Reaching New Heights
Harnessing the Potential of Drone Data Capture with Cesium

FOSS4G NA 2019
I work primarily with the community, so I’ll tell our story through their stories
Price isn’t really falling but market continues to grow thanks to improving sensors, better cameras, longer battery life, increasing ease of use

Hobby drones are projected to continue to grow, but with declining rate of growth. Commercial drones, which are already disrupting agriculture, insurance, construction industries are expected to find new markets and further transform existing markets.

Growth of drones

Projected Number of Model Drones in USA

Projected Number of Commercial Drones in USA

Projections from FAA Aerospace Forecast Fiscal Year 2018-2038,
Onboard sensors: high res still or video cameras, LIDAR, radar, altitude sensors, infrared cameras, low-light cameras

https://www.dronecommunity.biz/drones-data/: a small drone fleet could easily create 150 terabytes of data per day

More data is great, but you quickly become buried in it
What do you do with all that data?

The aliens have the answer ...
Oblivion: Tom Cruise fighting alien drones

We don’t support the robot apocalypse, but we do want to handle data as well as this drone:

Gorgeous live data feeds sent back to human partners, and we want to create visualizations as sophisticated as this drone’s eye, with tracks, terrain, 3D views, interactive movement, etc.

We can’t follow DNA tracks yet ...
3D Tiles: Designed for true 3D with a free-roaming camera
- Streams only visible tiles
- Supports interactive selection and styling
- As accurate as your data

https://cesium.com/cesium-ion/
https://cesium.com/content/cesium-world-terrain/
https://trendspek.com

Classic use case

They have super high resolution data that they need to be able to share with remote inspectors.
3D Tiles makes that possible

Cesium ion: Use Cesium because it’s compatible with 3D Tiles
With ion they’re able to fuse their data with Bing maps for context
https://trendspek.com

Stream extremely high res images with 3D Tiles through Cesium ion
• Tools including
  • compare models
  • timeline viewers
  • click for original full resolution image of point in a tileset
  • measurements

https://trendspek.com
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Lots of nice interactive tools to enable collaboration
The Propeller Platform creates highly accurate data visualizations from aerial imagery acquired by drones. Work sites and assets can be explored, measured, and annotated in 2D and 3D maps, as well as in point clouds and photo inspection models. Propeller Platform is used for site design and progress tracking, land surveying, remote asset inspections, and stockpile management, to name a few applications.

Propeller: https://www.youtube.com/watch?v=szXqC6NW3fA
• 3D map built on CesiumJS
• Resolution up to 1 cm/pixel

Ref: [https://www.propelleraero.com/propeller-platform/](https://www.propelleraero.com/propeller-platform/)

CesiumJS: Interactive 3D, time dynamic visualization of multiple data types with accuracy as good as your data
• 3D map built on CesiumJS
• Resolution up to 1 cm/pixel
• Uses orthophotos, high-resolution terrain, point clouds, and contours

Ref: https://www.propelleraero.com/propeller-platform/
Interactive tools allow users to measure from points, lines, areas, and volumes directly on the Cesium map. Measured quantities are visualized in Cesium using custom geometry, and the shapes used also show in the photos.

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- Resolution up to 1 cm/pixel
- Uses orthophotos, high-resolution terrain, point clouds, and contours
- Take measurements directly on the map

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• Take measurements directly on the map
• Compare data captured over time

Ref: https://www.propelleraero.com/propeller-platform/
Plan flights and monitor them in real time
Assess navigation errors, communication link margins, and FAA airspace incursions.

Fuses web-based visualization with back-end API analytics to bring enhanced flight-planning and safety analytics to commercial drone operators

OneSky’s apps on the DroneDeploy App Market provide
a flight’s predicted height above the terrain throughout a planned route
a one-hour forecast of the number of GPS satellites available in a flight’s range as well as the positional accuracy those satellites will likely provide.

Unmanned Traffic Management (UTM) framework product.
Traditionally, the drone flight community has used 2D maps for mission planning and flight tools.
we wanted to instead represent airspace in 3D to provide better situational awareness for pilots and users of the framework.
• UTM flight planning:
  • airspace represented by 3D volumes (served as 3D Tiles)

Makes it easy to identify potential navigation errors, communication link margins, and FAA airspace incursions.

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Image from https://onesky.xyz/gettingstarted
In addition to air volumes, you need to see potential terrain or building intersections, especially for urban environments.
Useful to confirm that an expected number of satellites will be available throughout the duration of the operation as well as an overview of the navigation solution's quality in terms of Dilution of Precision.

Sophisticated analysis tells you if drone will be have appropriate precision and connection to navigation guidance at any given planned flight time.
Currently the command, control, and data exchange between a UAS and the pilot in charge is accomplished via direct RF communication. The limitation in this scenario is the ability of the pilot to maintain communication with the aircraft at longer distances and in more challenging environments, such as urban landscapes with dense buildings.

An obvious solution to this could be relying on cellular networks. With networks boasting coverage areas across a majority of the country, it would perhaps make sense to allow drones to communicate across them, breaking the tether of a direct point-to-point communication link. This could enable autonomous flights to be monitored and controlled from longer distances well beyond line of sight, which of course is the current restriction. OneSky has begun using their existing modeling and simulation capabilities to look into this issue a bit deeper. The unique aspect here is the ability to model urban environments such as buildings and terrain, and look at RF communication system capabilities within these environments.
In the example below, is downtown Nashville, TN with only two cellular towers being modeled. You can see the difference in expected received signal strengths between the first analysis being done at roughly ground level height, and the second being done at 200 ft above ground level. It is easy to see the impact that these buildings have on the RF signal’s ability to propagate throughout the area.
Leading cloud-based platform for commercial drones

World’s largest drone data repository.
Have been gathering increasing amounts of data
Users upload captured imagery to the cloud and use it to create and share detailed maps and 3D models.

Massive photogrammetry models and point clouds

Our 3D Tiling pipeline tiles data into 3D Tiles for easy visualization
DroneDeploy’s custom app uses Cesium ion’s 3D tiling pipeline to efficiently visualize massive datasets, even on mobile.
And many more ...

- Asset inspection
  - monitor high radio towers
- Insurance
  - assess roof damage and cause
- Construction
  - monitor building progress
- Mining
  - analyze earth movement
- Forestry
  - count trees
- First responders
  - deliver medical supplies

cesiumjs.org/demos
What are you building?

• Share your Cesium or 3D Tiles story
  • Sarah Chow, sarah@cesium.com
• For the latest on Cesium:
  • 5:30, E4. Omar Shehata
  • Making Massive 3D Data Accessible: What’s New and What’s Next for Cesium and 3D Tiles?
• Come by the Cesium booth to talk more