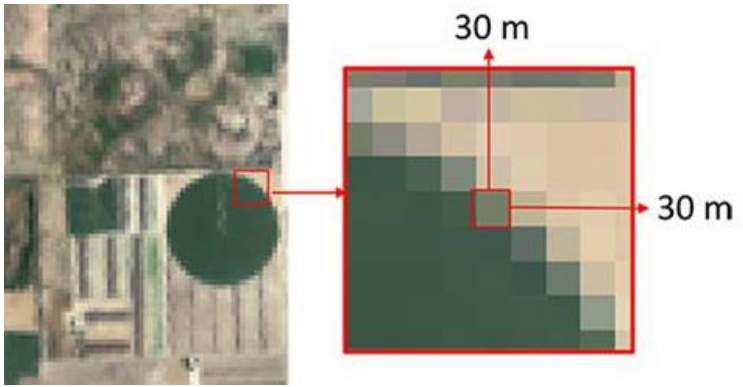
REPETITIVE LINE SCANNING

- More efficiency
- High precision
- Agriculture fields
- Forestry
- Hill slopes
- Construction site inspection
- 70.4° * 4.5°

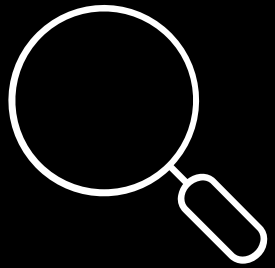
Pixels and Rasters

- A PIXEL is the smallest unit in an image (raster)
- Resolution refers to the physical spacing between the centres of adjacent sensor cells (pixels)
- A smaller pixel size provides a higher resolution image





Resolution

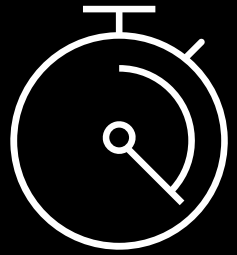


SPATIAL

Determines the scale of your observation

SPECTRAL / RADIOMETRIC

Affects the energy that you can detect



TEMPORAL

Affects the frequency and duration of your observation

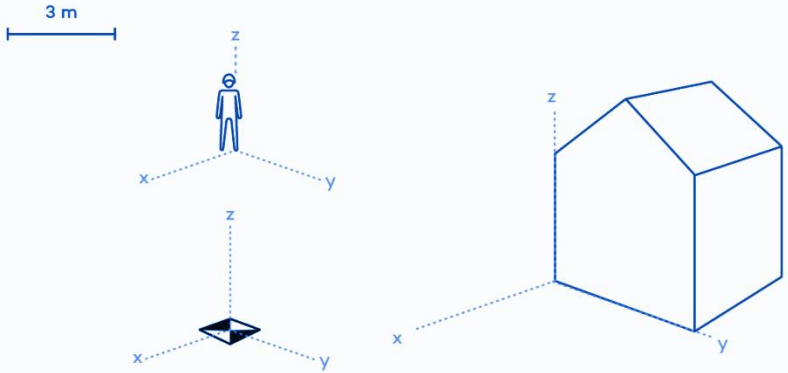
Ground Sampling Distance

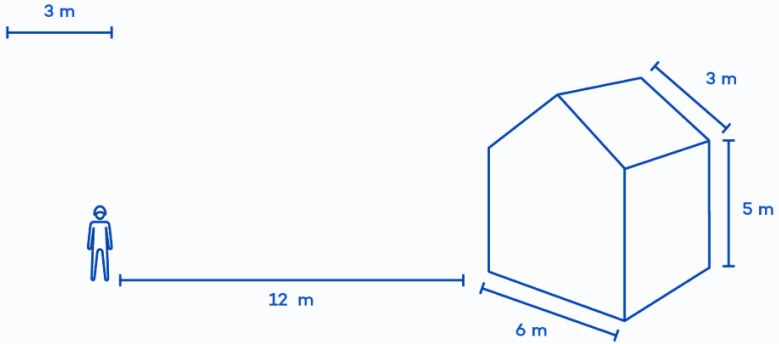
LOWER GSD	**HIGHER GSD**
- Higher spatial resolution - Lower flight altitude, more flight lines required, longer flight times - More data to process	- Lower spatial resolution - Higher altitude, less flight lines, faster data acquisition

COMMON MISCONCEPTION:
While a lower GSD will give you more detail of an object in your project area, GSD is **NOT** the same as accuracy.

For Example: If you have a GSD of 1cm your map is not accurate to 1 cm. If you had no surveyed GCPs you would be relying entirely on the photogrammetry processing algorithm to stitch your images together which does **not imply** that you have
1) A measure of relative accuracy that is the same as your GSD (image resolution) and
2) Any measure of absolute accuracy.
+ GSD does not not give you any measure of reliability or repeatability. You would need surveyed GCPs to assess the reliability of your photogrammetry survey.

Ground Control Points (GCP): Improve absolute and relative accuracy of your data.





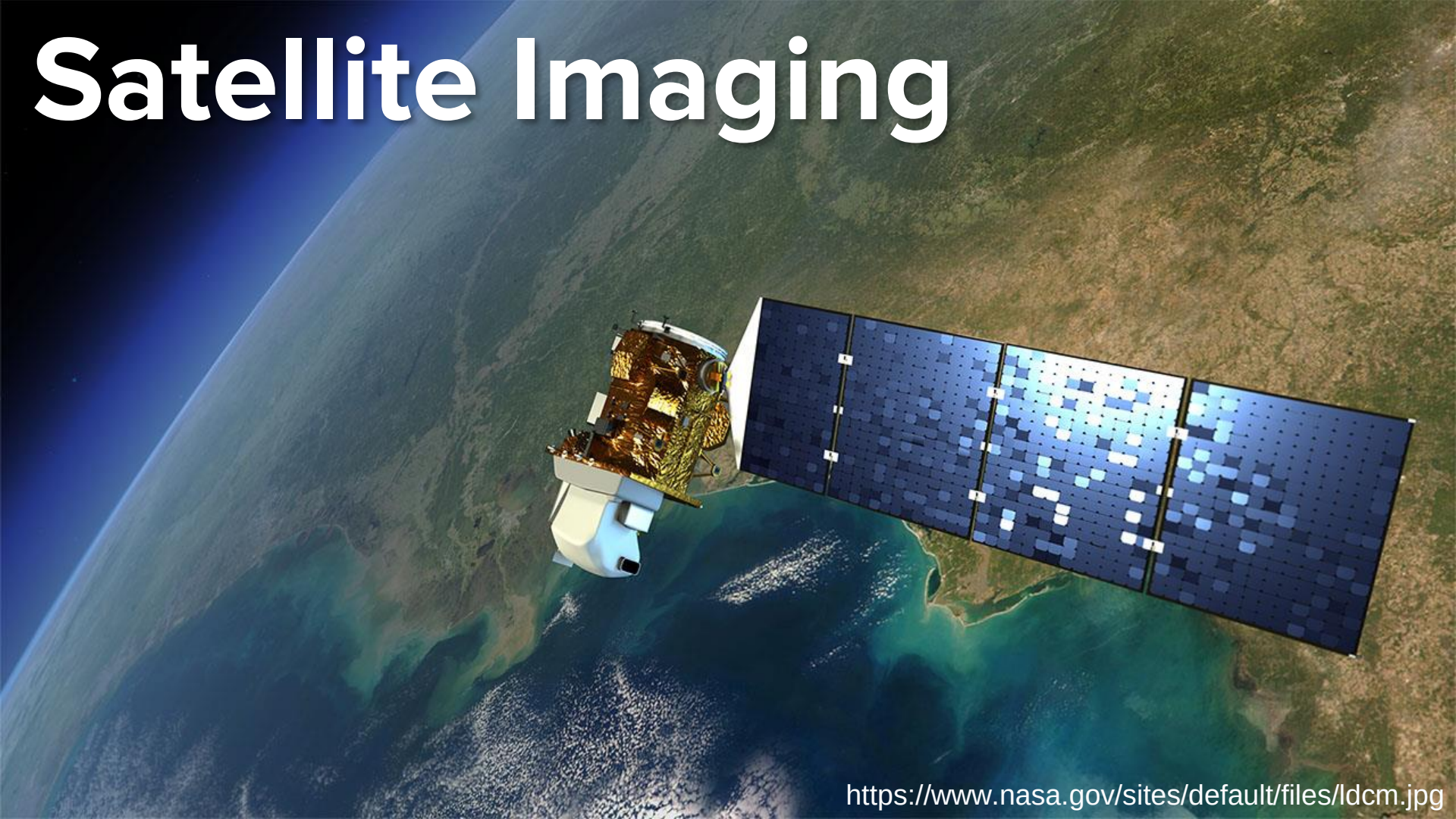
Absolute Accuracy

- GPS coordinate for every pixel of the image.
- Represents a true position on earth.

Relative Accuracy

- Comparing features within a reconstruction.
- For measurements and volumetrics of features.

Satellite Imaging



https://www.nasa.gov/sites/default/files/ldcm.jpg

Planes and Helicopters

suu.edu

Fixed Wing / VTOL


Drones /
Multirotor
CANDRONE


Hovermap


Leica

Is Every Drone Similar?

- Phantom 4 RTK ~$8000 + RTK Base station ~$4000 = $12,000 CAD Total.
- 1-inch, 20 Megapixel CMOS sensor with Global shutter

- DJI P1 (~$8,000) + Drone (~13,000) + RTK Base station (~$4000) = $27,000 CAD Total.
- 45 megapixel Full-Frame Sensor with Global shutter
- Fast photo interval of 0.7 seconds.

Draganfly Long Range LiDAR

MADE IN NORTH AMERICA

750M SCANNING RANGE

2CM GLOBAL ACCURACY

MULTIPLE RETURNS (4)


Is a Drone Right
For You?
CANDRONE

Consumer Level Drones

- Gain perspective
- Practice flying
- Conduct inspections
- Scan for hazards

THANK YOU FOR YOUR TIME

Candrone provides full-service sales, rentals, training + services

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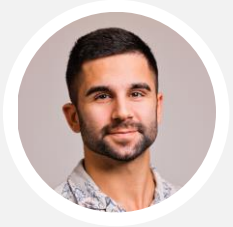
Prepared for you by



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