Benha University

Shoubra Faculty of Engineering

Photogrammetry 2B
Lecture 7: Introduction to Drone Systems

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Drones & UAV's

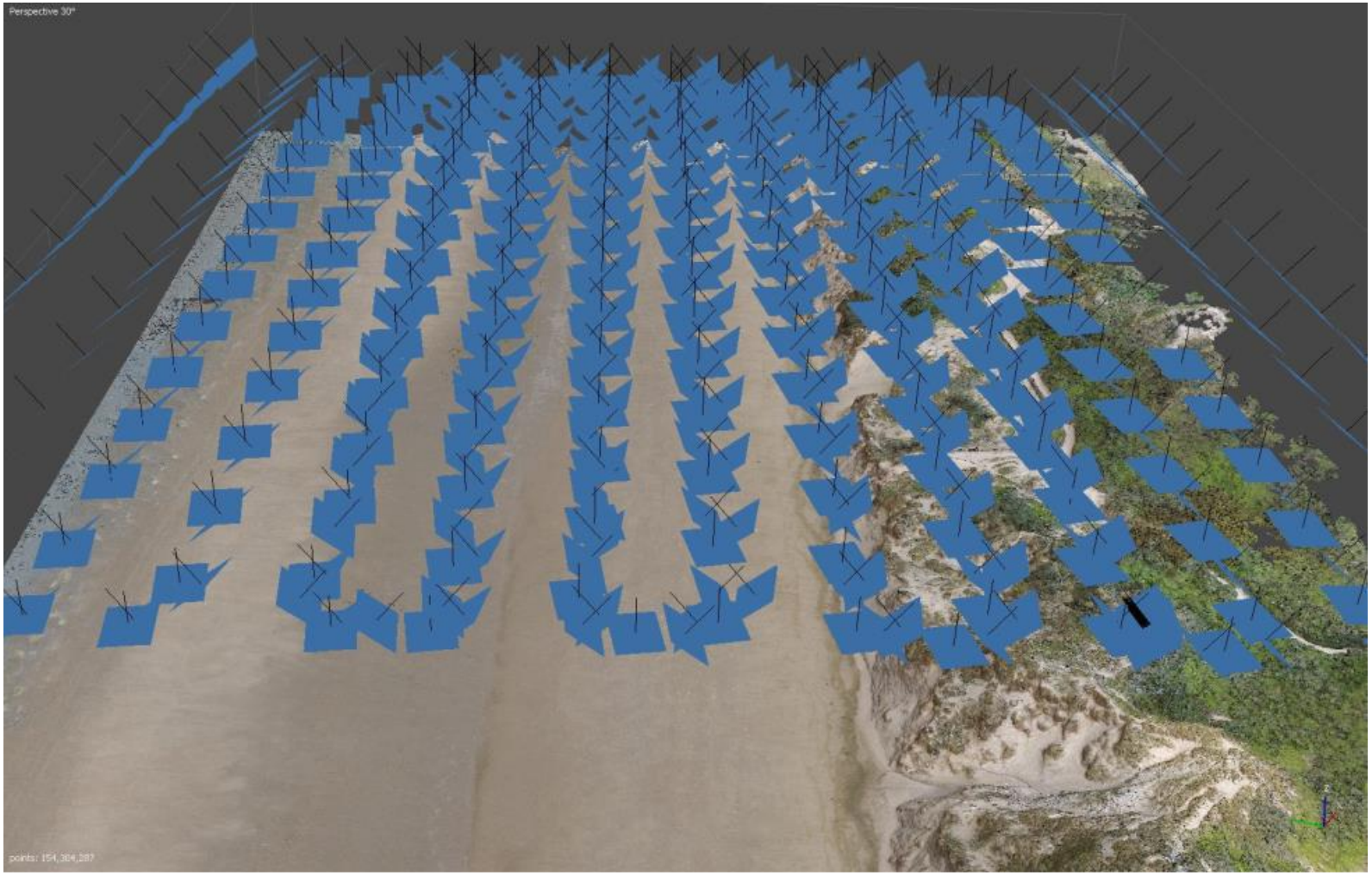
A UAV (Unmanned Aerial Vehicle) or UAS (Unmanned Aerial System) is any aircraft that can navigate without a human pilot on board. Sometimes referred to as a drone.

With the advancements in the UAV industry today, there are more UAVs in the air than at any point in history.

Creating Imagery from UAV's

UAVs are programmed to fly a course at a set elevation. At a predetermined time interval, photographs are taken. These photos overlap enough to create a seamless image compiled of the collage of pictures.

Creating Imagery from UAV's



Logistics

Quadcopter UAV DJI Phantom IV Pro

Powerful workstation

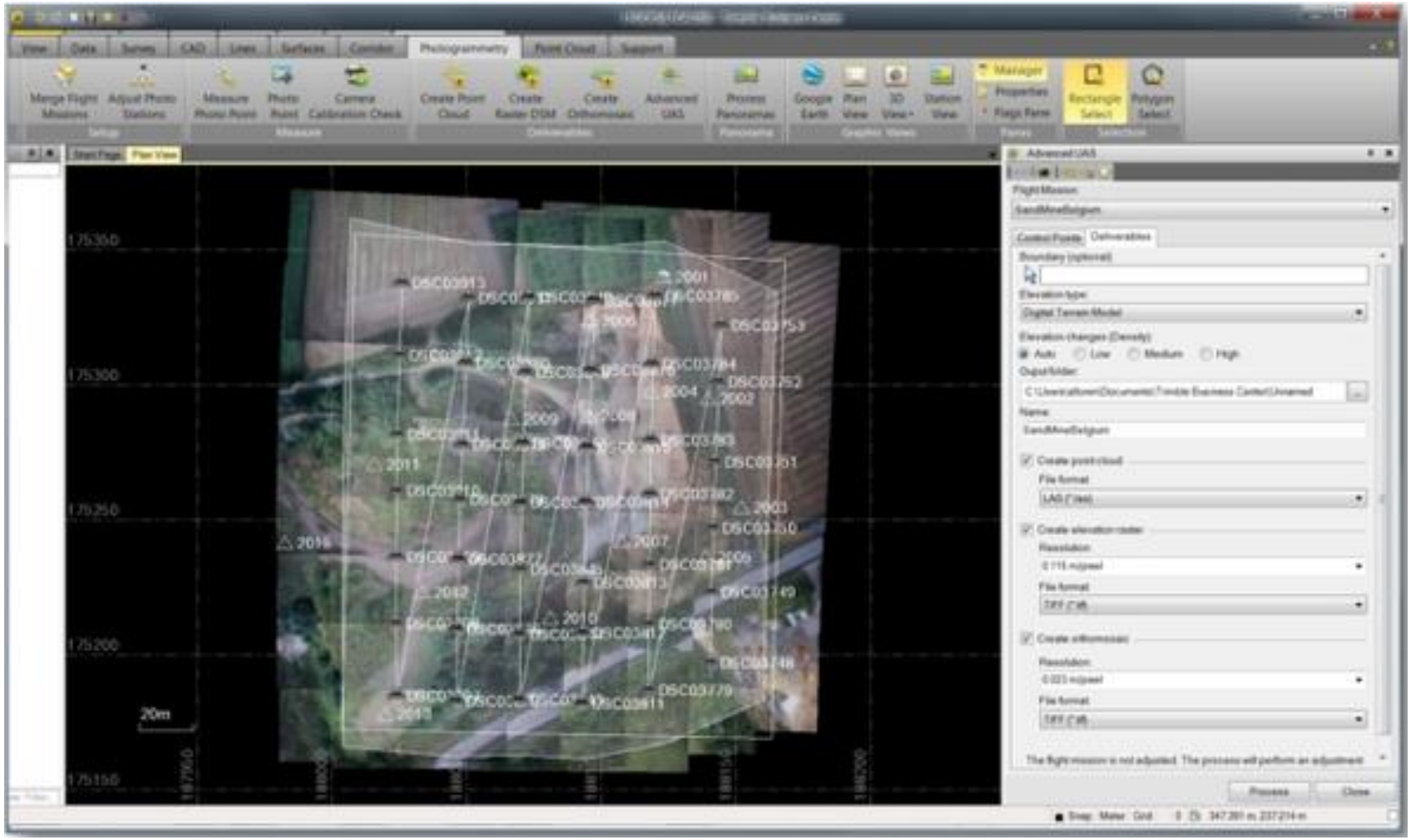
Optimized flight plan

Ground control points

Information needed to prepare for drone photogrammetry flight

- Data needed:
  - Client requested GSD (ground spacing of pixel centers)
  - Focal length of camera
  - Size of the camera’s sensor
  - Flying height
  - Size of area to be photographed
  - Overlap
  - Side lap
  - Write time to save each image
  - Ground speed of aircraft

Information needed to prepare for drone photogrammetry flight



Information needed to prepare for drone photogrammetry flight

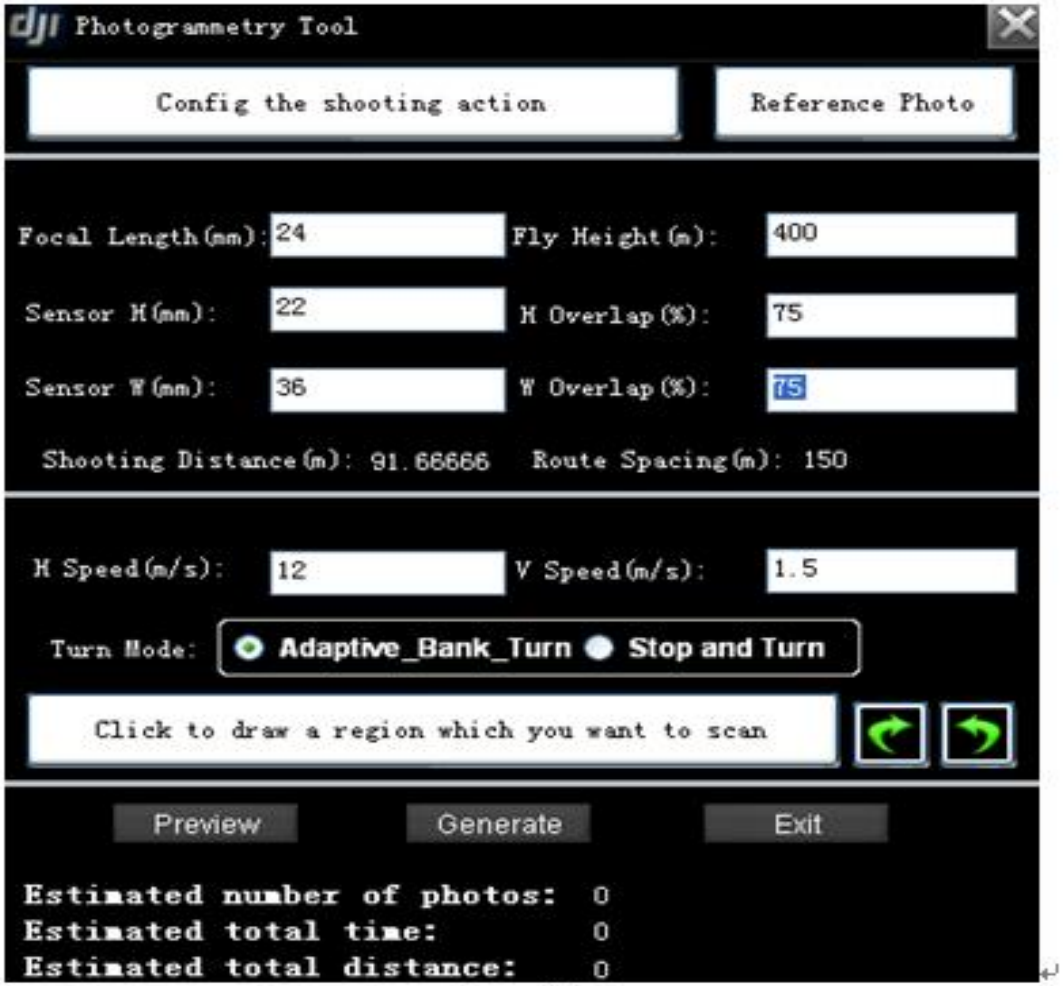


Fig.①

Fig.②

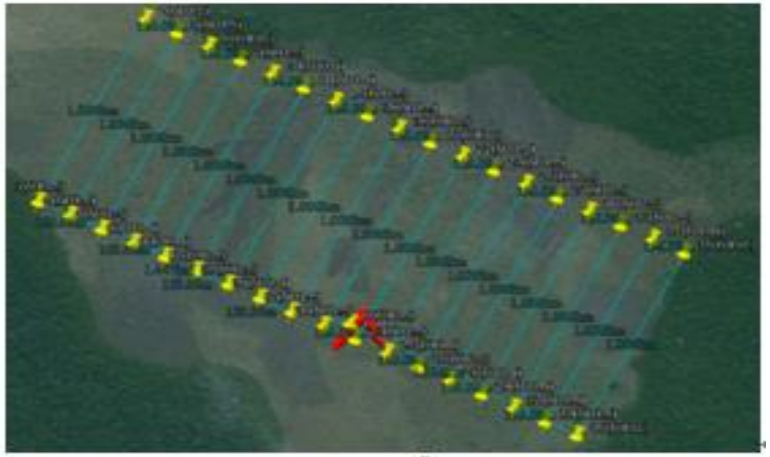


Fig.③

Steps for completion of a Photogrammetry Project

- Obtain suitable images.
- Write logger data to images EXIF file.
- Ortho rectify images – correcting aberrations caused by lens and camera imperfections.
- Stitch images – using high speed computers to fingerprint the images combined with data from the aircrafts logger to stitch the initial mosaic. Then individual DEM points are calculated using stereographic triangulation algorithms based on the relative location of each image to the ground.
- Enhancing GIS accuracy – orientation and placement can be enhanced by tying accurately surveyed ground control points to locations within the images.
- Delivering the product – once all steps are completed the software can deliver DEMs which can be used in industry standard GIS software such as Arc-GIS and Global Mapper. In addition ortho photos can be created in Geo TIFFs and Google Earth formats. As an added benefit, beautiful extreme resolution photos can be delivered.

Types of UAV

Trimble ZX5

Rotary Wing / Multirotor

Advantages	Disadvantages
VTOL	Shorter battery life
Surveillance or Surveying	Multiple points of failure

DJI Phantom 3 Professional

Altavian Nova F7200

Fixed Wing

Advantages	Disadvantages
Longer Battery life	May need launcher device
Better for large areas	Needs open area for takeoff/landing

Trimble UX5

Why incorporate GCP's?

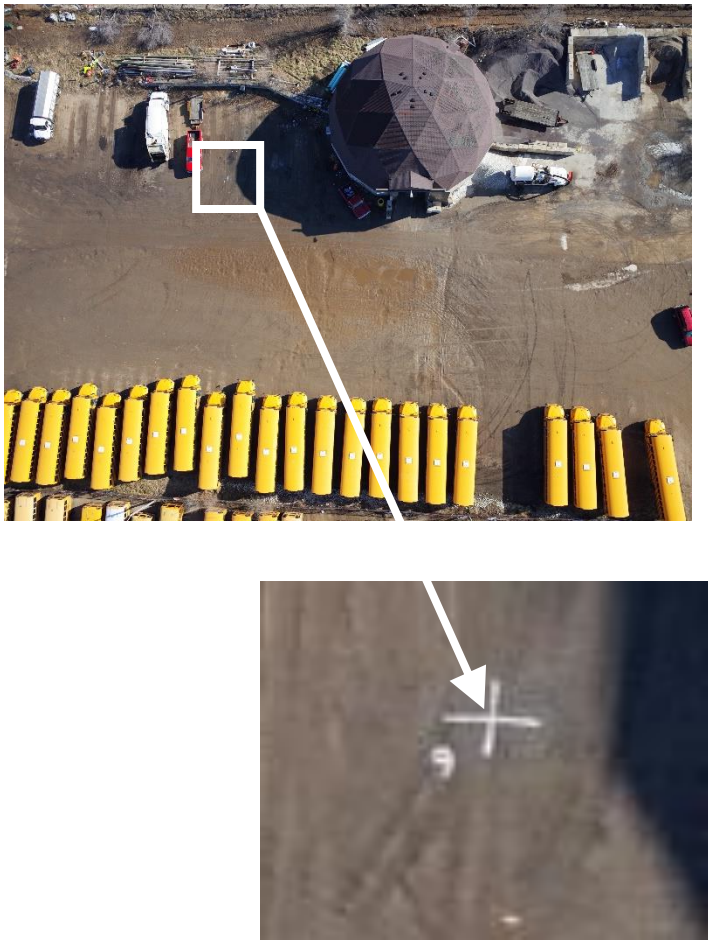
By utilizing GCP's, data accuracy can be increased to 1-2 inches as opposed to 3 feet or more in native georeferencing.

GPS your GPC's

GPC's are collected with high-accuracy, survey grade GPS. Points are then imported into the image processing software.

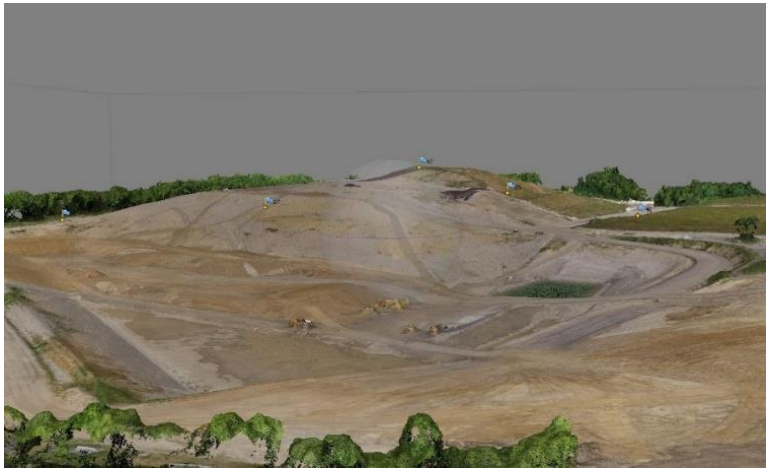
So how are GCP's used?

After control points are collected and the aerial photography is brought into the system, points are manually selected from multiple photos to get achieve the high accuracy results.



How can this data be used?

Data that has been collected by UAVs and has been manipulated via post processing, can yield many results such as elevation and volume calculations.



DJI Phantom 4 Pro

Flight Time = 28 minutes

Coverage = 150 acres

Camera = 20MP Exmor R CMOS

Max Speed = 44 mph

Primary use: ameture videography & imagery

DJI Inspire 1

Flight Time = 18 minutes

Coverage = 100 acres

Camera = 12MP & 16MP

Max Speed = 49 mph

Primary use: videography & inspection work

DJI Spreading Wings S1000

Flight Time = 15 minutes

Coverage = 100 acres

Camera = Professional grade

Max Speed = 58 mph

Primary use: Professional photos & industrial applications

Event 38: E384

Flight Time = 100 minutes

Coverage = 400 acres

Camera = 18-28 MP

Max Speed = 29 mph

Primary use: surveying & mapping

Assembly video

Sensefly Ebee RTK

Flight Time = 40 minutes

Coverage = 300 acres

Camera = 20 MP

Max Speed = 40 mph

Primary use: Surveying & mapping

Takeoff video

Trimble UX5

Flight Time = 50 minutes

Coverage = 400 acres

Camera = 24 MP

Max Speed = 50 mph

Primary use: surveying & mapping

Photo of launch

Firefly6

Flight Time = 45 minutes

Coverage = 400 acres

Camera = 24 MP

Max Speed = 40 mph

Primary use: surveying & mapping

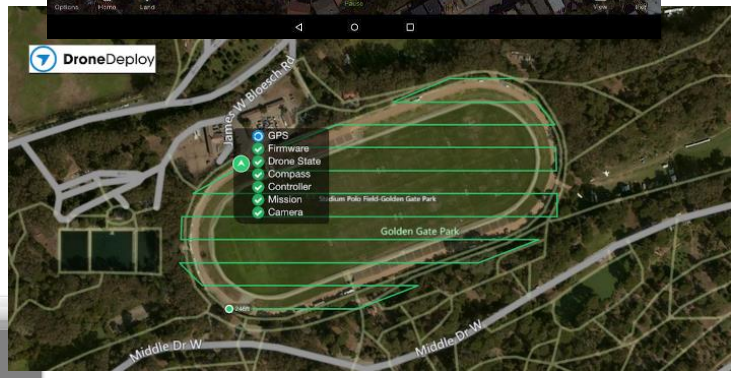
Choosing the right drone

- Let application drive the purchase decision (ag, site survey, inspection work, etc.)
- Use popular flight controllers and platforms
- Spend twice as much time choosing the sensor package as you are for the bird
- Can the platform carry different types of sensors

Different UAV processing tools

Pix 4D

Drone Deploy
Drone2Map



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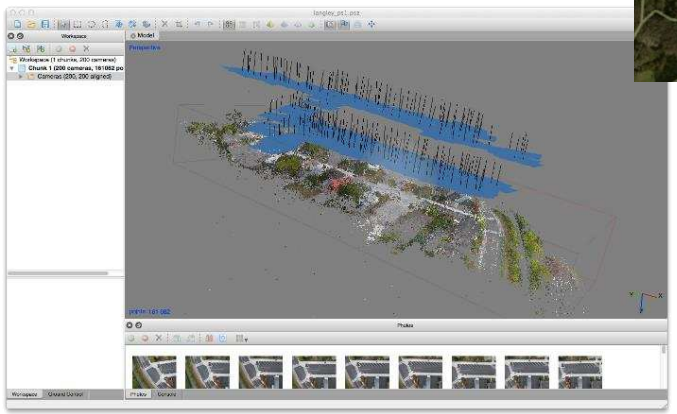


Why is this important?

Utilizing drones for this manner is beneficial in multiple ways. One main advantage is the tremendous saving of time spent for jobs. What used to take days to complete, now takes hours.

Deliverables from UAV

Orthomosaic

A photo map that has been geometrically corrected to uniform scale

Numerous Overlapping Images

- Make 2D Measurements (distance, area)
- GIS integration

3D Model

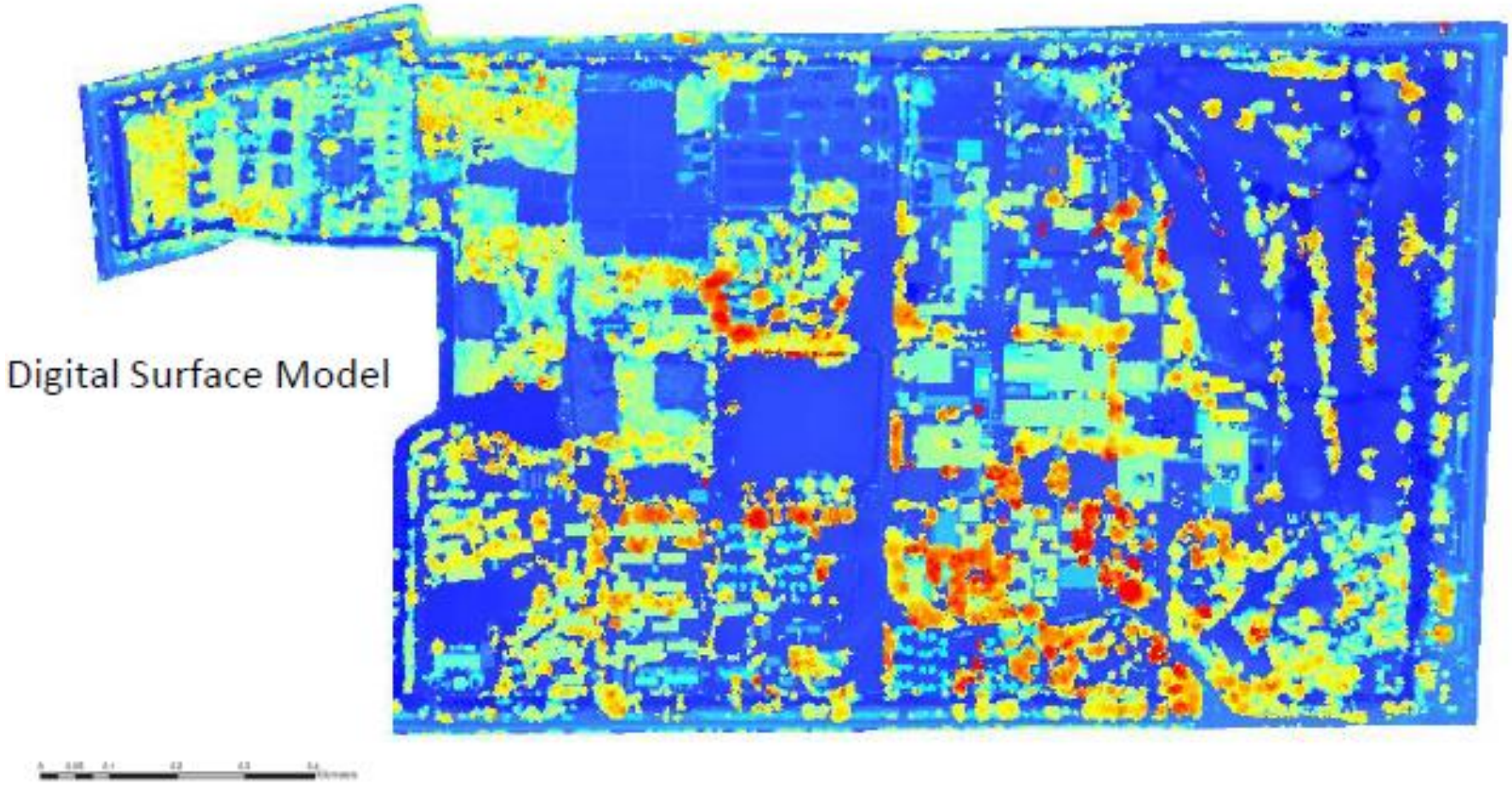
Composed of points in 3D space

Useful for 3D measurements, Volumetric Calculations

Digital Surface Model

Expresses elevation data

Digital Surface Model

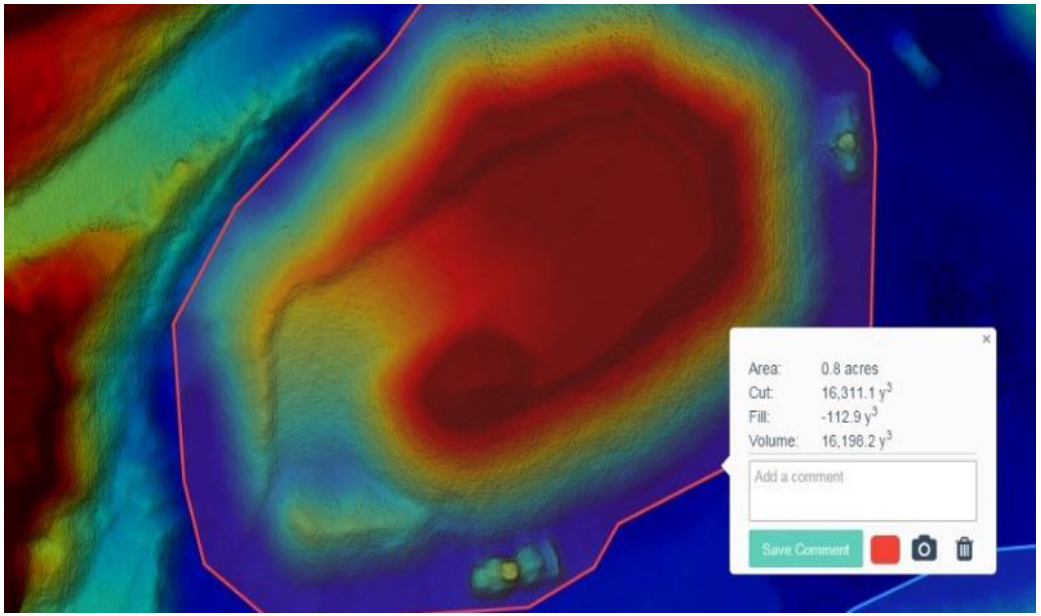


Advantages and Disadvantages of UAVs

Advantages	Disadvantages
✓ An affordable cost ✓ Productivity gains in the field : o a technique that is quick and easy to set up o larger areas measured faster than by GNSS ✓ A high density of measurements (several hundred per m^2 depending on flight height, image resolution and available computing power) much higher than that of a topographic LiDAR (1 to 2 points/m^2). ✓ A high level of accuracy (error margin ± 3 to 5 cm) ✓ A 3D study of the shoreline ✓ 3D models showing invisible elements with GNSS surveys (e.g. sand/vegetation boundary, vegetation type, wrach line, etc.) ✓ Useful 3D models for scientific communication	✓ Sensitivity to weather conditions (wind, rain) ✓ Flight time and limited range (battery life: 20 to 25 minutes) ✓ Long processing times, high computing power required (workstation) ✓ Need ground control points to obtain a very precise geo-referencing of the model ✓ Vegetation (trees) must sometimes be removed from models ✓ Administrative regulations sometimes binding for UAV overflights

Applications for UAV's

By utilizing UAVs to calculate volume, a quarry or gravel pit can better manage their inventory and stockpiles with increased accuracy and efficiency.



Applications for UAV's

County assessors can utilize drone imagery to see if any structures have been built without documentation and proper permits thus resulting in more revenue via taxes.

Applications for UAV's

In the future it is predicted that UAVs will be used in emergency responses such as post hurricane devastation, wild fires, tornadoes, and much more. This will allow organizations the ability to better track damage and create response plans.

Supplementary files:

- https://www.youtube.com/watch?v=UnnJcg6o1vk&t=5862s
- https://www.youtube.com/watch?v=Nd__dC6miWU
- https://www.youtube.com/watch?v=FVKXj8oHtn8

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Thanks

Dr.Eng. Hassan Mohamed