Extreme Reality Computing from a Hexacopter

Mike Gemmell - Autodesk
Dominique Pouliquen - Autodesk
William Pryor - SKYCATCH
Hannu Linberg - DPR Construction

Class summary

Scene re-creation with the help of an unmanned aerial vehicle (UAV/Drone) has many applications that range from disaster recovery to infrastructure concept design. Creating these scenes with the help of a UAV is becoming more common as the flying camera UAV craze explodes worldwide. This session will cover camera equipment and UAVs, and we'll also discuss building custom UAVs, taking pictures from a UAV, post-processing pictures with Lightroom.

We will also hear from SKYCATCH, a firm that is currently working with DPR to utilize automated drone systems on construction projects. SKYCATCH will also provide an update for us on the FAA's progress with setting standards for the commercial use of drones.

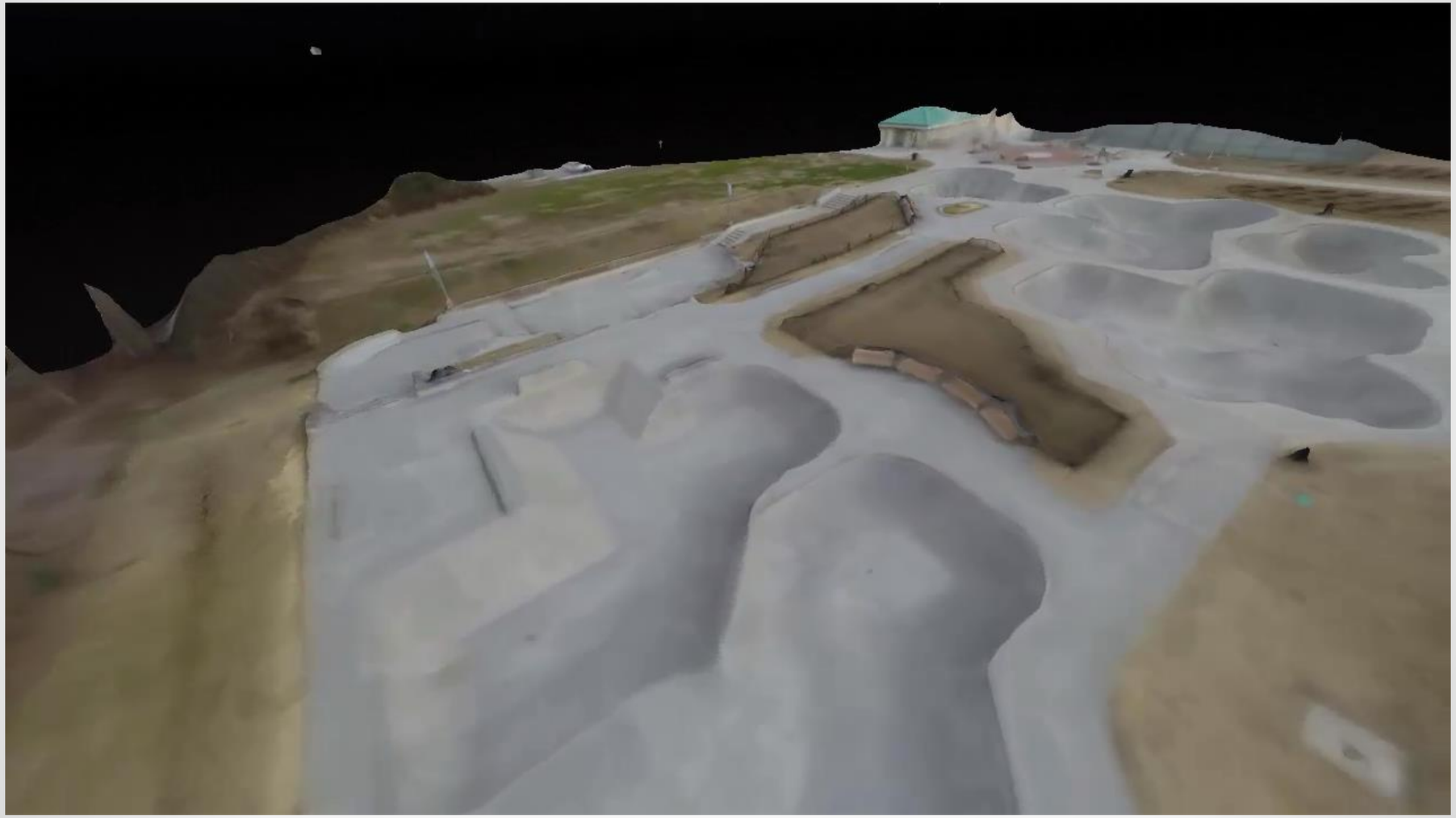
Key learning objectives

At the end of this class, you will learn about:

- UAV’s / Drones used to create 3D models
- Photography from a drone
- Photo post-processing for best results
- Current use cases for construction
- Latest on FAA Commercial use

Skate Park

Gopro Hero 3+



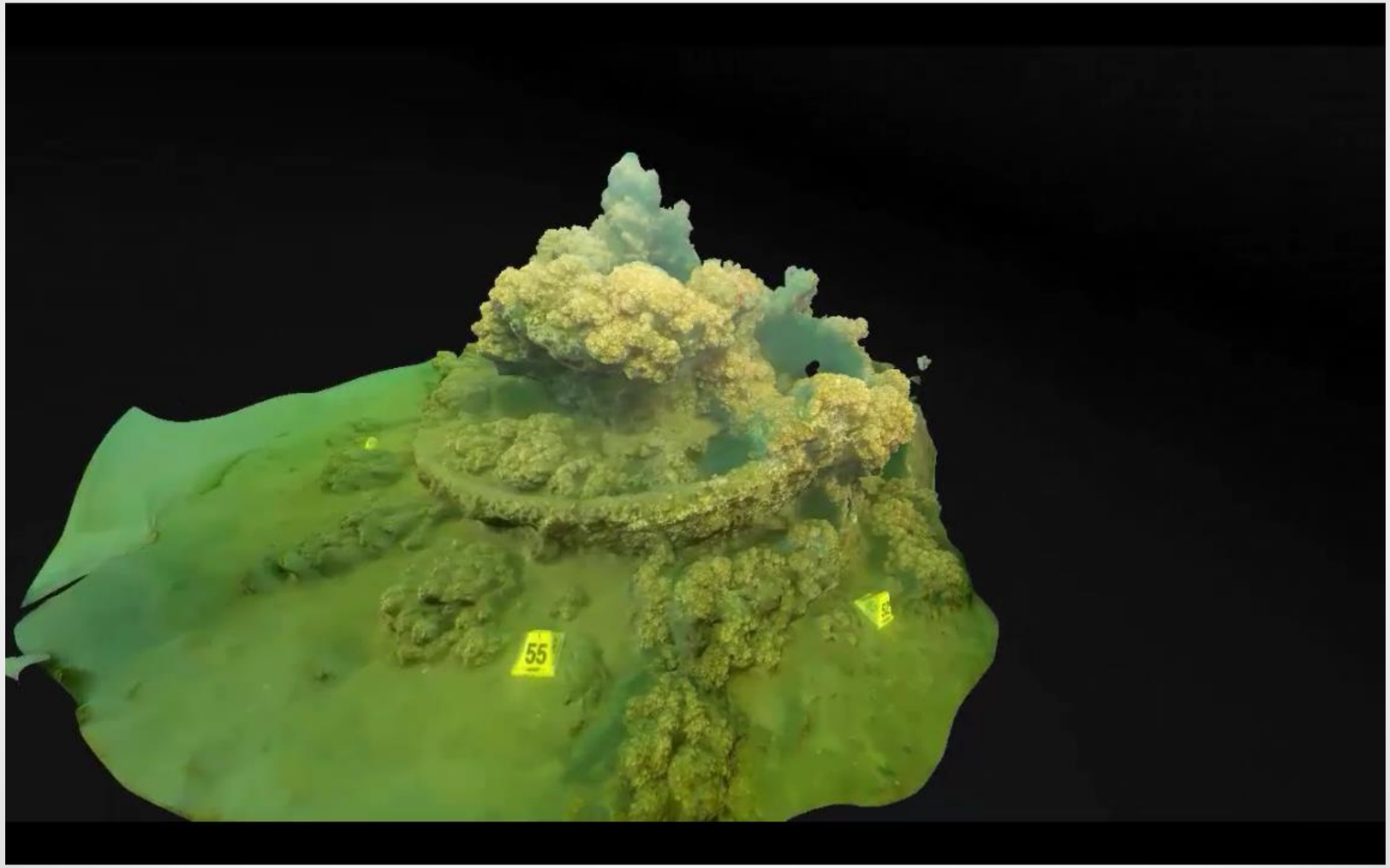
Louvre Tablet

Olympus OMD



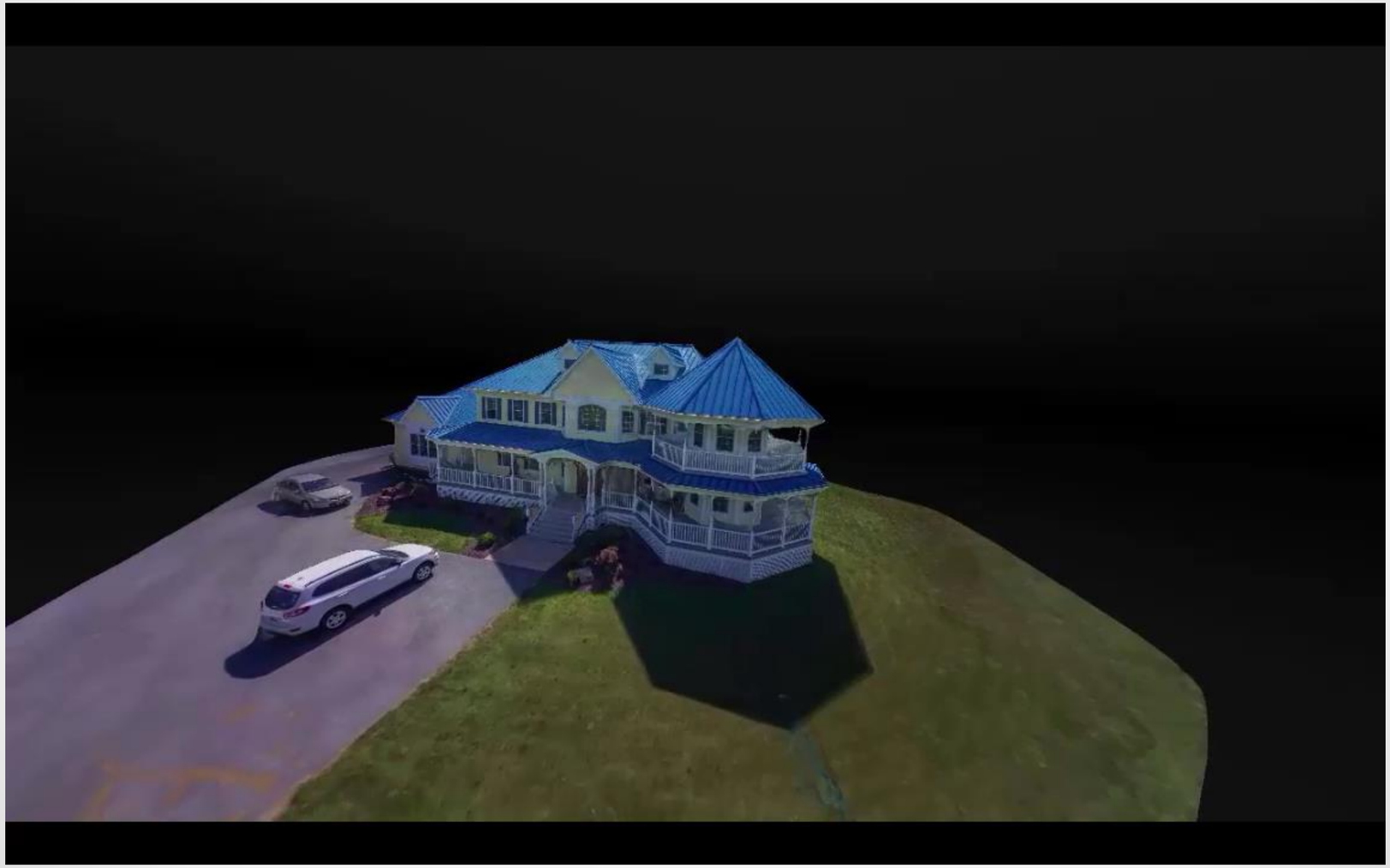
USS Arizona – Air Duct

Nikon D800



Rochester House Example

Sony a7R
Voigtlander 20mm Rangefinder



Original Gym – 2014

Sony a7R
Voigtlander 20mm Lens



Most Frequent Questions

- How did you learn to fly?
- What kind of drone should I get?
- What camera should I use?
- How do we get the best results?
- How accurate is this?
- Am I allowed to fly?

Learning to Fly

- www.flitetest.com -RotorBones 

- www.atlantahobby.com -Cliff Whitney 

- http://www.brilliancephotography.com -Bob Hughes
- https://www.youtube.com/user/AnthonyMorganti
- Presentation: https://autodesk.box.com/s/xjes6nna0zfem4p7qski
- Octocopter Fusion Model: http://a360.co/1wuGcag

Flight Controllers **Power Systems** **Lipo Batteries**

Radio Transmitters **Drone Setup** **Camera Gimbals**

Learning to Fly

Blade MDX



Learning to Fly

Flying while under Nerf-Gun fire…

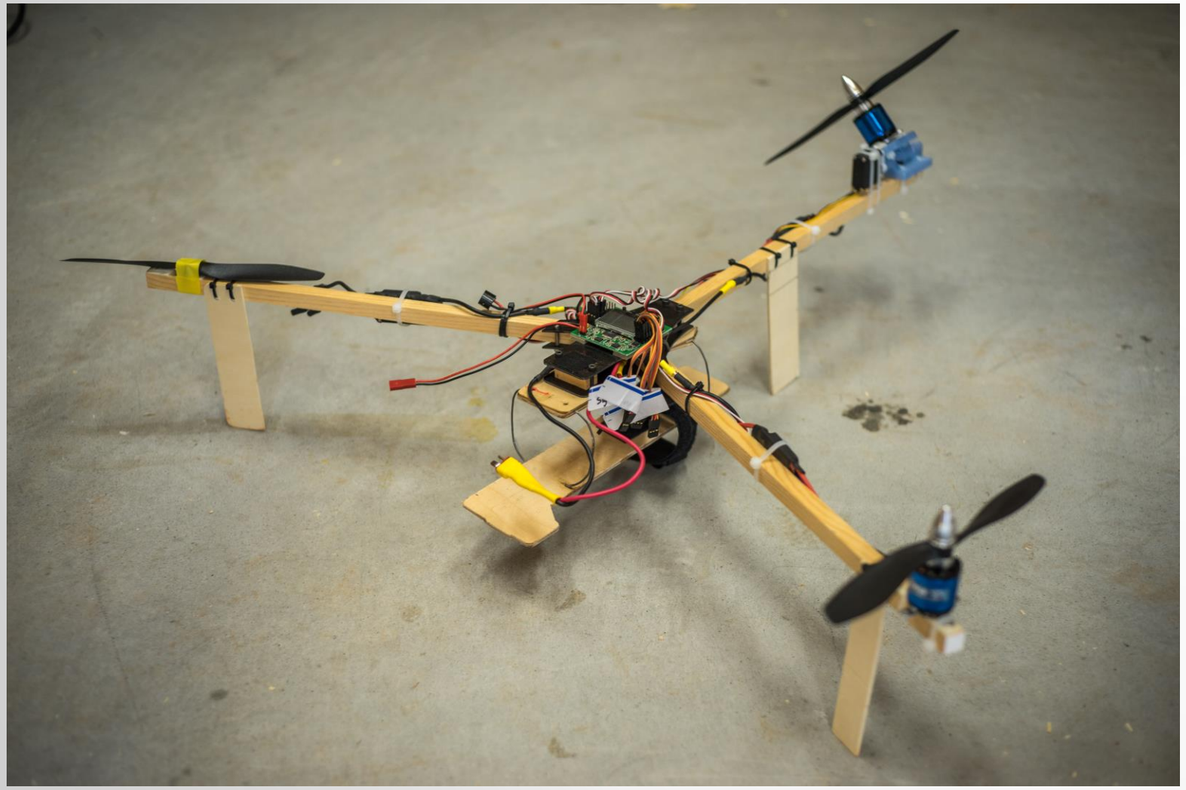


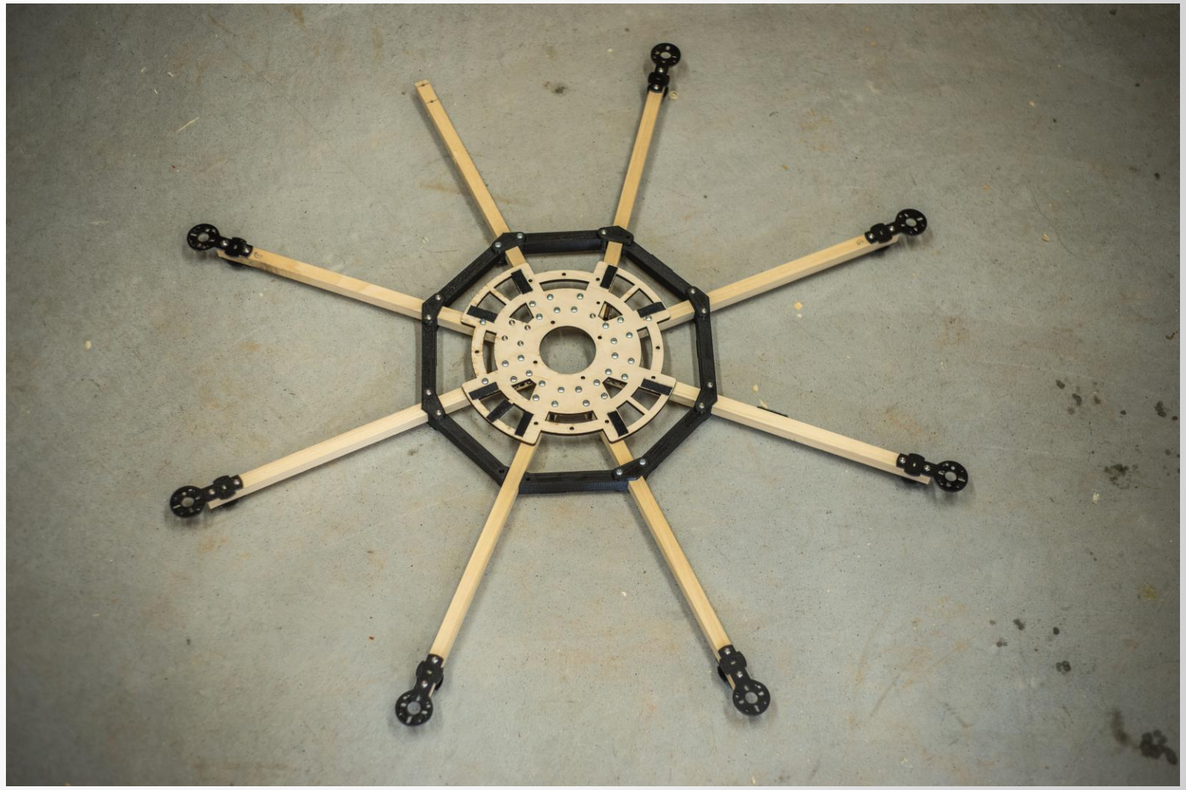
Learning to Fly



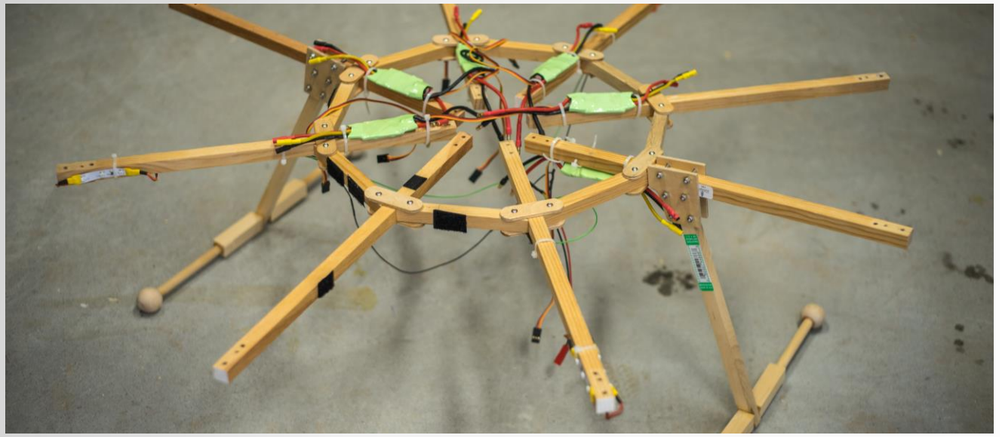
What kind of drone?

- My progression based on cameras needed





What kind of drone?

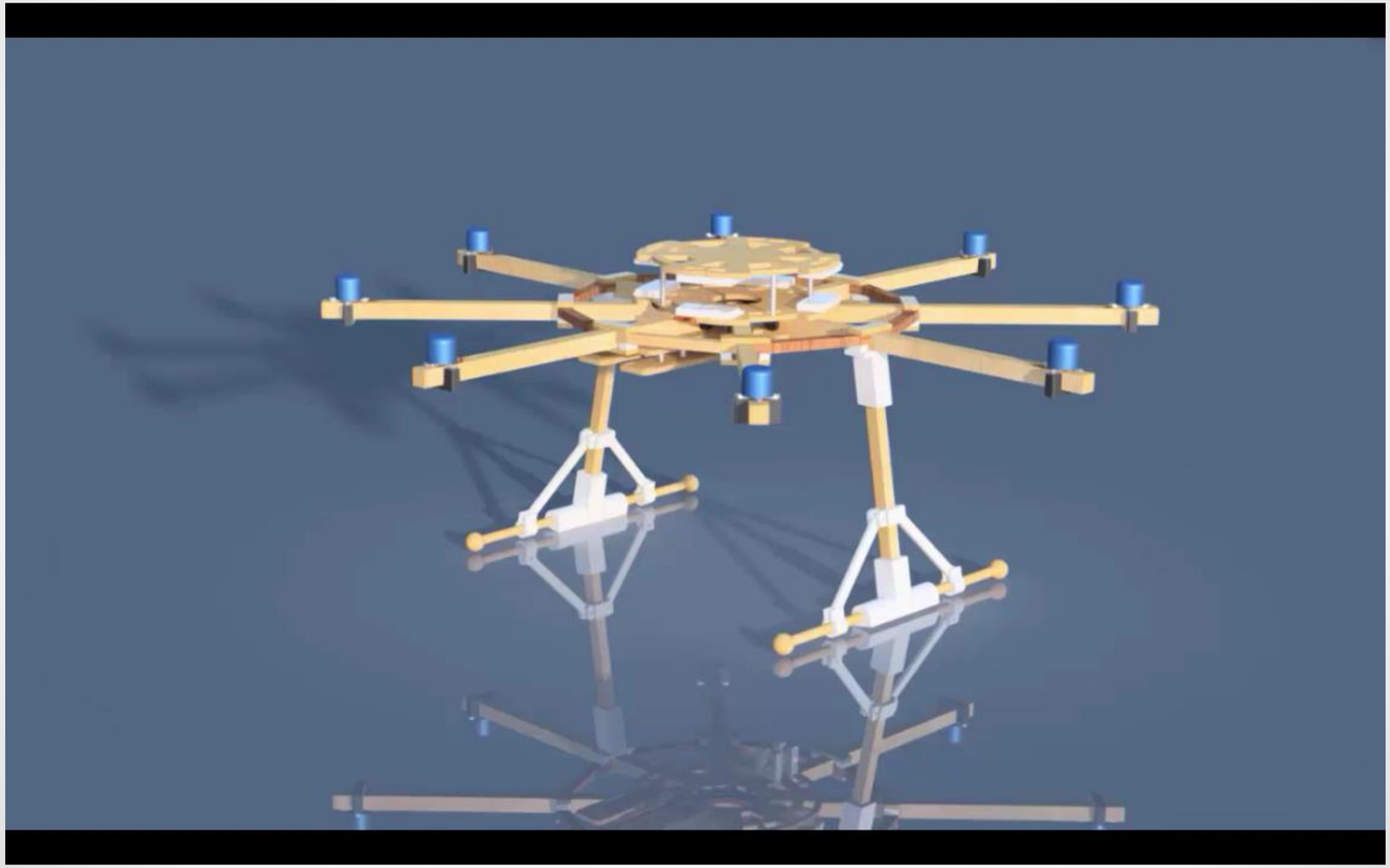




Octocopters:

- Good Lift
- Redundant Power
- Poor wind performance
- Poor flight performance
- Poor flight time
- Not portable

Custom Designs in Fusion 360



What kind of drone?





Hexacopter:

- Good Lift
- Good flight preformance
- More portable

Super Quadcopter / X8:

- Great Lift
- Great flight performance
- Longer flight times
- Very travel friendly

Summary – What to Consider in Drone Selection

- Camera payload
- Flight times required
  - Higher voltages
  - Spin larger props as slow as possible
  - Reduce weight
- Flight Control Systems
  - GPS hold
  - Waypoints ?
- FPV
  - Goggles vs. LCD

What Camera should I use?



GoPro Hero 3+

Weight: 75g

Lens (Fish Eye)

Sensor: 4-6mm (12MP)



Weight: 560g

Lens: Olympus 12mm Prime

Sensor: Micro 4/3’s (16MP)

What camera should I use?



Sony NEX 6

Weight: 443g
APS-C 16MP Sensor
Kit – 16-50mm Zoom Lens



Sony a7R:

Weight: 630g
Sensor: 35mm, 36MP
Lens: Voigtlander 20mm Skopar
Adapter: Fotodiox M39-NEX

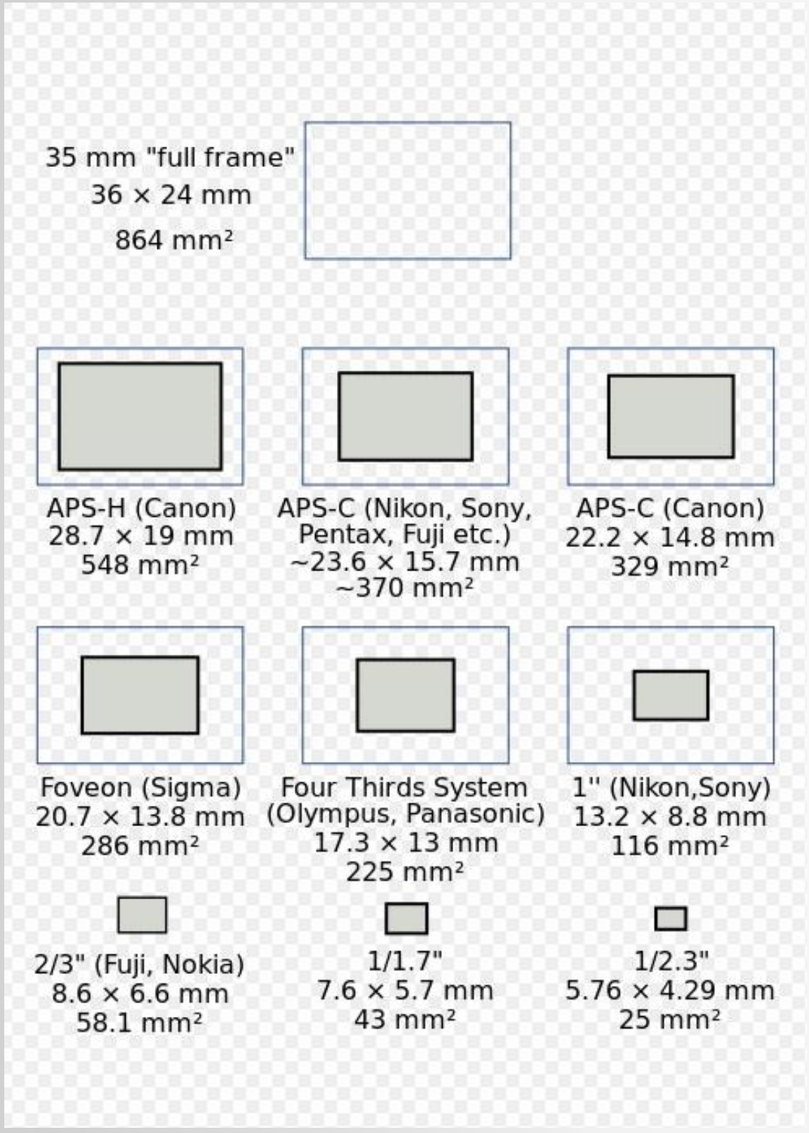
Digital Sensors

Physical Size Comparison



from: cameraimagesensor.com

Digital Sensors



Sony a7R

Sony NEX 6

Olympus OMD

GoPro

from: http://en.wikipedia.org/wiki/Image_sensor_format

Camera Settings

- Manual or Shutter Priority
- Pre-set focus to infinity
- Shutter at 1/500 – 1/1000
- Aperture at F5.6 – F16
  - Try to center at lens sweet spot usually F5.6 – F8
- ISO – sensor sensitivity
  - 100 – 800 (lower best, higher settings introduce more noise)
- RAW digital format when possible

Sensor Comparison

GoPro 3+



Olympus OMD



Sony a7R



GoPro Hero 3+

2:1 Zoom



Olympus OMD

2:1 Zoom



Sony a7R

2:1 Zoom



Lens Discovery

Minolta 50mm manual focus





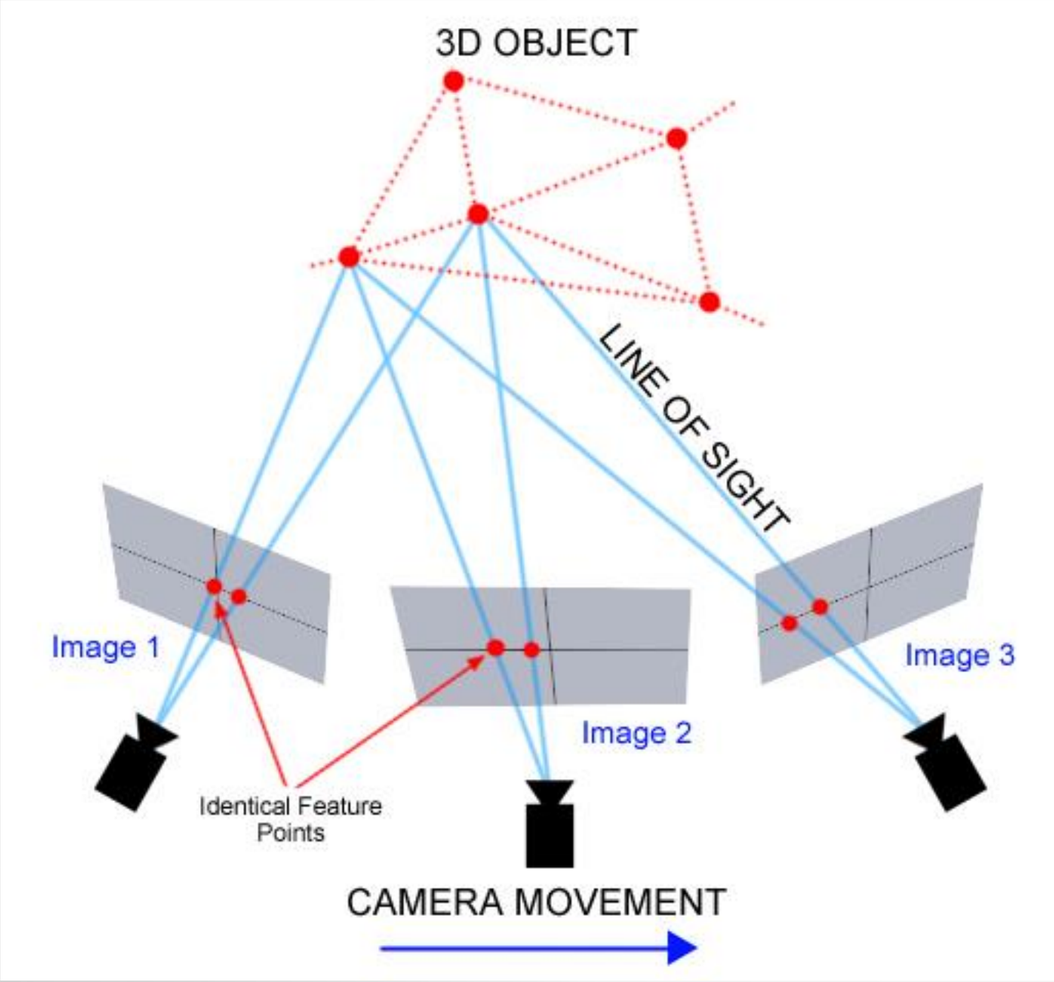
Lens Discovery



Lens Selection

- Prime(fixed focal length) better than zoom
- Wide angle *usually* better than longer focal distances
- Manual focus to infinity better than auto focus
- Be aware of Depth of Field

What is photogrammetry?



The application of parallax!

Triangulation of similar points in overlapping imagery: 20,000 - 40,000 points per image.

Sounds easy, right?

Flight Path for Photo Sequence

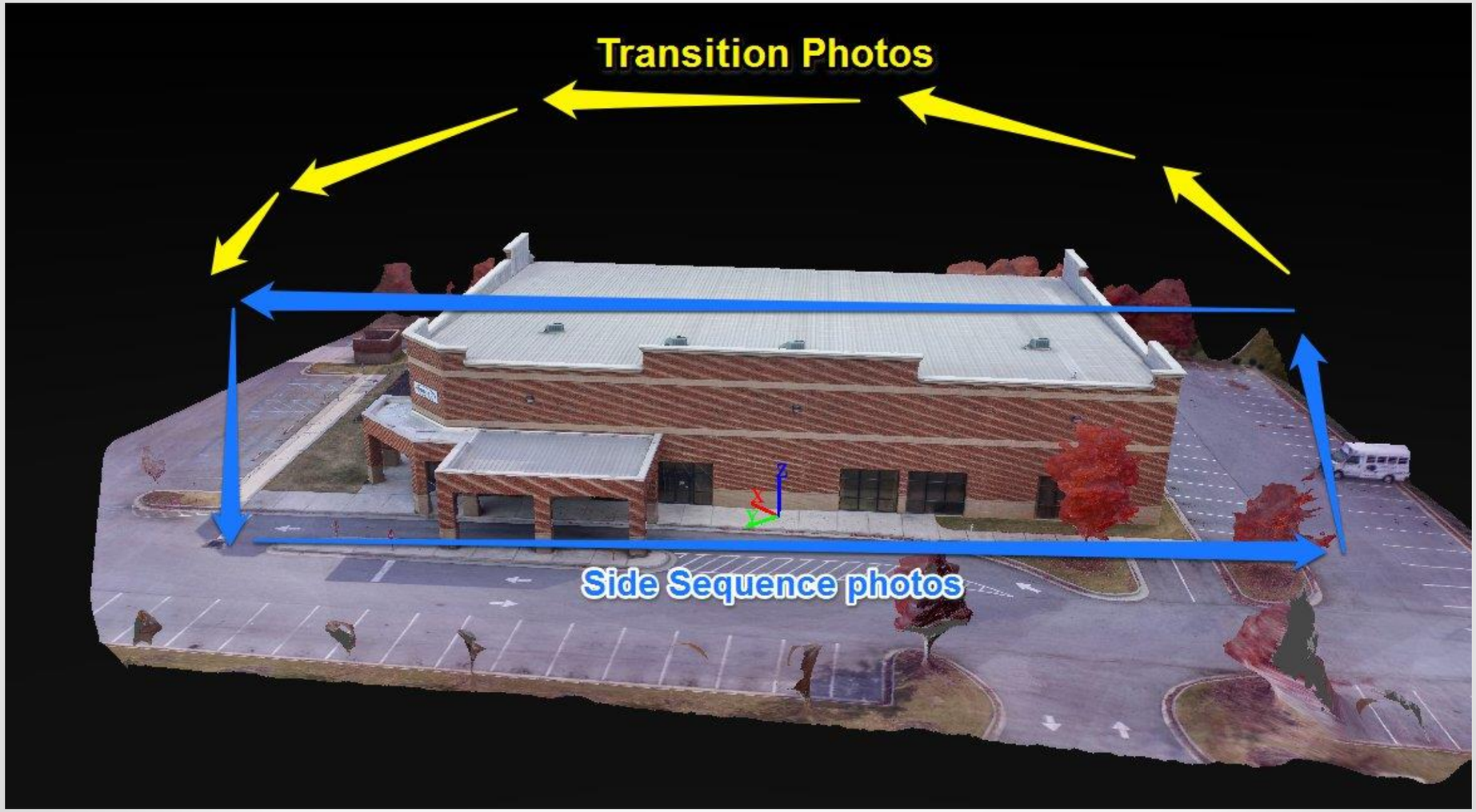


Photo Sequence

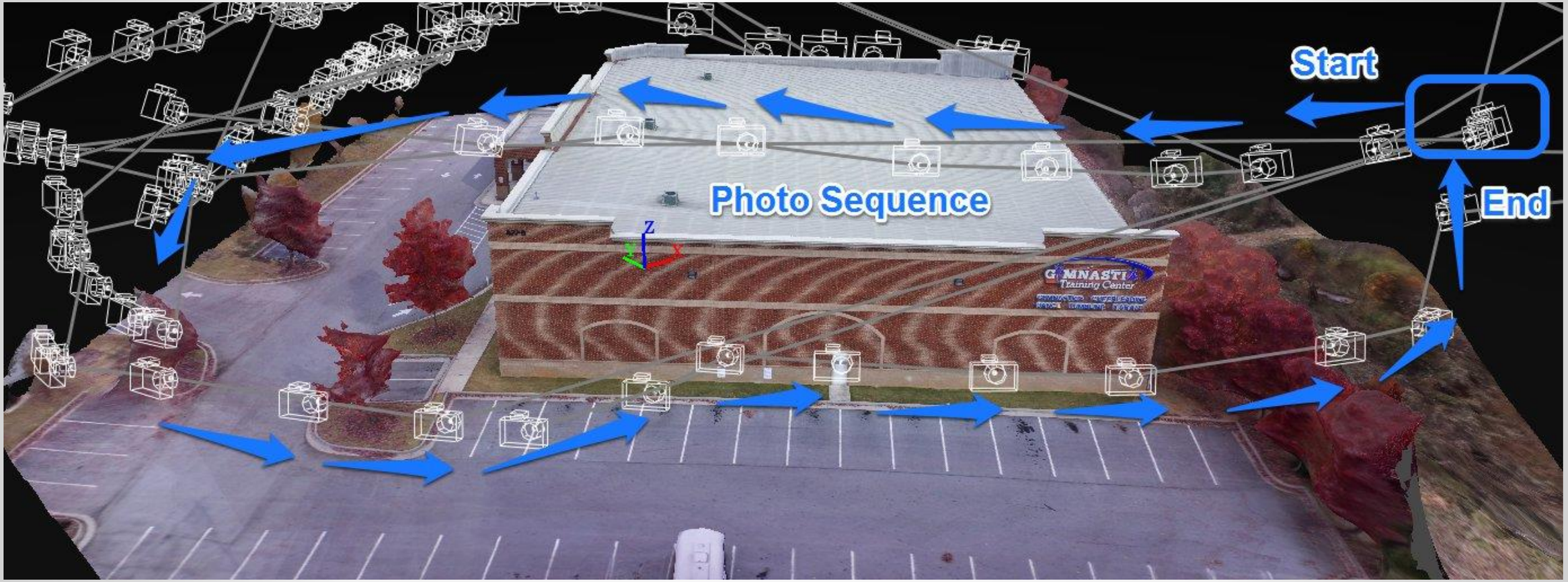
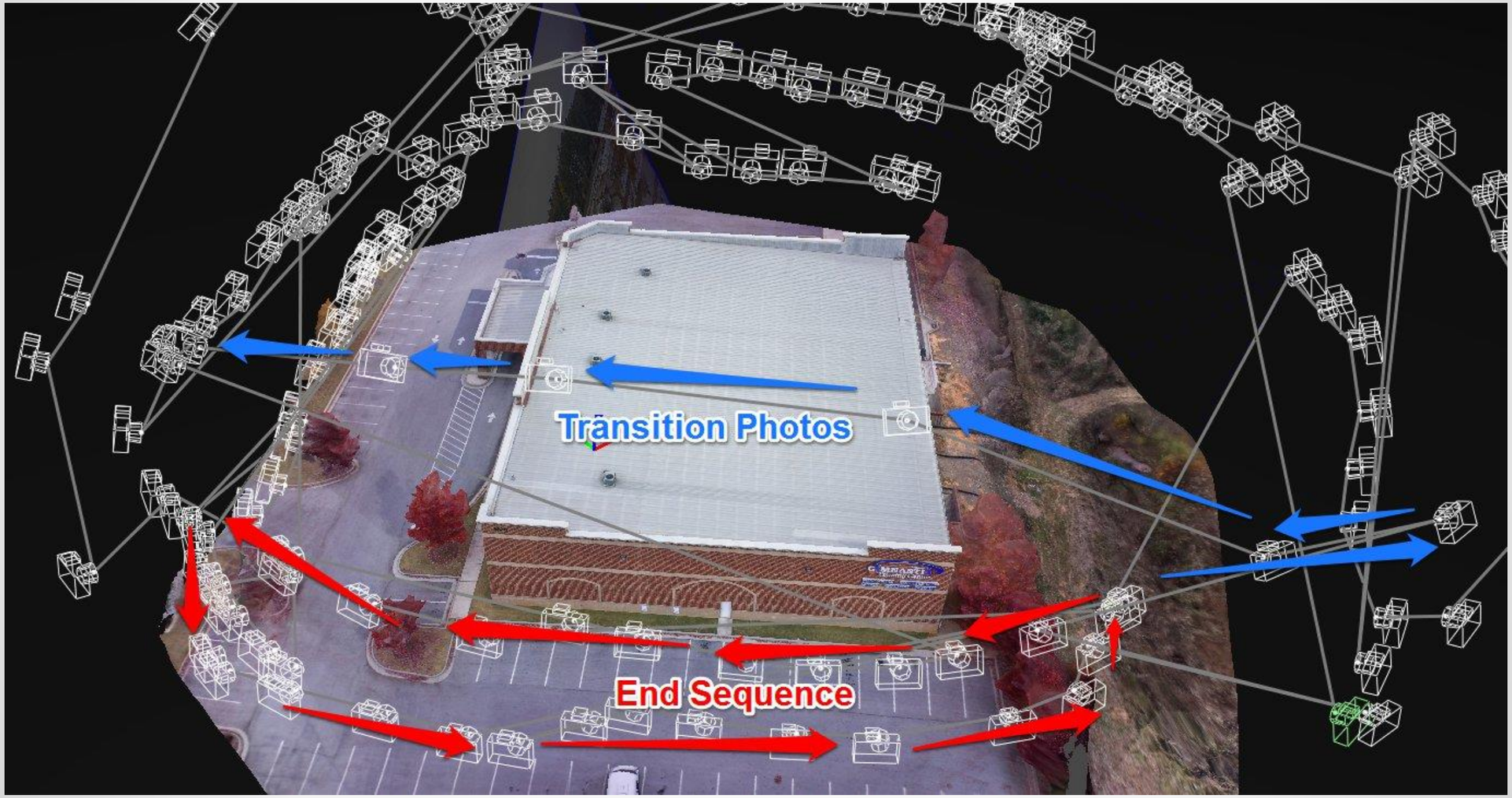


Photo Sequence



Flight Paths – Photo Sequence Shots



Flight Path Video

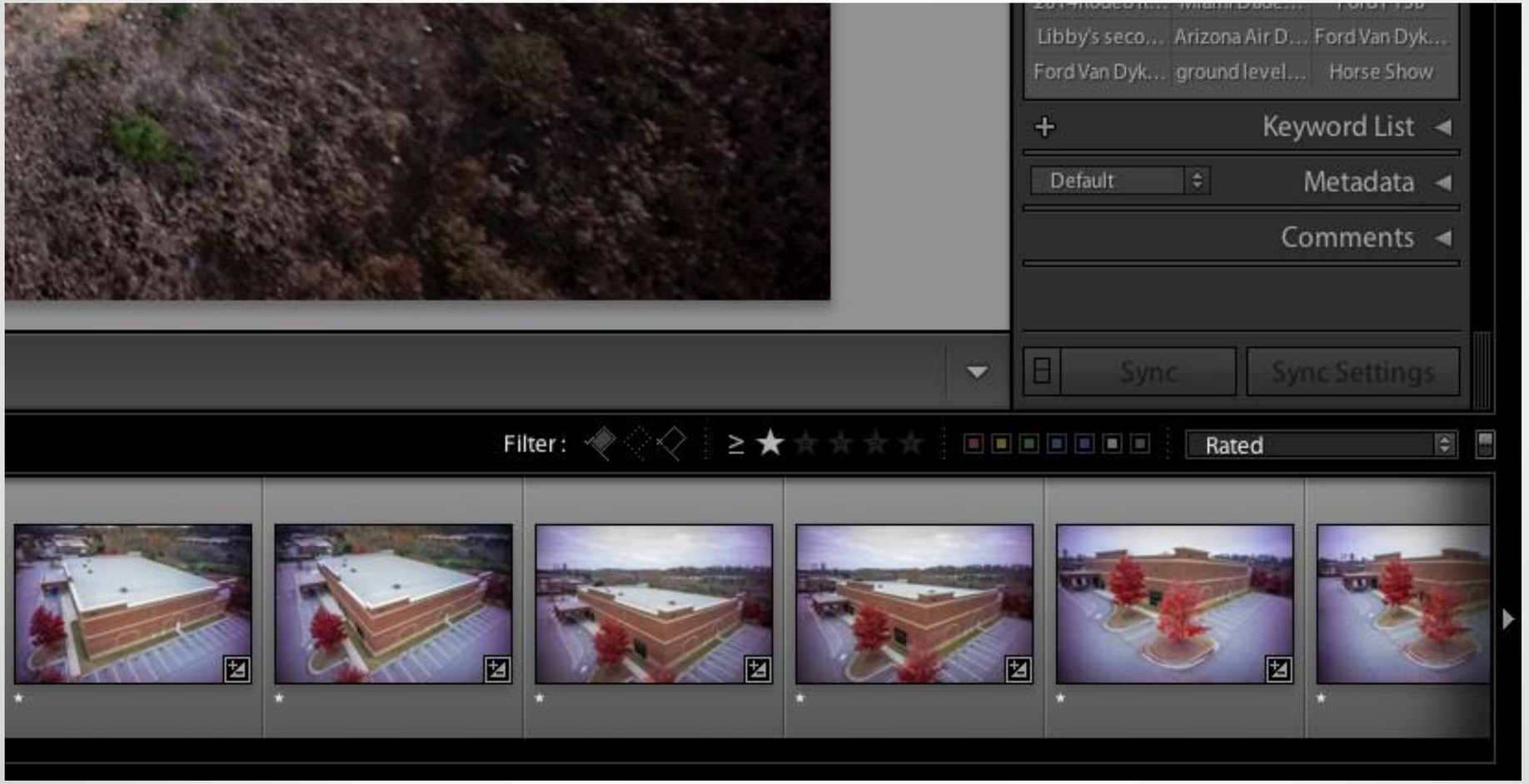


Enhancing Photos with Post Processing

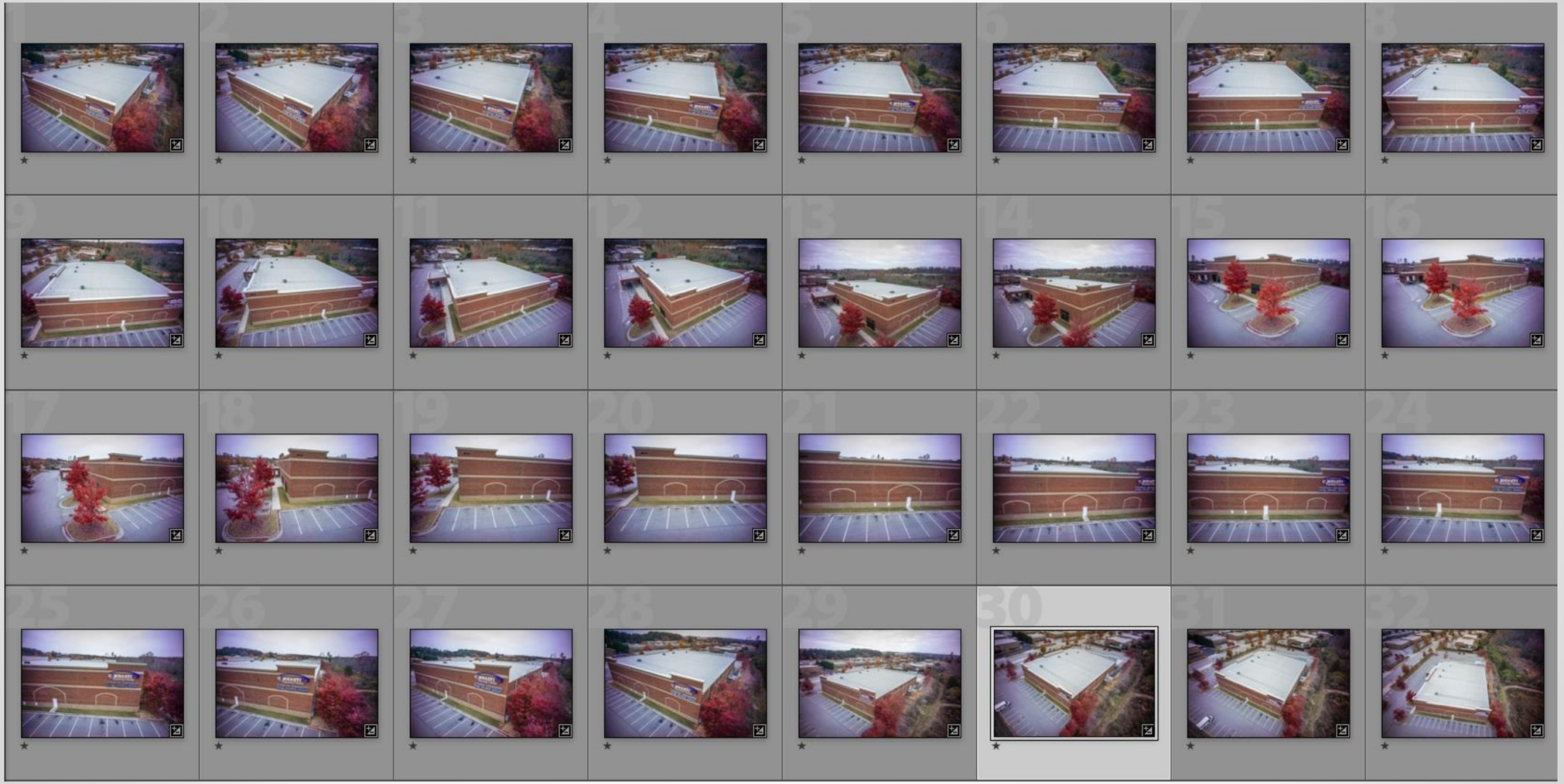
- Shoot in RAW when possible
- Lightroom used to sort & process photos
  - Weed out bad shots
  - Re-order photo sequence for best transitions
  - Revise exposure, clarity, highlights, shadows, blacks, & whites
  - Sync settings to all photos
  - Export to JPEG
- https://www.youtube.com/user/AnthonyMorganti

Weed out bad shots

Use Rating feature in LR

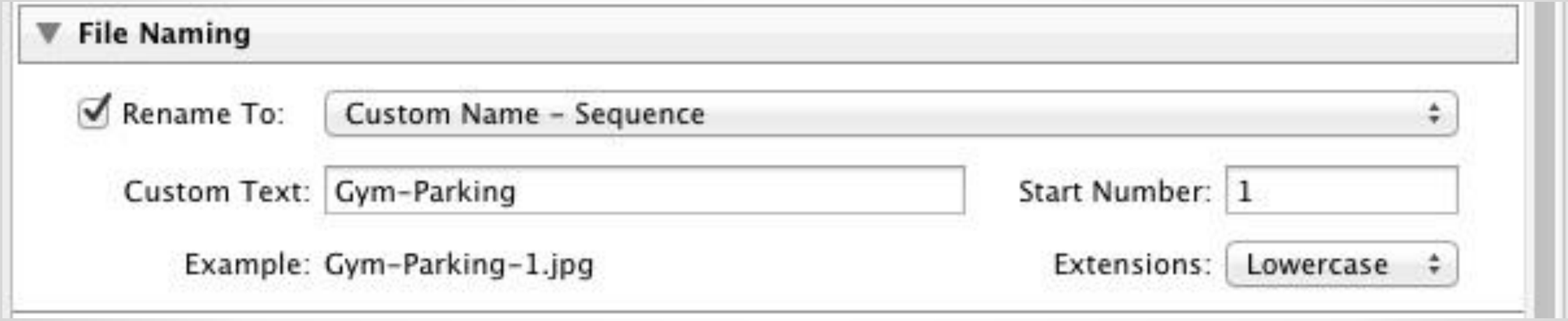


Sequence photos for good overlap



Lightroom photo re-order key

- Save File Naming using ‘Custom Name – Sequence’



Typical Lightroom exposure settings

Order of Edits:

Hightlights

Shadows

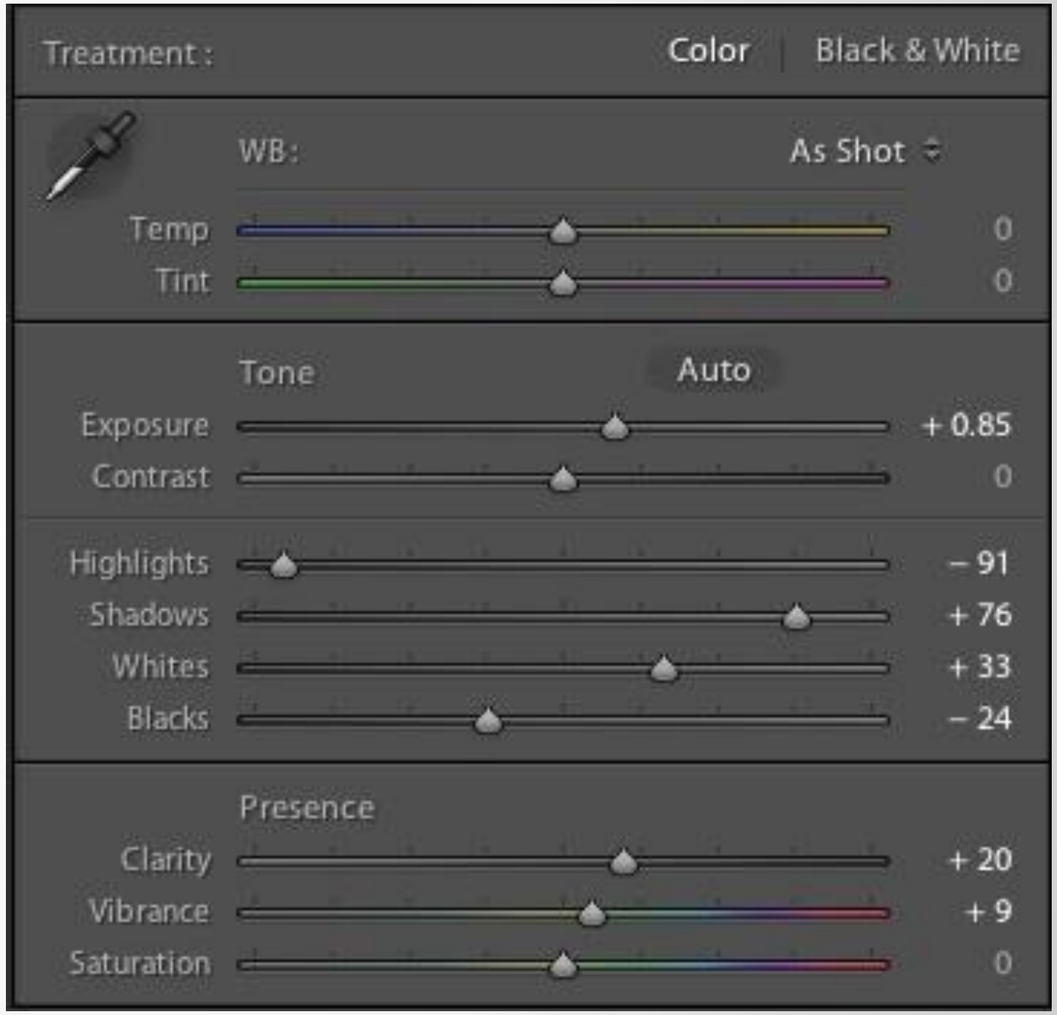
Whites (alt key)

Blacks (alt key)

Exposure

Clarity

Vibrance



Post Process Results



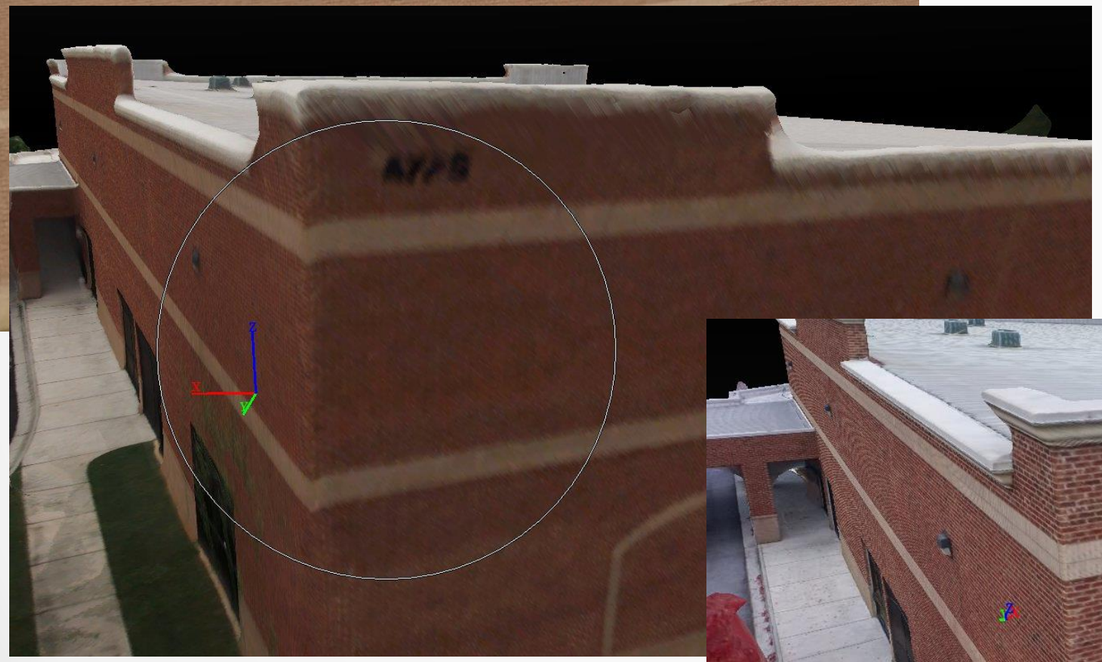
Before

After

Gym Results – Sony a7R vs. Olympus OMD vs. Gopro



GoPro Hero3+



Olympus OMD

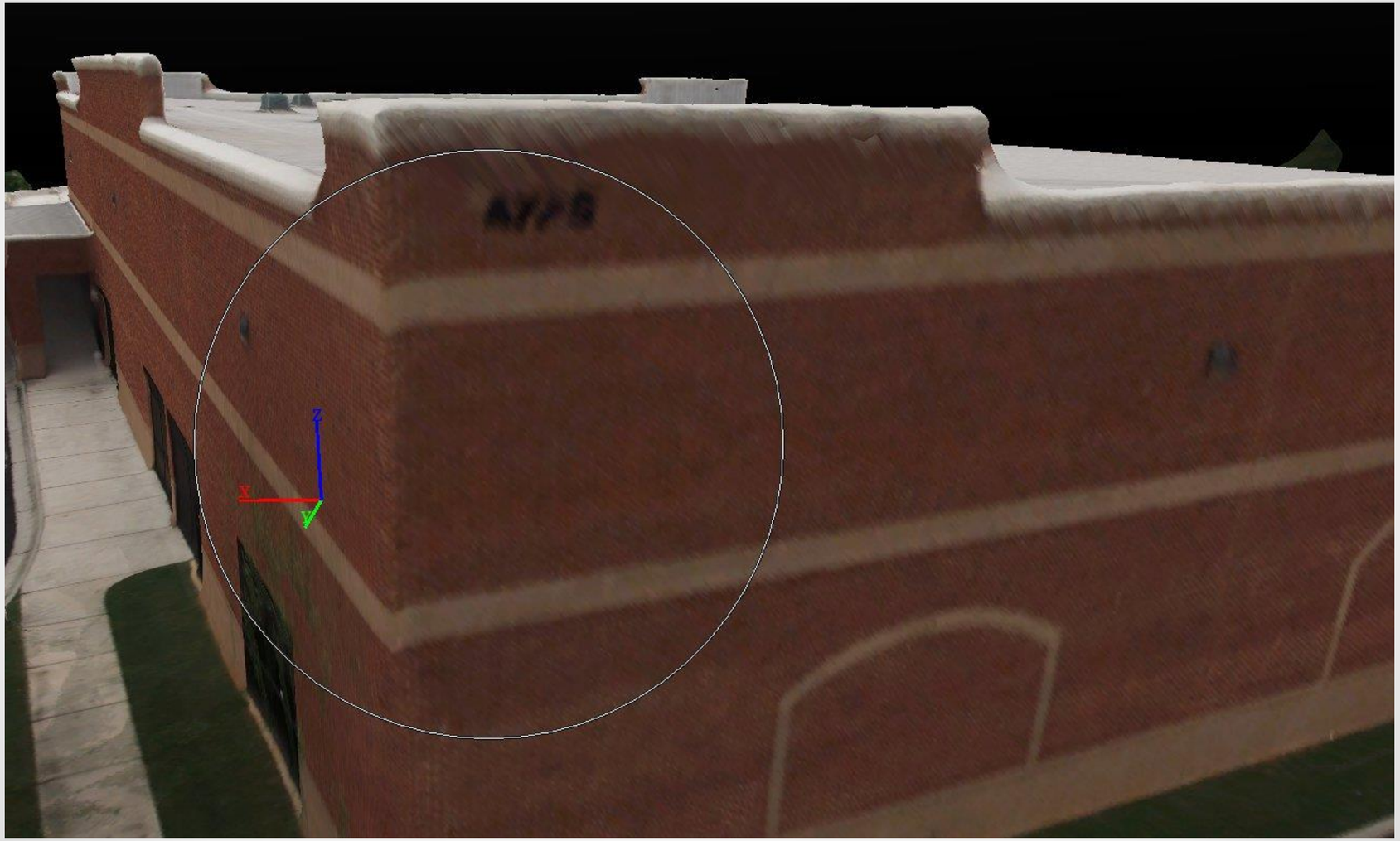


Sony a7R

Gym Results – Olympus OMD



Gym Results – Olympus OMD



Gym Results - GoPro



Bob Hughes
Mark Wagasky
Applied Software

Gym Results - GoPro



Gym Results – Sony a7R

Sony a7R



Gym Results – Sony a7R

Sony a7R



Summary: How do I get the best results?

- Use the best camera you can lift with your drone
- Flight Patterns
- Photo sequencing
- Transition Shots
- Photo Post Processing (Lightroom)

How accurate is this?



Accuracy





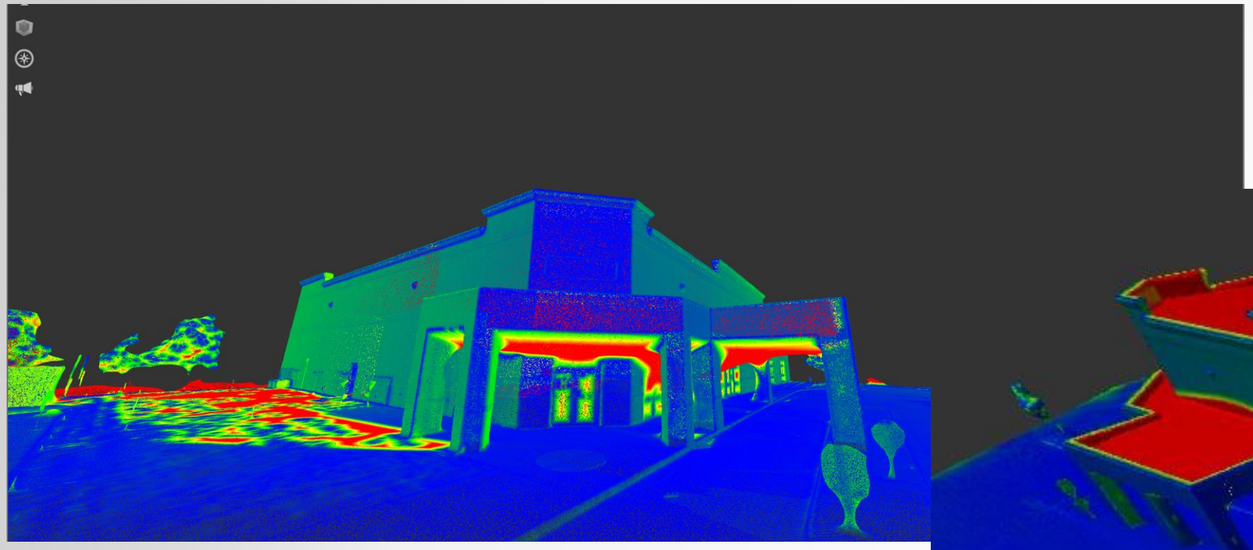


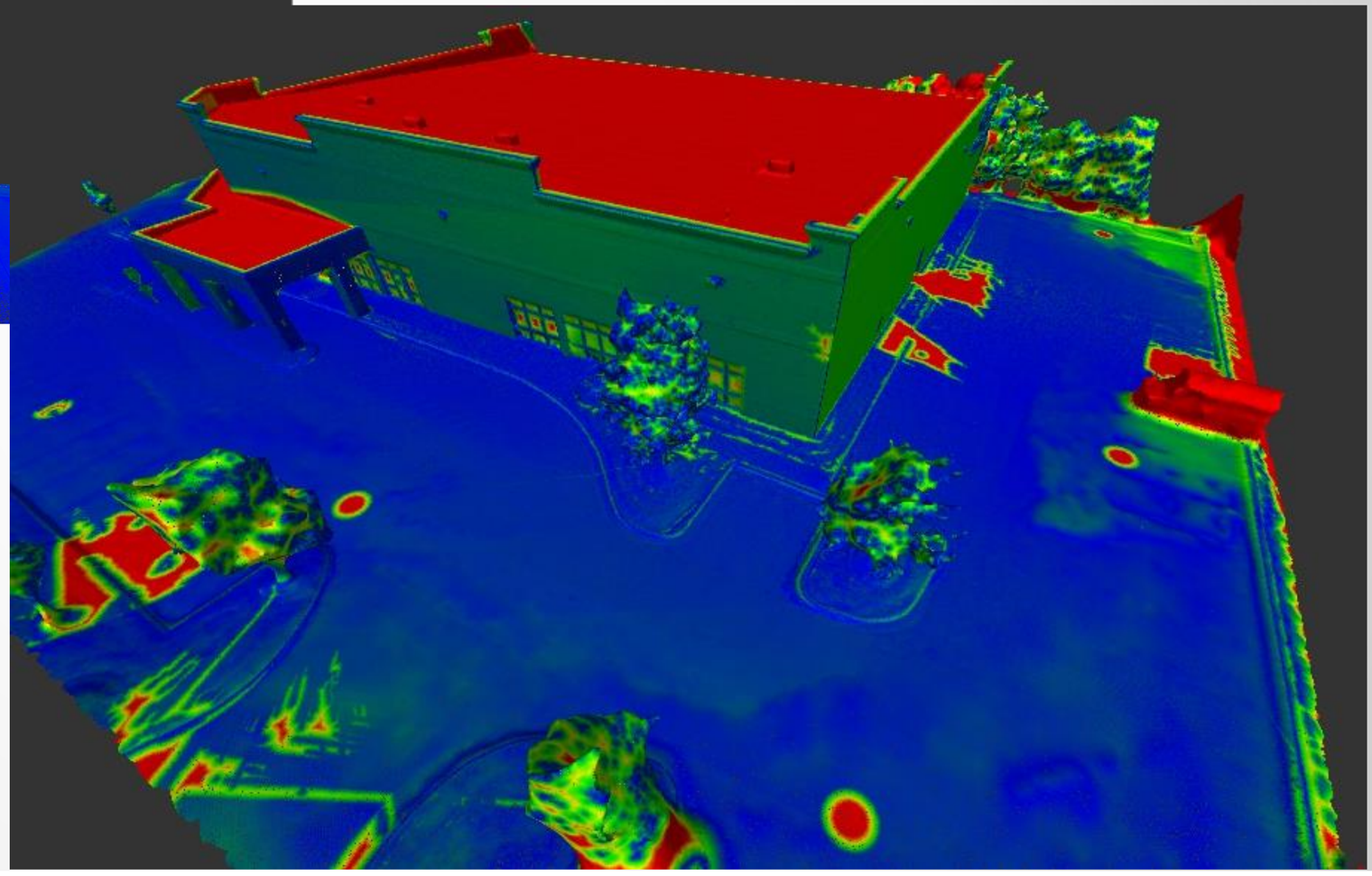
Faro 330 Scanner



Zoltan Ferenczy
Repro Products

Accuracy

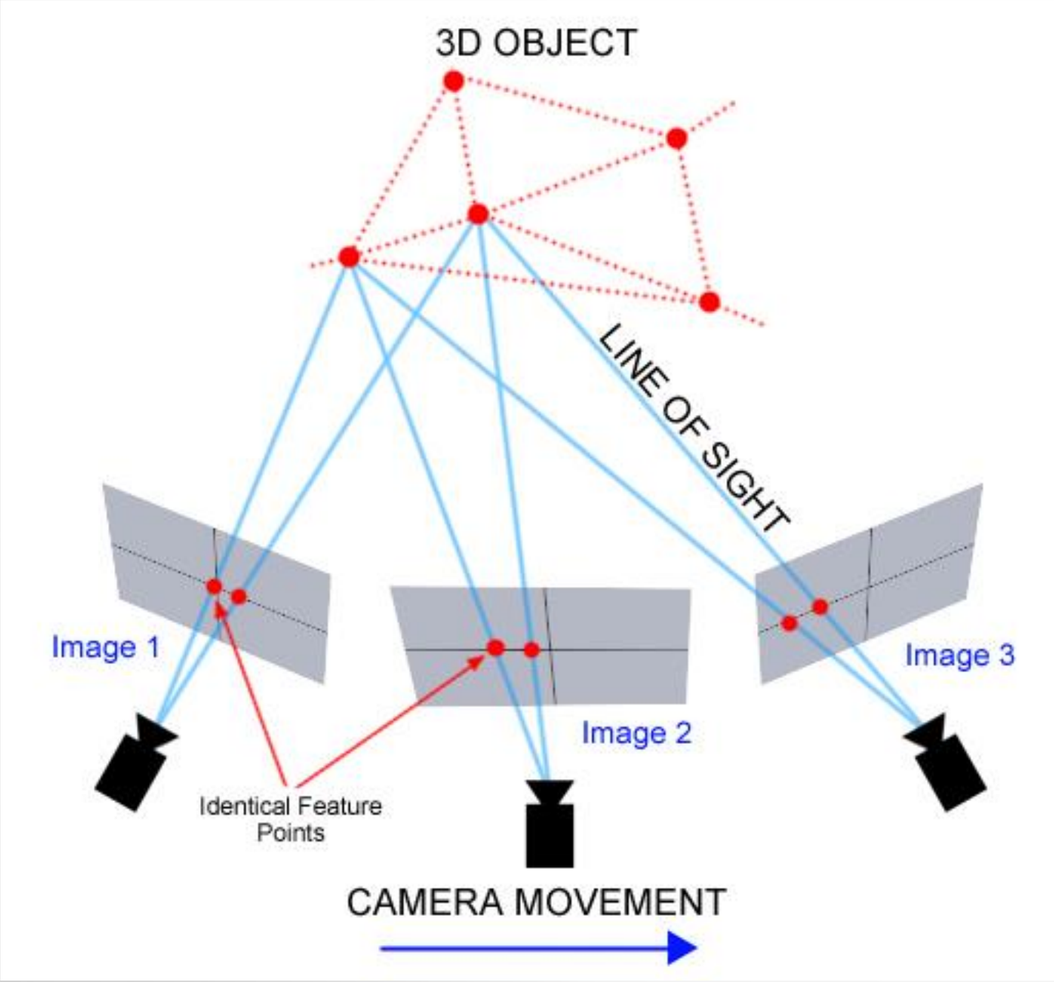




SKYCATCH

AU 2014

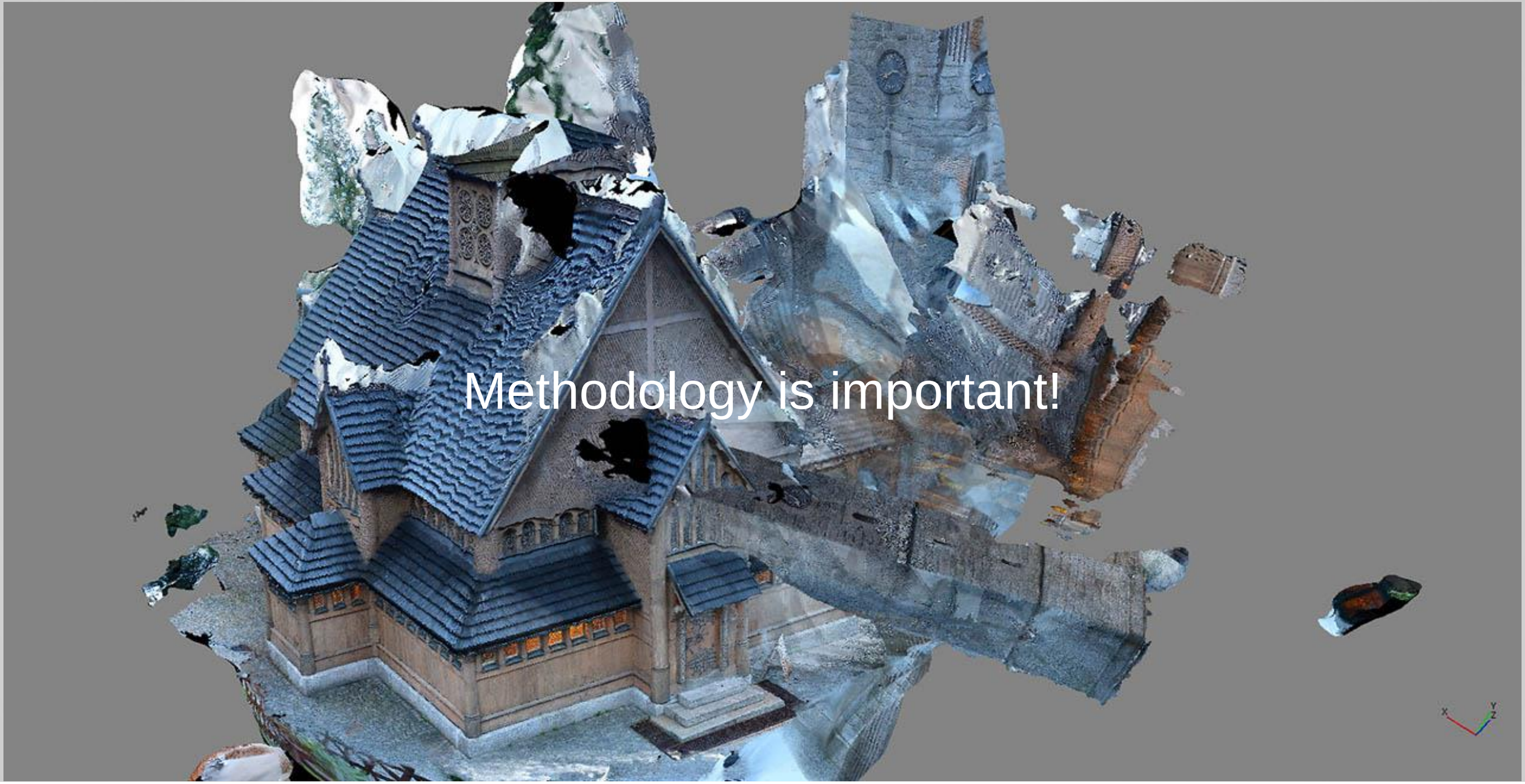
What is photogrammetry?



The application of parallax!

Triangulation of similar points in overlapping imagery: 20,000 - 40,000 points per image.

Sounds easy, right?


Methodology is important!

What the Client Wants

Drones are cool...



What the Client Wants

But data drives decisions.



UAV's in Daily Use

- Mature deployments show ROI on all stages of project
- Maximum effectiveness when used from beginning to end of project
- Major benefits:
  - Situational awareness: clash *prevention*
  - Common operating picture: a clearinghouse for ground truth
  - Common issue tracking: data is shared by default
  - Project history: daily as-builts

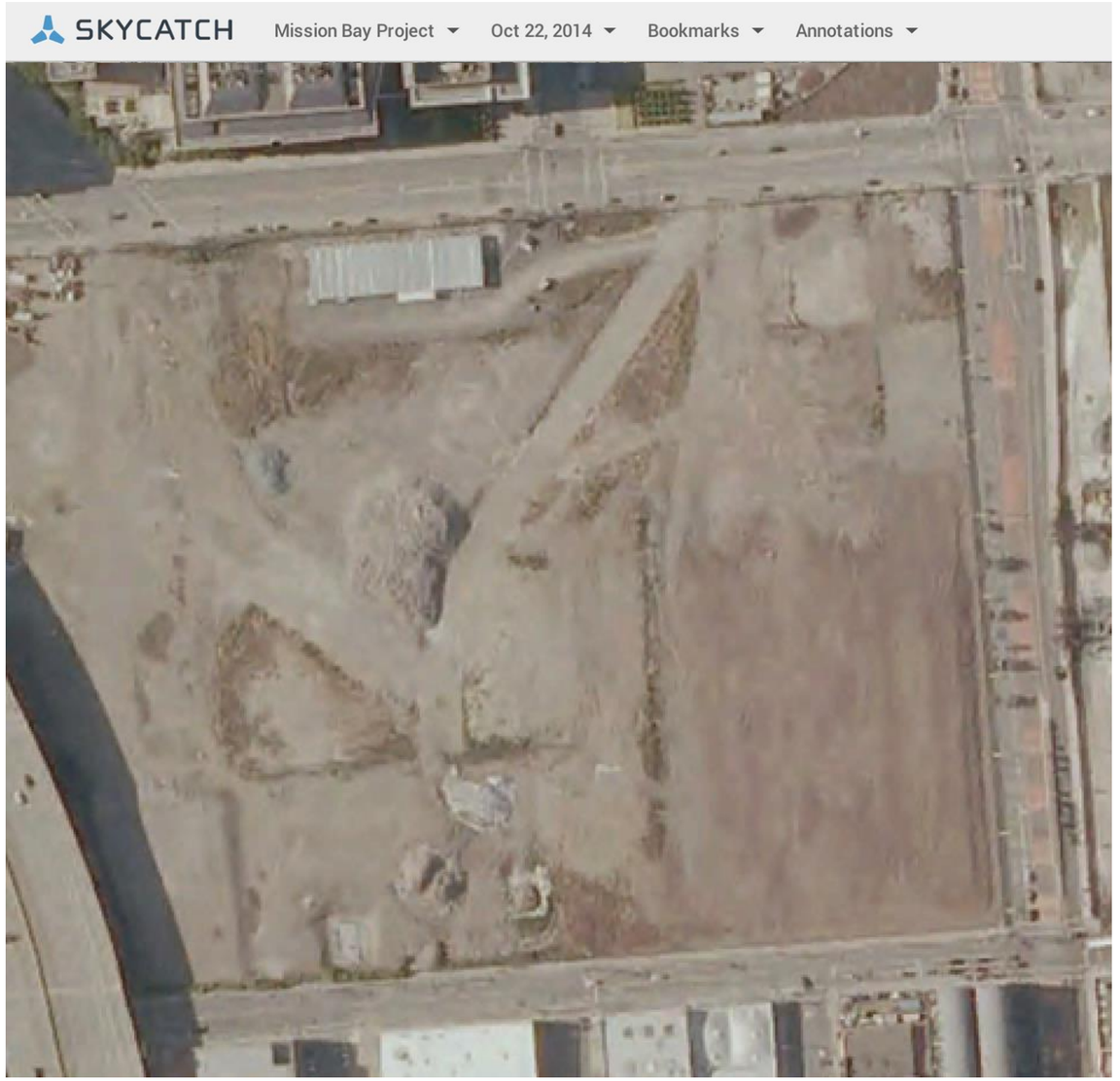




Preconstruction

Site Survey: UAV provides a *much* more thorough operating picture vs. conventional survey.

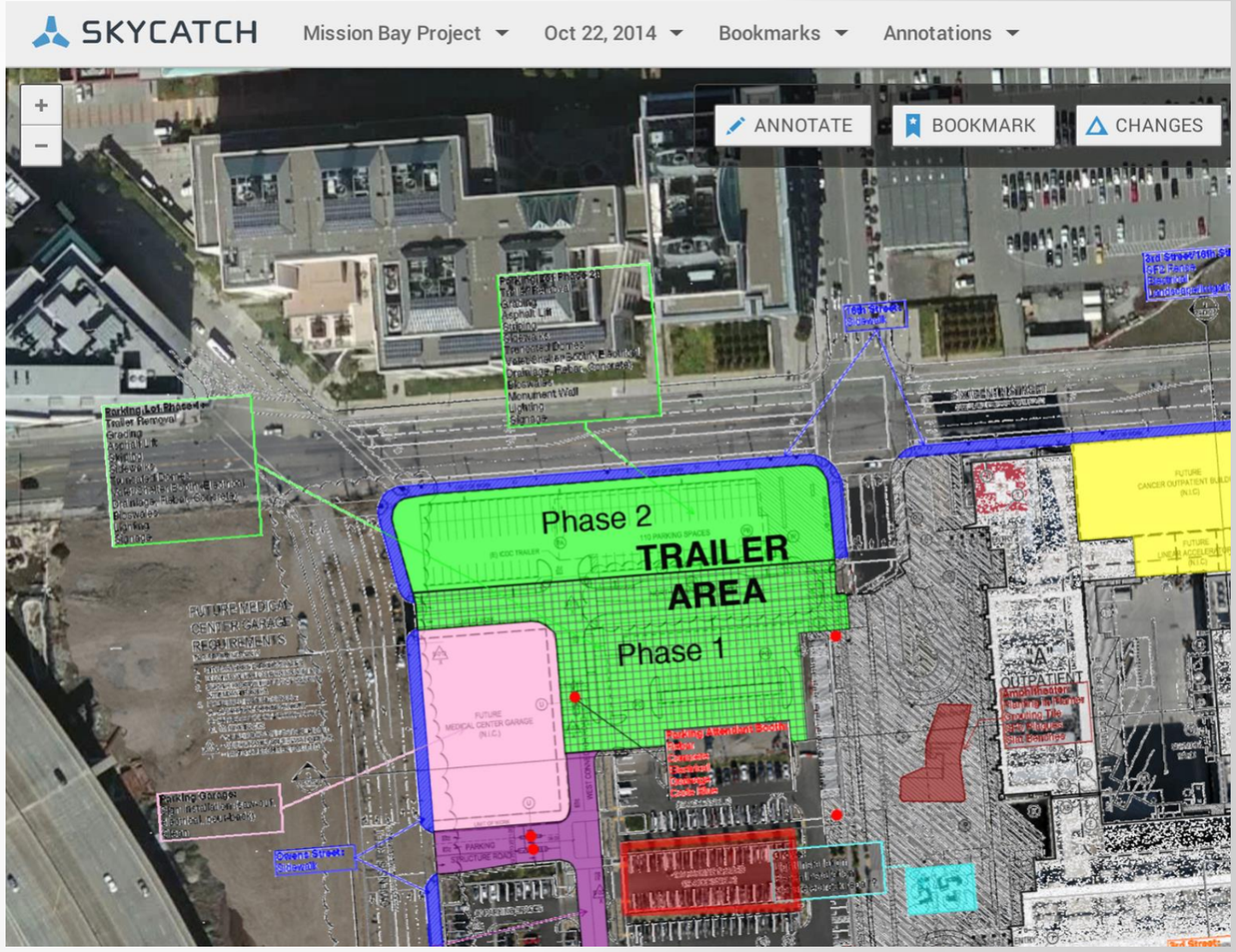
Topography, existing structures, surrounding environment are captured at extremely low cost.



Site Logistics Development

Delivering live, relevant markups and overlays that are easy for *everyone* to consume -- in office or field; designer or skilled worker.

Logistics, utilities, haul routes, traffic control, emergency access, laydown areas, landscaping, temporary facilities, etc, each have own layers and can be quickly checked for conflicts.

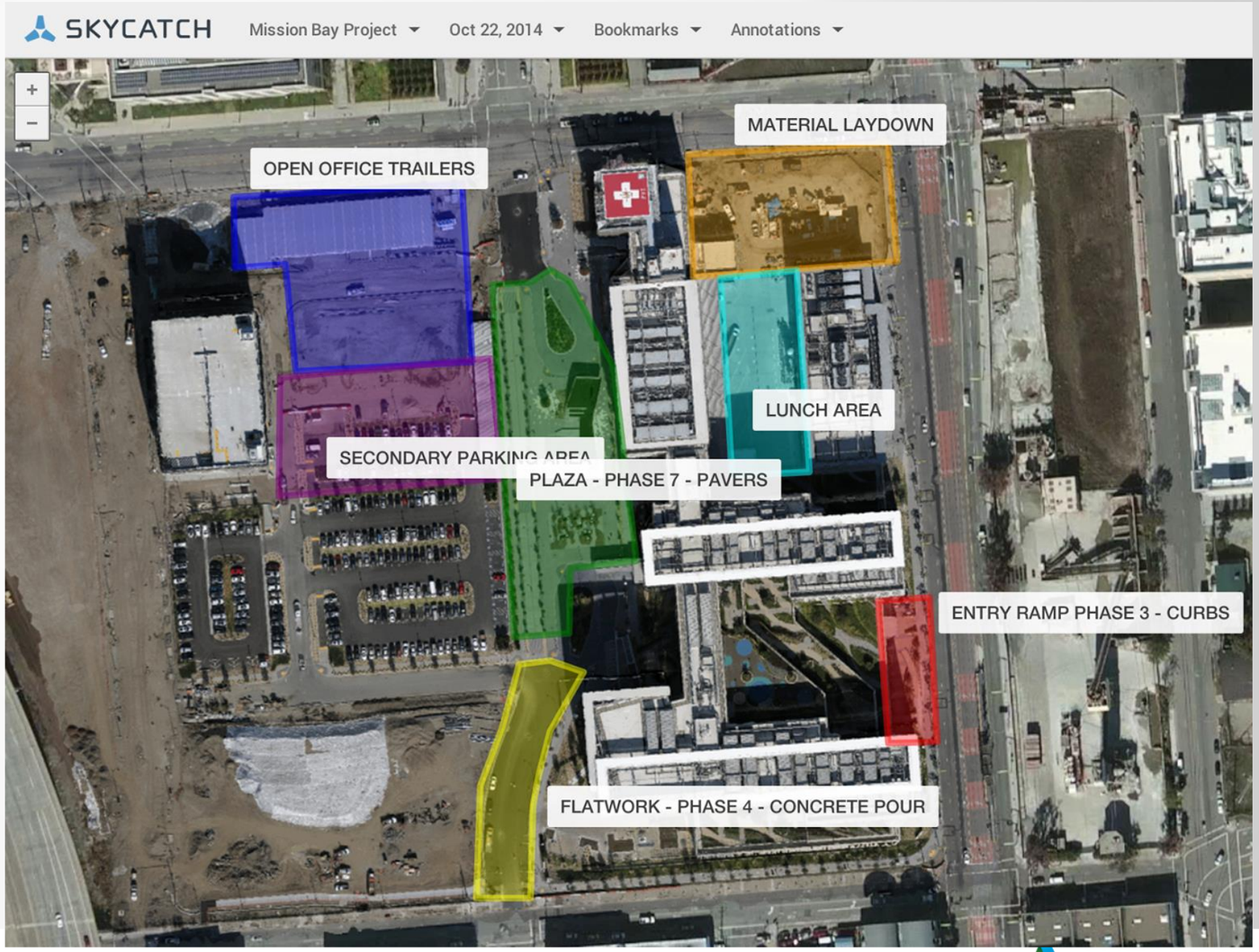


Construction Operations

Real time logistics planning:
because no plan survives contact with the enemy!

Planners can resolve conflicts before they arise using 2 - 4 week look ahead plans.

Daily safety & planning meetings use previous day's map -- data freshness is unprecedented.

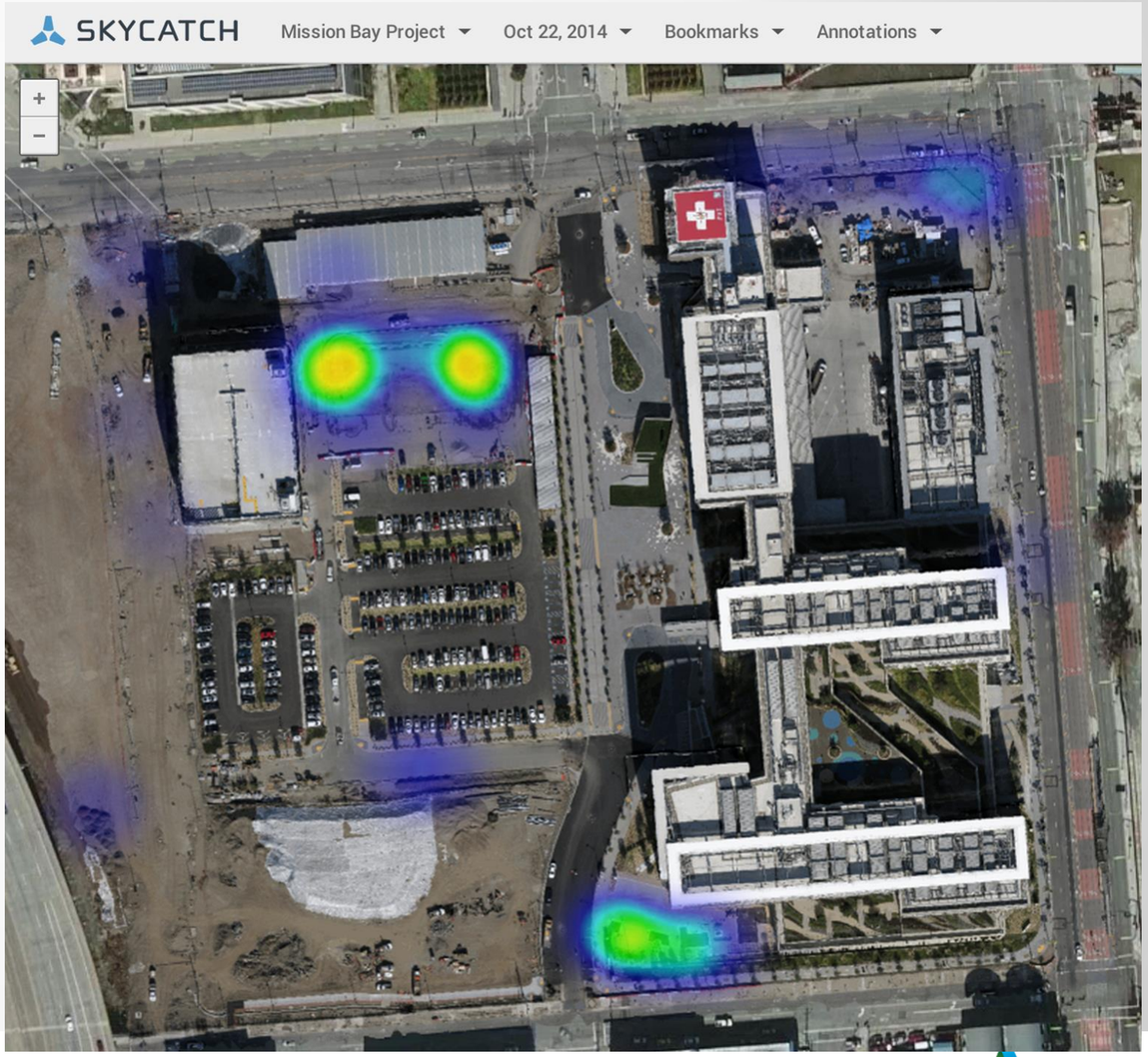


Construction Operations

Smart change detection reveals where work is being put into the site.

Computer vision software can tell apart changes in parking spaces vs. excavation, erection, etc. Only relevant changes are presented.

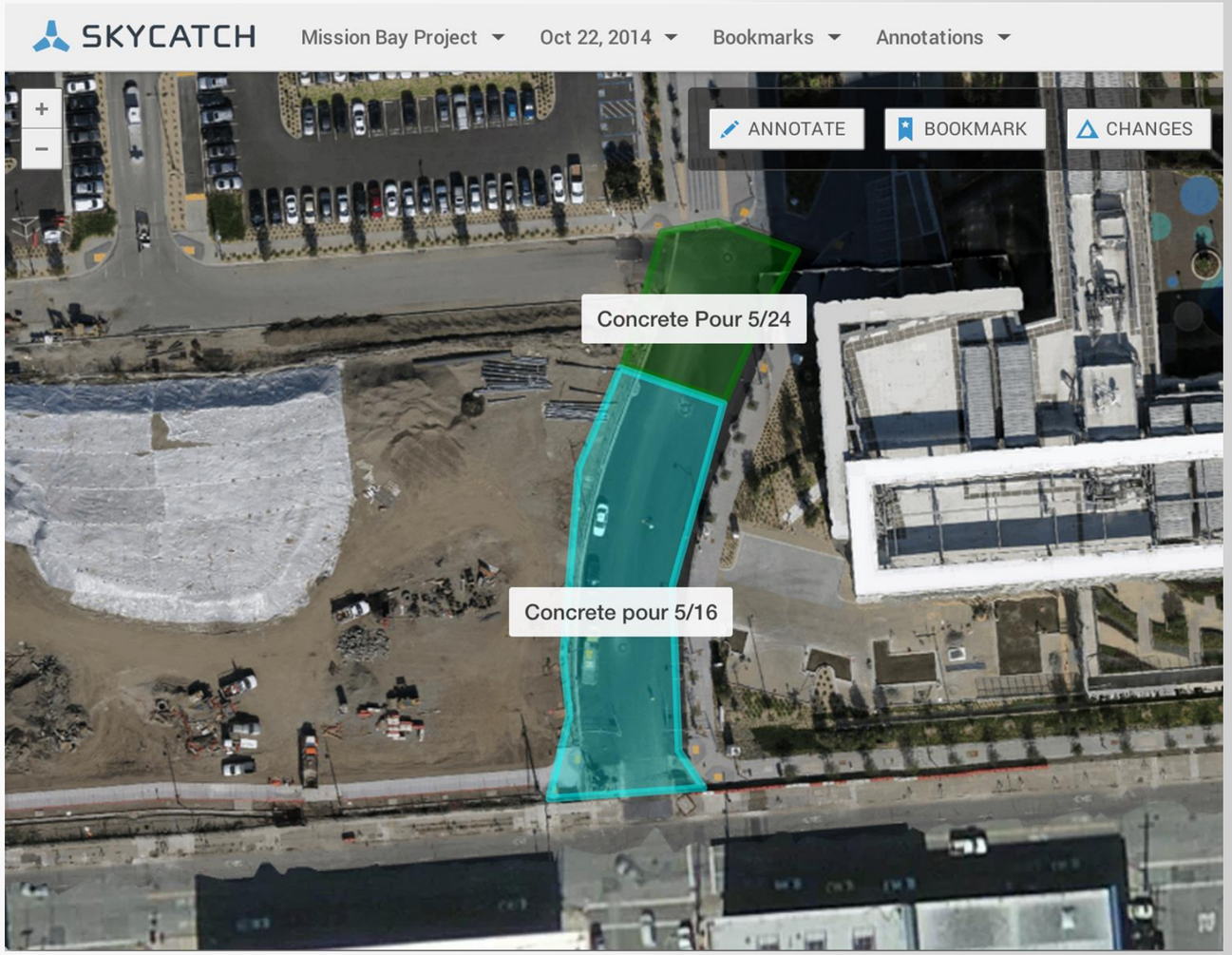
On large sites, this is critical to focusing inspection efforts and progress tracking.



Quality Control

Monitoring plans vs. progress -- persistent high level & detail view of entire site, including subcontractor performance, etc.

Historical data by default: schedule deviations can be investigated post-hoc.



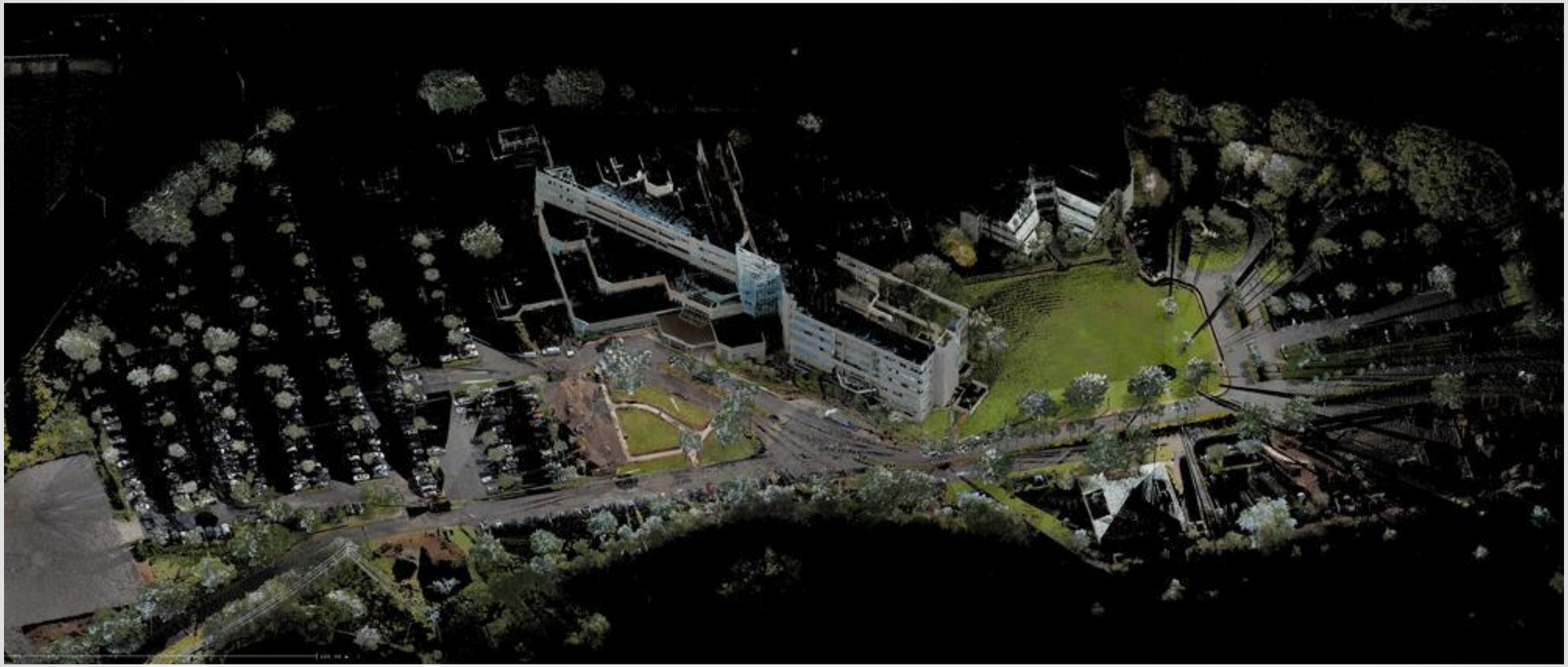
Owner Handover

Client benefits: communicate to the public about progress & ensuring their concerns are being addressed -- especially on high profile projects!

As-builts are created by default. Full history of build is documented and easy to consume.



Pushing Reality Capture Boundaries



Riegl Laser Scan: 20 acres, 6 hours, 15 setups

Pushing Reality Capture Boundaries



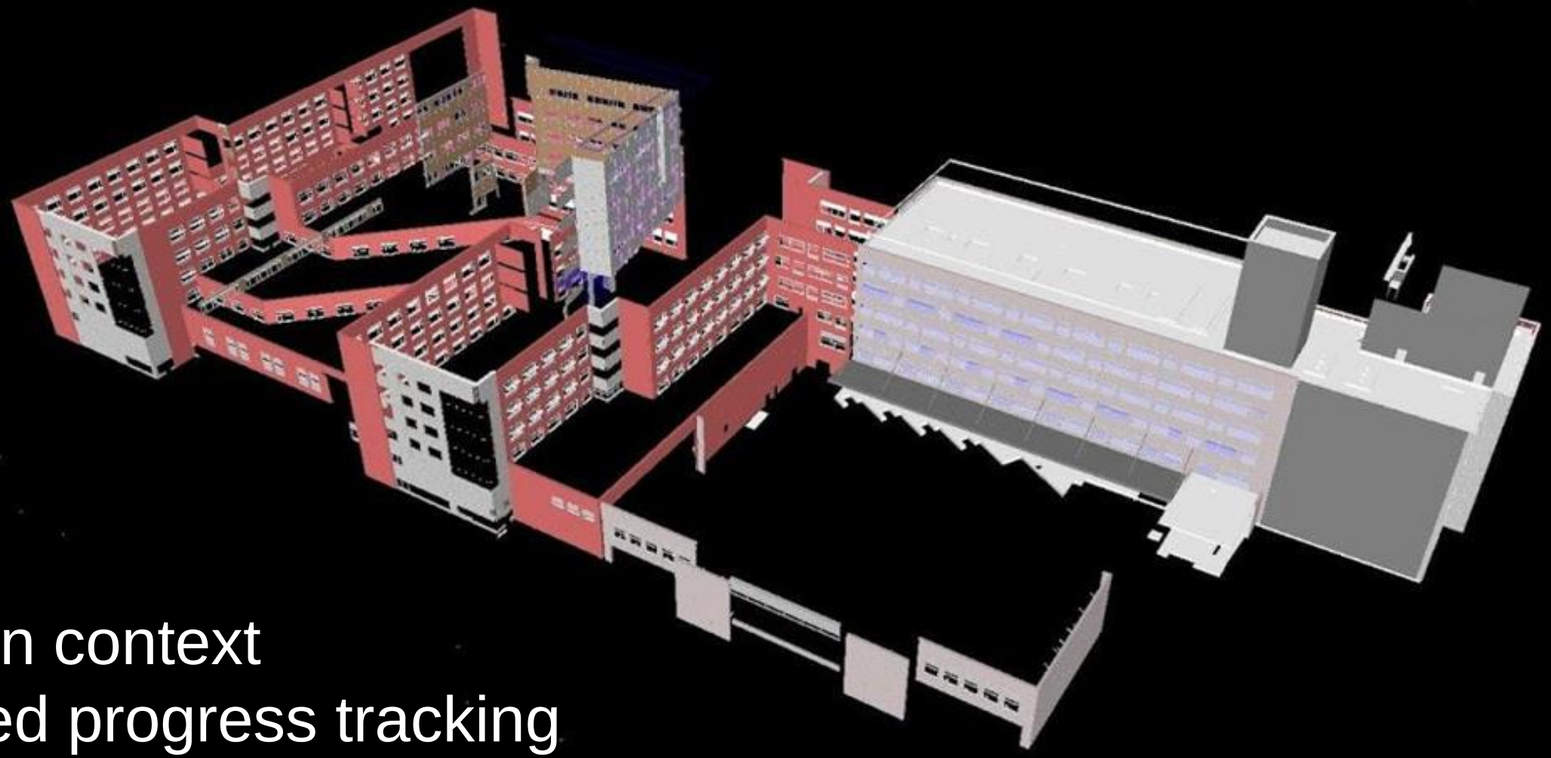
Skycatch Aerial Scan: 20 acres, 20 minutes, 1 flight

Pushing Reality Capture Boundaries



Registered scans in ReCap Pro: Skycatch within 0.05% of LIDAR

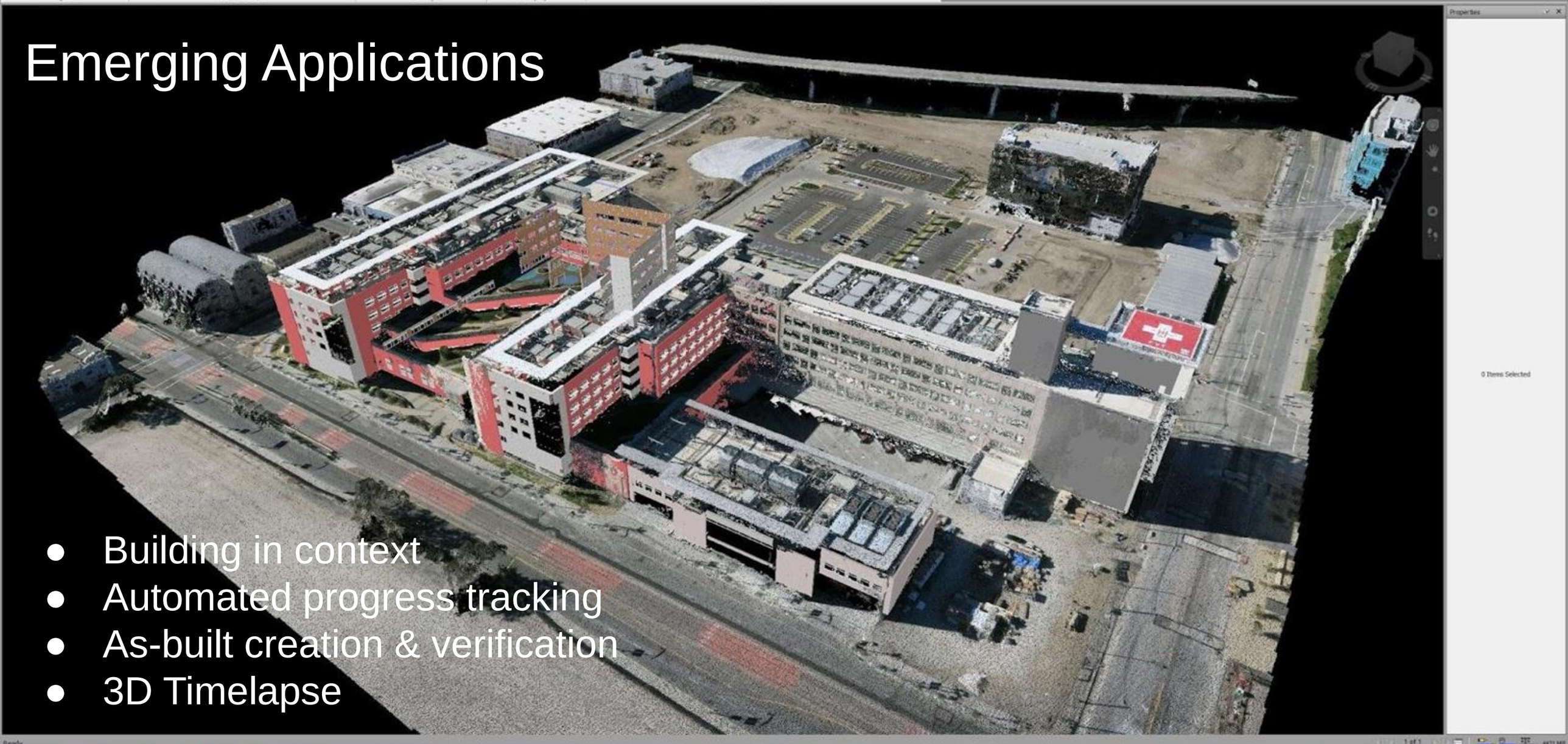
Emerging Applications



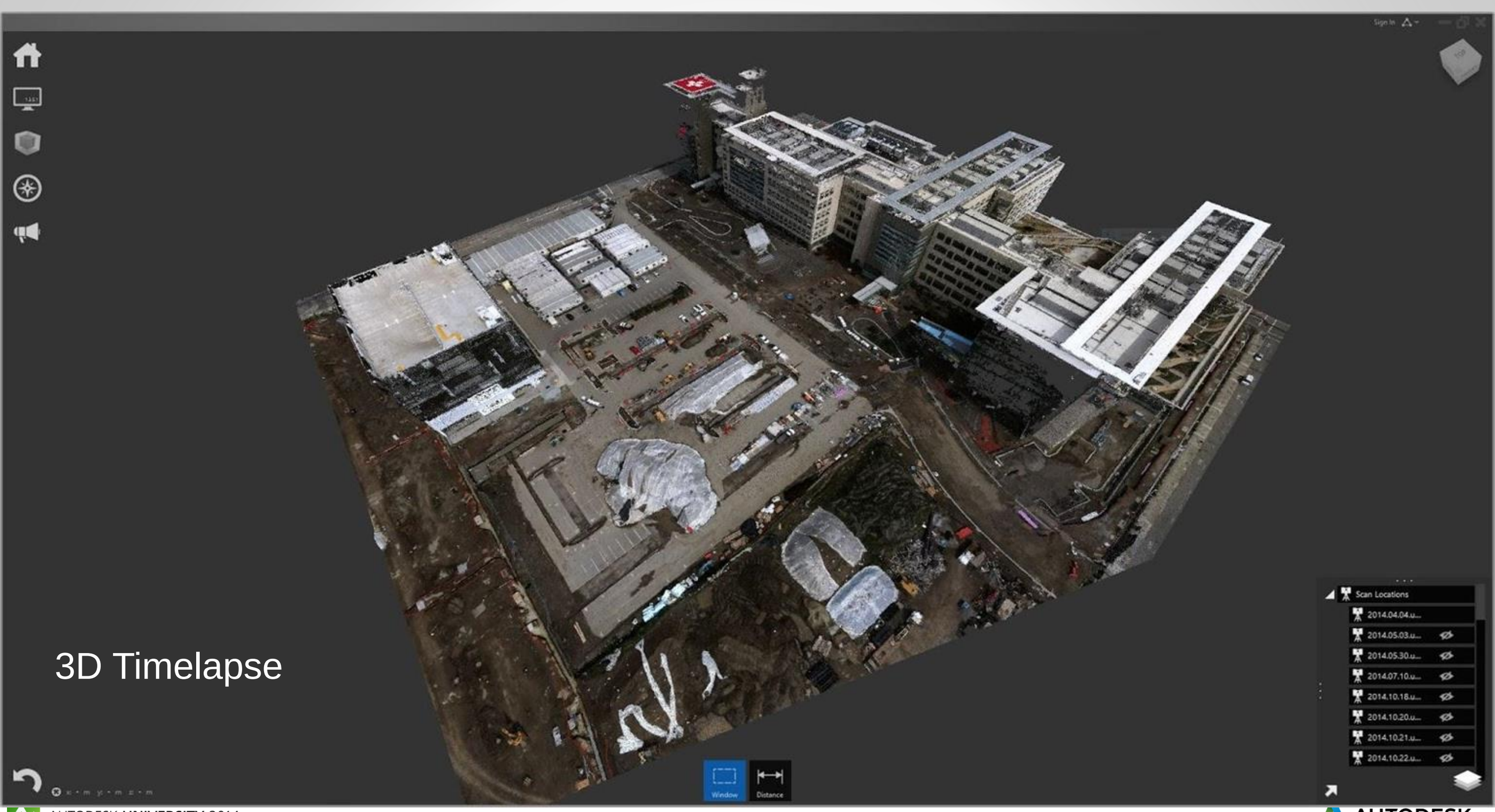
- Building in context
- Automated progress tracking
- As-built creation & verification
- 3D Timelapse

AUTODESK.

Emerging Applications



- Building in context
- Automated progress tracking
- As-built creation & verification
- 3D Timelapse



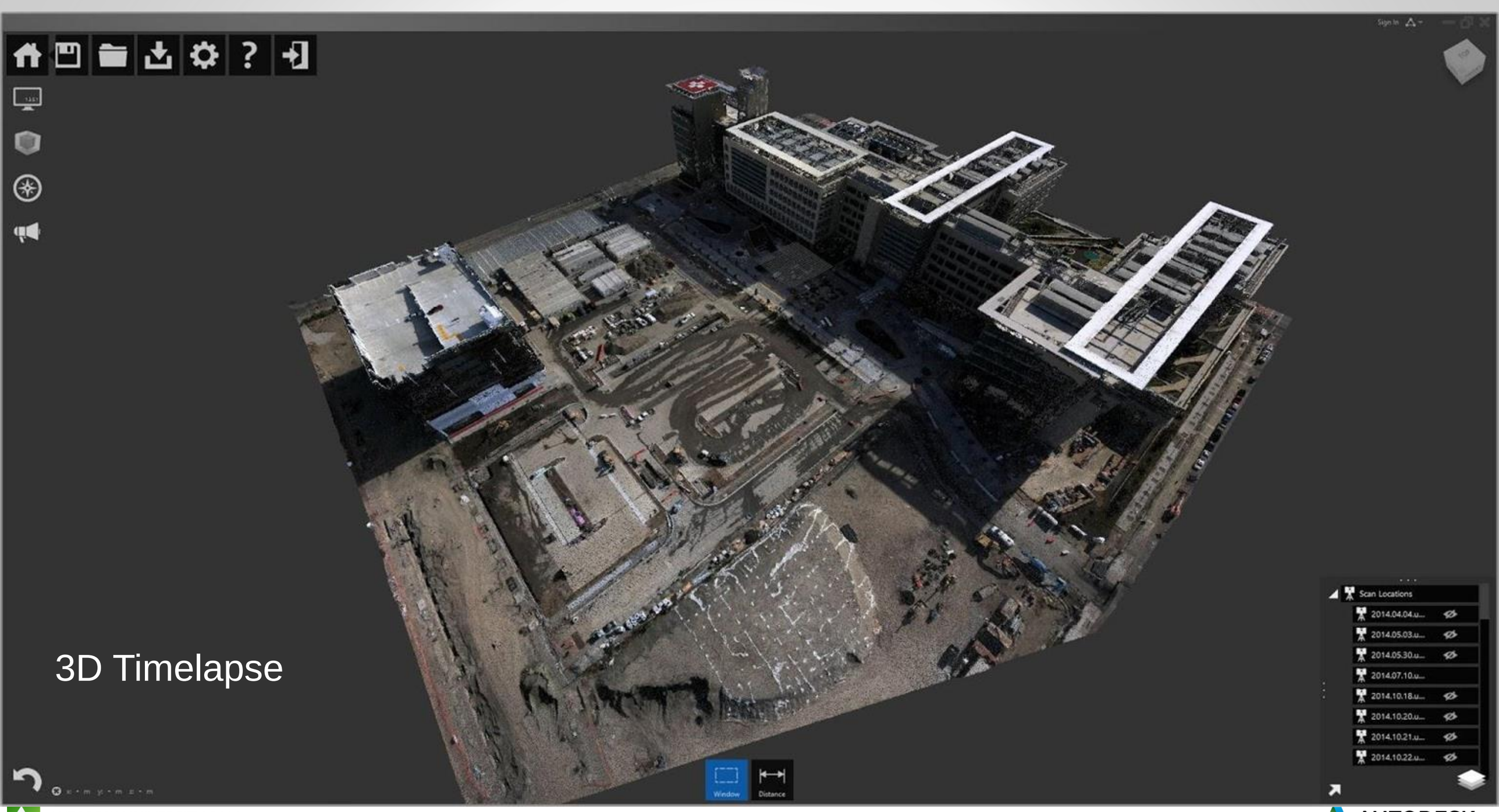
3D Timelapse



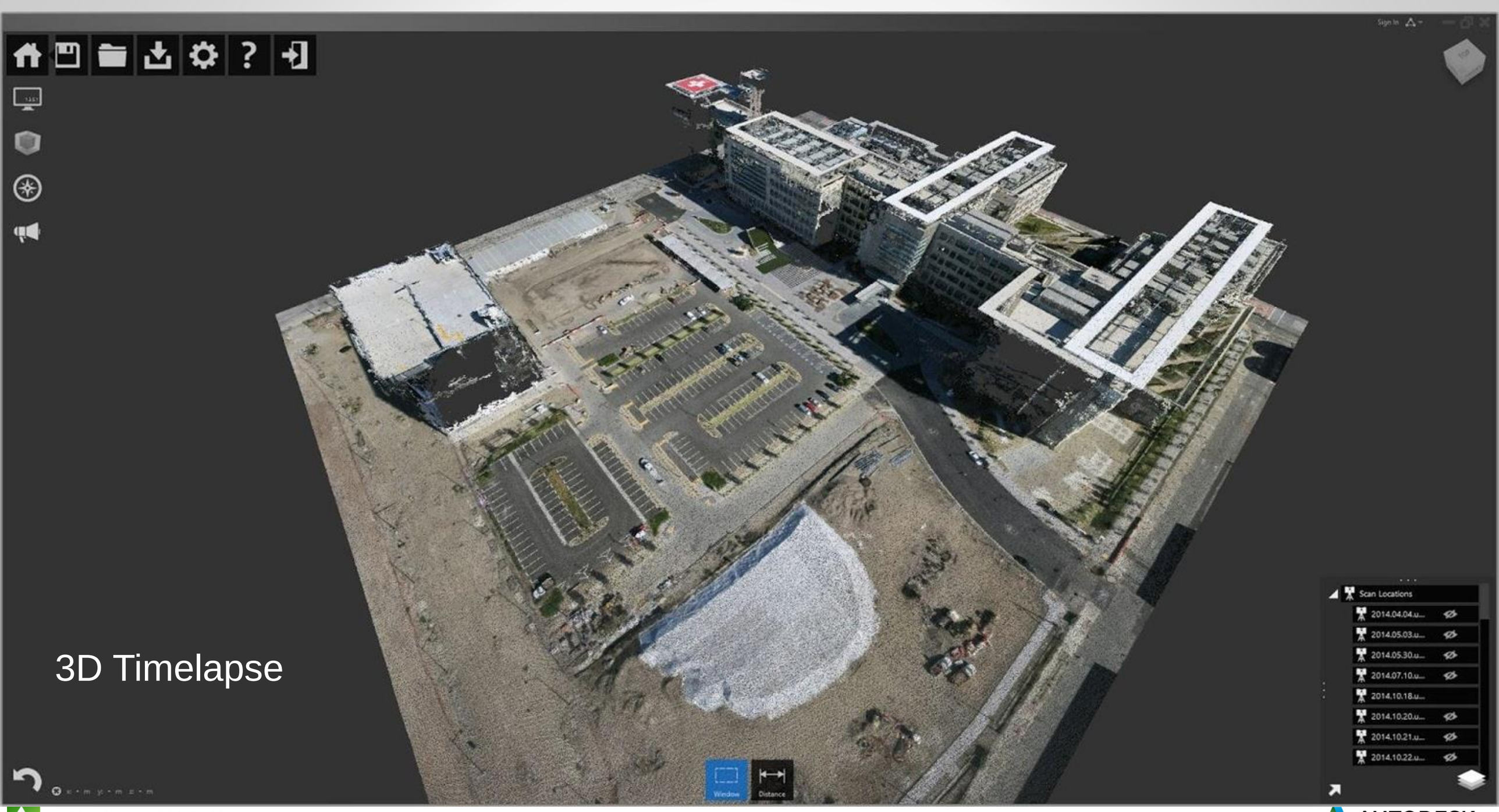
3D Timelapse



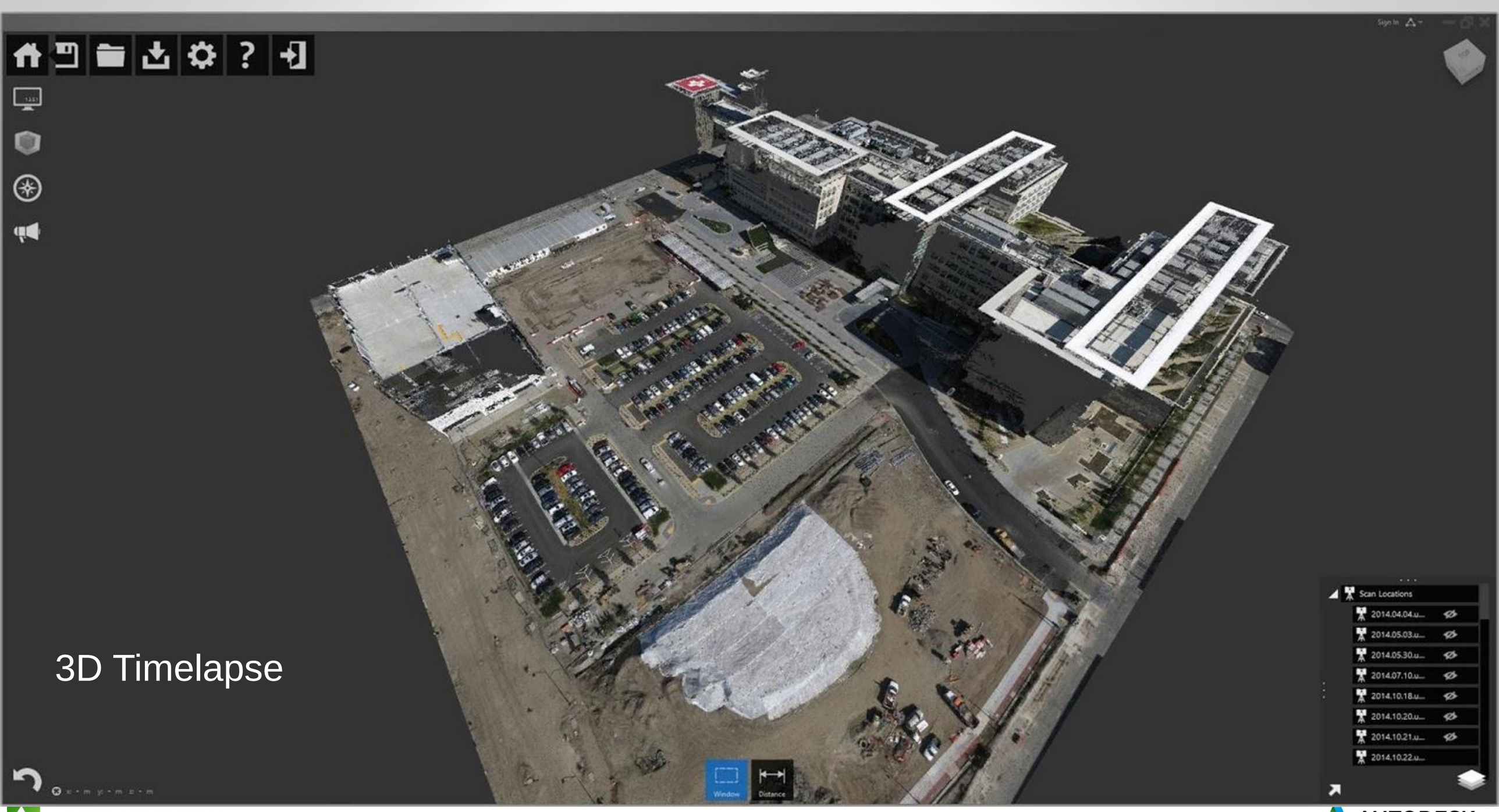
3D Timelapse



3D Timelapse



3D Timelapse



3D Timelapse



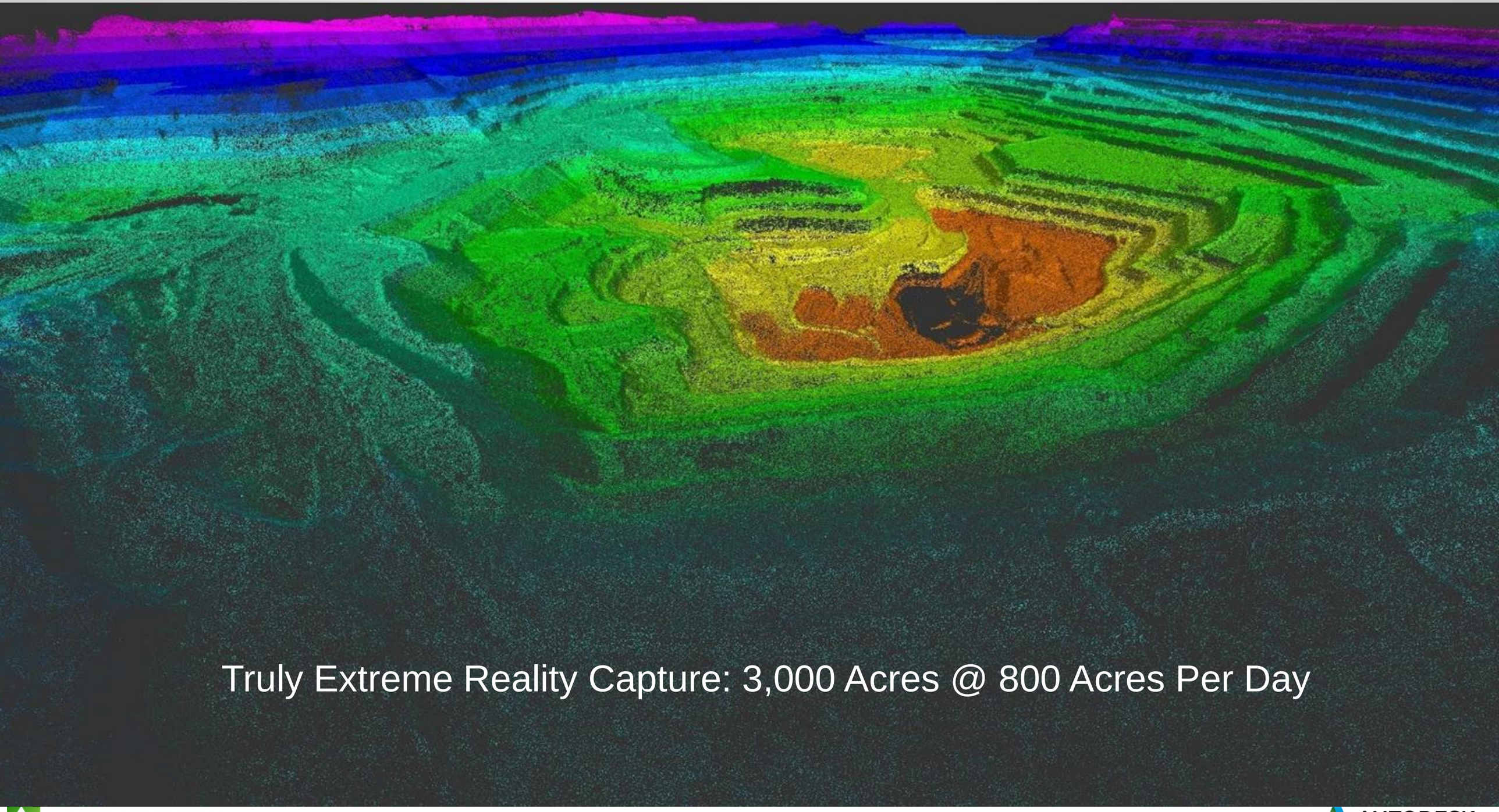
Truly Extreme Reality Capture: $2B Urban Vertical Project



Truly Extreme Reality Capture: Log Stockpile Measurements



Truly Extreme Reality Capture: 3,000 Acres @ 800 Acres Per Day


Truly Extreme Reality Capture: 3,000 Acres @ 800 Acres Per Day

UAV Regulations: How to Start Flying Today

- Positive changes in Canada and Australia deregulating small UAVs (under 2 kg)
- Regulatory environments in Europe – France, Germany, England – allow for flying today with registration
- FAA to come out with small rule by end of month or early January – will be implemented before mid-2016. Will allow for streamlined registration of UAVs in USA
- In the mean time, the FAA is allowing UAVs to fly commercially before rulemaking is completed through Section 333 exemptions. The FAA has already begun granting these Section 333 exemptions to fly, with over 70 applicants waiting to hear.

Skycatch WORKMODE™

Tools developed for enterprise deployments now available to any UAV pilot.

Low barrier to entry for orthophoto and point cloud generation -- just fly, zip, upload, and we take care of the processing and delivery.

Maps are delivered in under 24 hours and can be wrapped in your logo.



Skycatch WORKMODE™

WORKMODE Workshop:
TODAY from 1PM - 4PM.
We'll provide the drones!

Become a WORKMODE Pilot:
skycatch.com/workmode/au#join





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