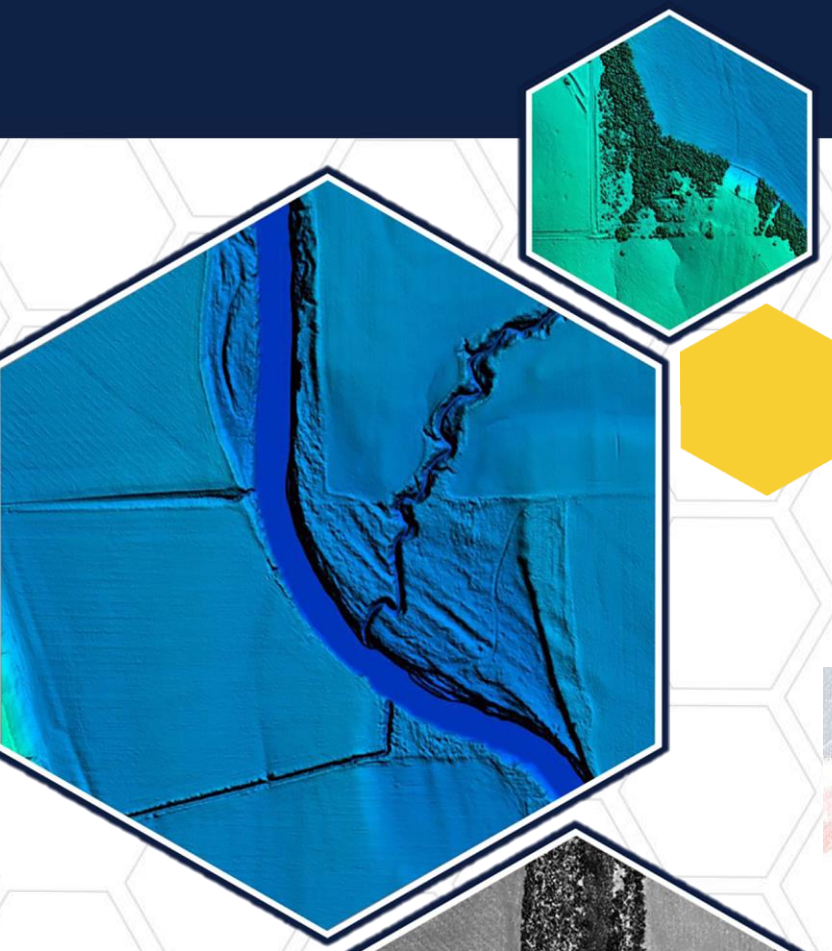

Utilizing Technology for Civil Engineering Solutions: UAS vs. Manned Aircraft

ASCE
AMERICAN SOCIETY OF CIVIL ENGINEERS

MONTGOMERY BRANCH
www.montgomery-asce.org

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Business Development Associate, Atlantic

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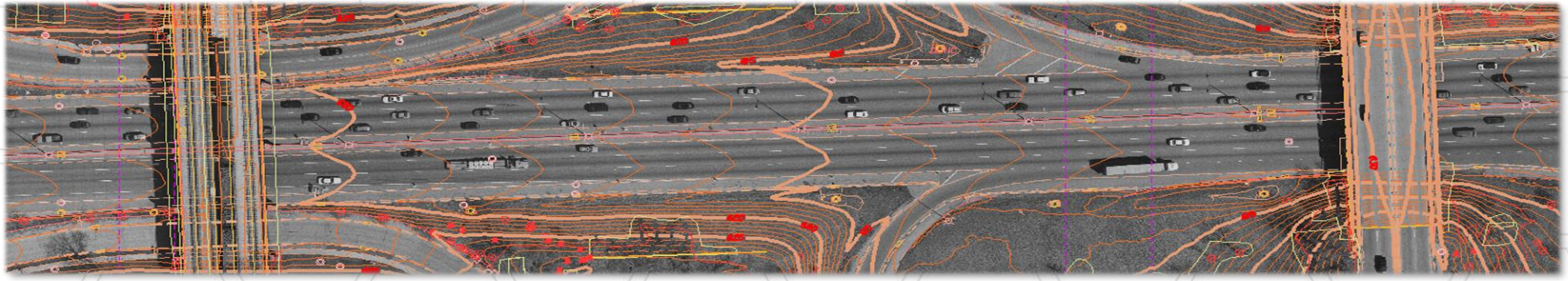
Overview

- Introduction to Aerial Surveying and Photogrammetry
- Manned Aircraft – Proven Solutions, Effective Mapping
- Unmanned Aircraft – Emergence, Innovation, Limitations
- Which platform makes sense? Why?



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Aerial Surveying

- Acquiring ground or surface data from an aircraft by means of photography or remote sensing (lidar, thermal, bathymetric, etc.)
- Been in practice since the mid-nineteenth century
- Platforms include fixed-winged airplanes, helicopters, balloons, blimps, UASs, amongst others
- **Photogrammetry** - Science of obtaining location, shape, and size of objects by measuring them using aerial photographs
- **Lidar** - Light Detection And Ranging

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Photogrammetry

- Multiple photographs with overlapping footprints that are mosaicked together to create one seamless image
- By observing the same object in different photos from different viewpoints, a 3D environment can be created – “aero triangulation”
- Airborne Global Navigation Satellite System (GNSS) utilized to extract spatial data of aircraft at the time of image exposure
- Photogrammetry is inferred through mathematics and manual interpretation – autocorrelated surface

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Photogrammetry

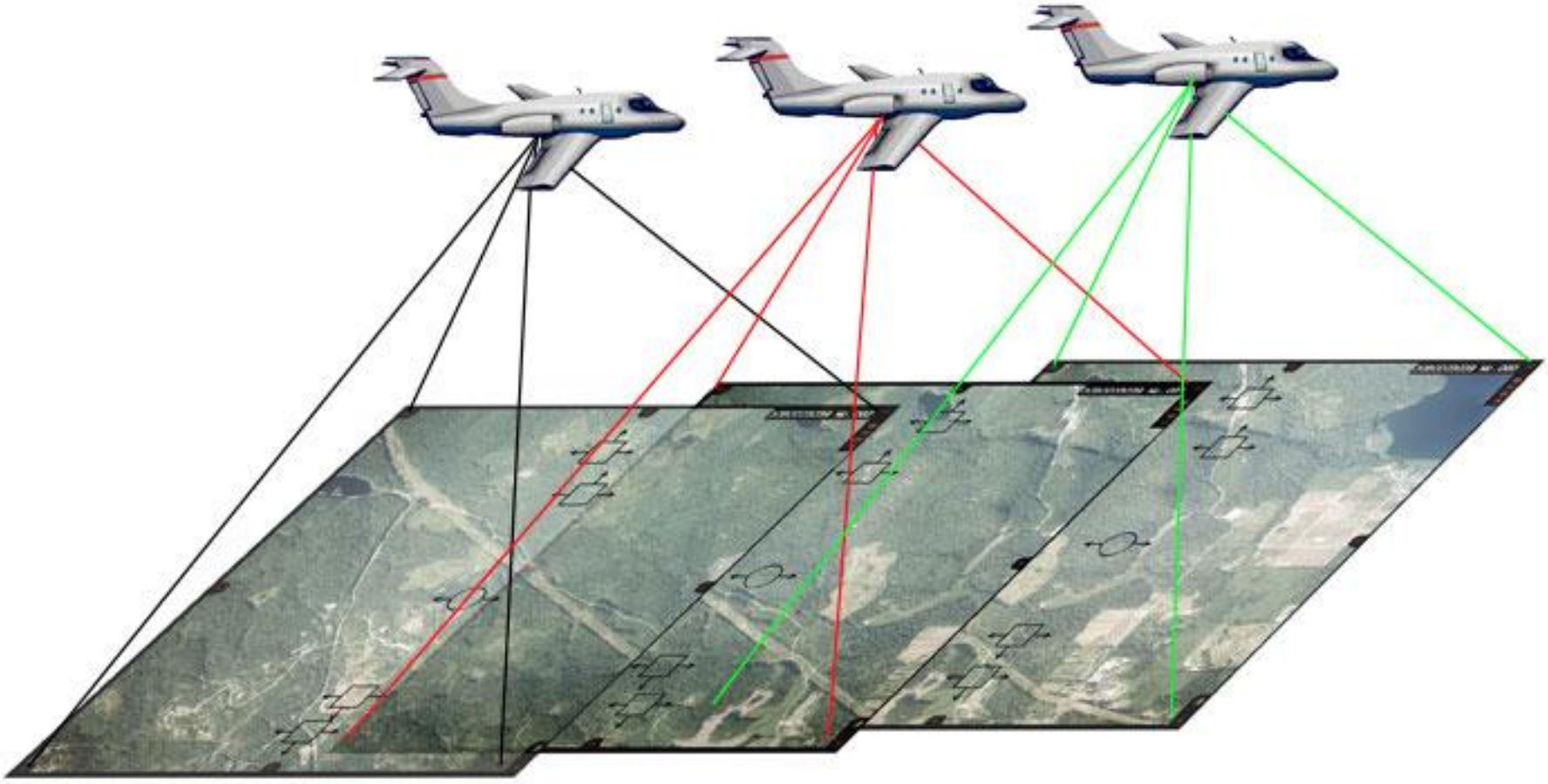

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Image Courtesy of Alnozom

Lidar

- Uses its own energy source to produce pulses of laser (light) which are emitted, reflected, and then received from surfaces
- Measures range distances from a single emission of energy
- Based on time between emission, reflection, and receive time
- Knowing the position and altitude of the sensor (airborne GNSS & IMU), the XYZ coordinate of the target can be calculated
- Direct terrain measurements; unlike photogrammetry, which is inferred through mathematics and manual interpretation
- Day or night operation, except when coupled with a digital camera

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Lidar

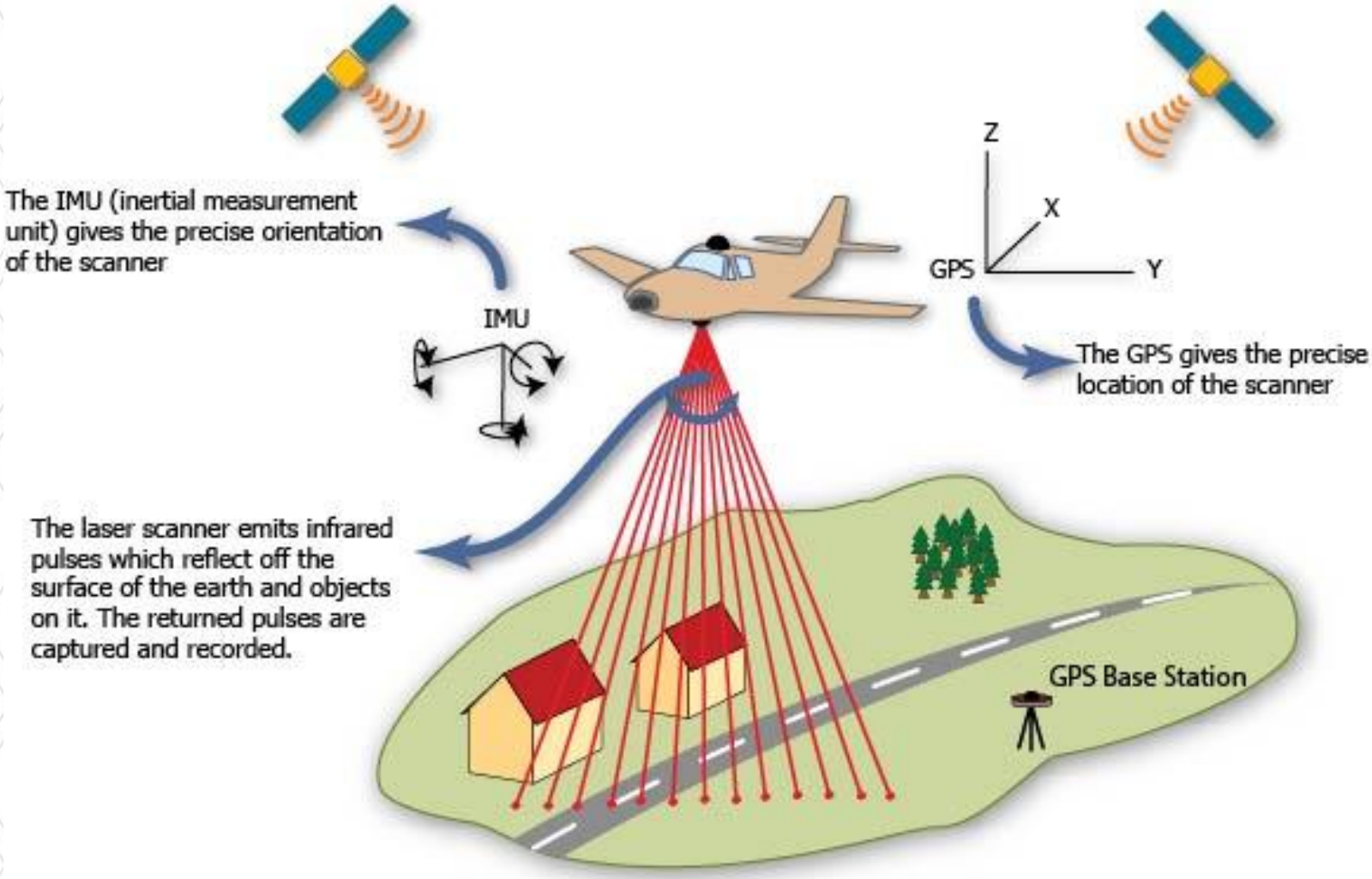

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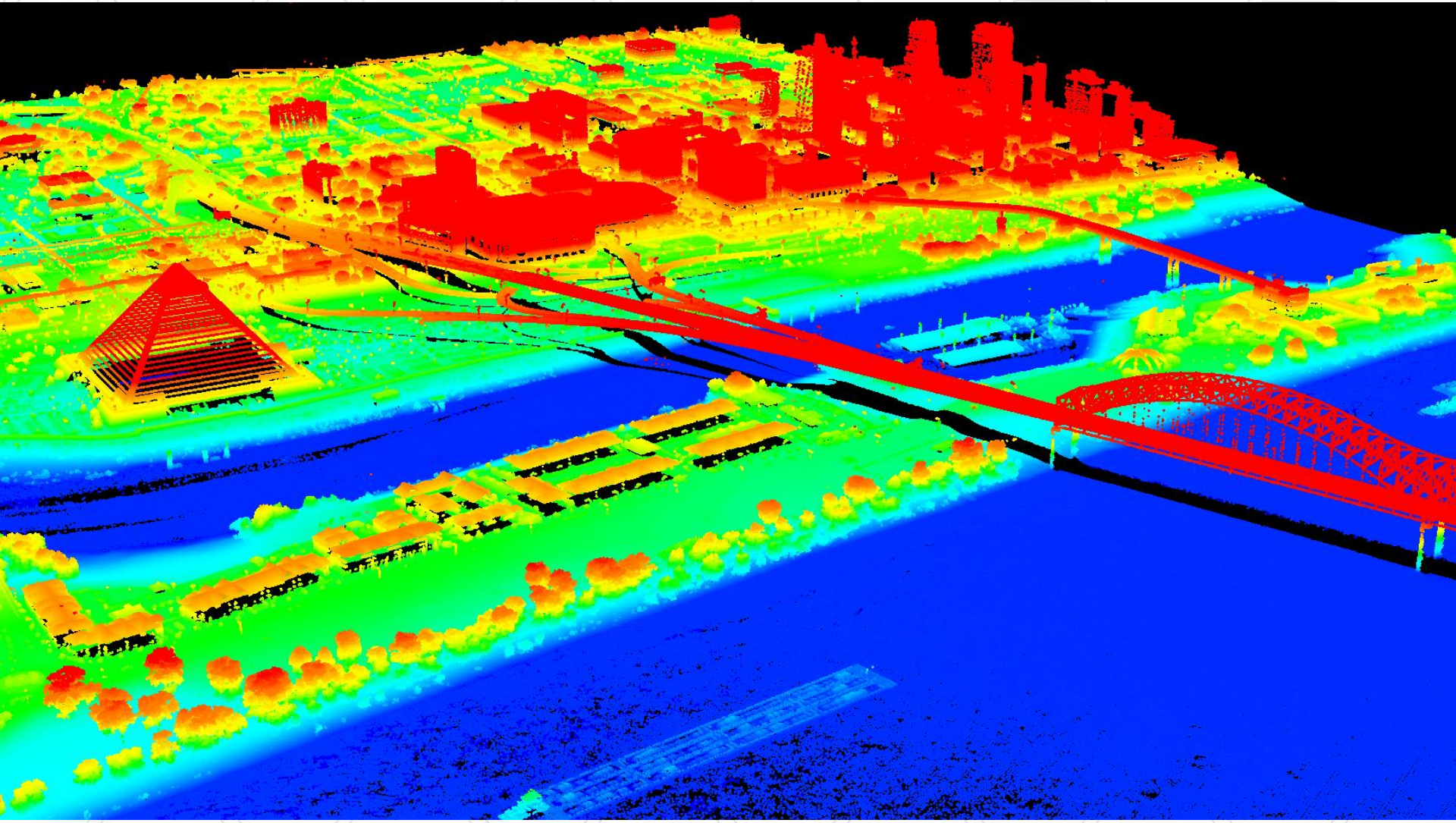
Image Courtesy of University of Arkansas – Center for Advanced Spatial Technologies

Lidar – Memphis, TN



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Manned Aircraft

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Atlantic's Cessna 210 – Crater Lake, Oregon, 2016

Manned Aircraft

- Manned aircraft have been utilized as a means of producing effective aerial surveying and mapping products since World War I
- Capable of mounting an array of different sized cameras and sensors
  - Can acquire both imagery and other forms of data simultaneously
- Long flying times, wide acquisition footprint
  - Cost efficient
  - Capable of acquiring multiple sites in a single flight mission
- Multiple aircraft equates to simultaneous acquisition of sites in completely different areas
- Access to all public airspace

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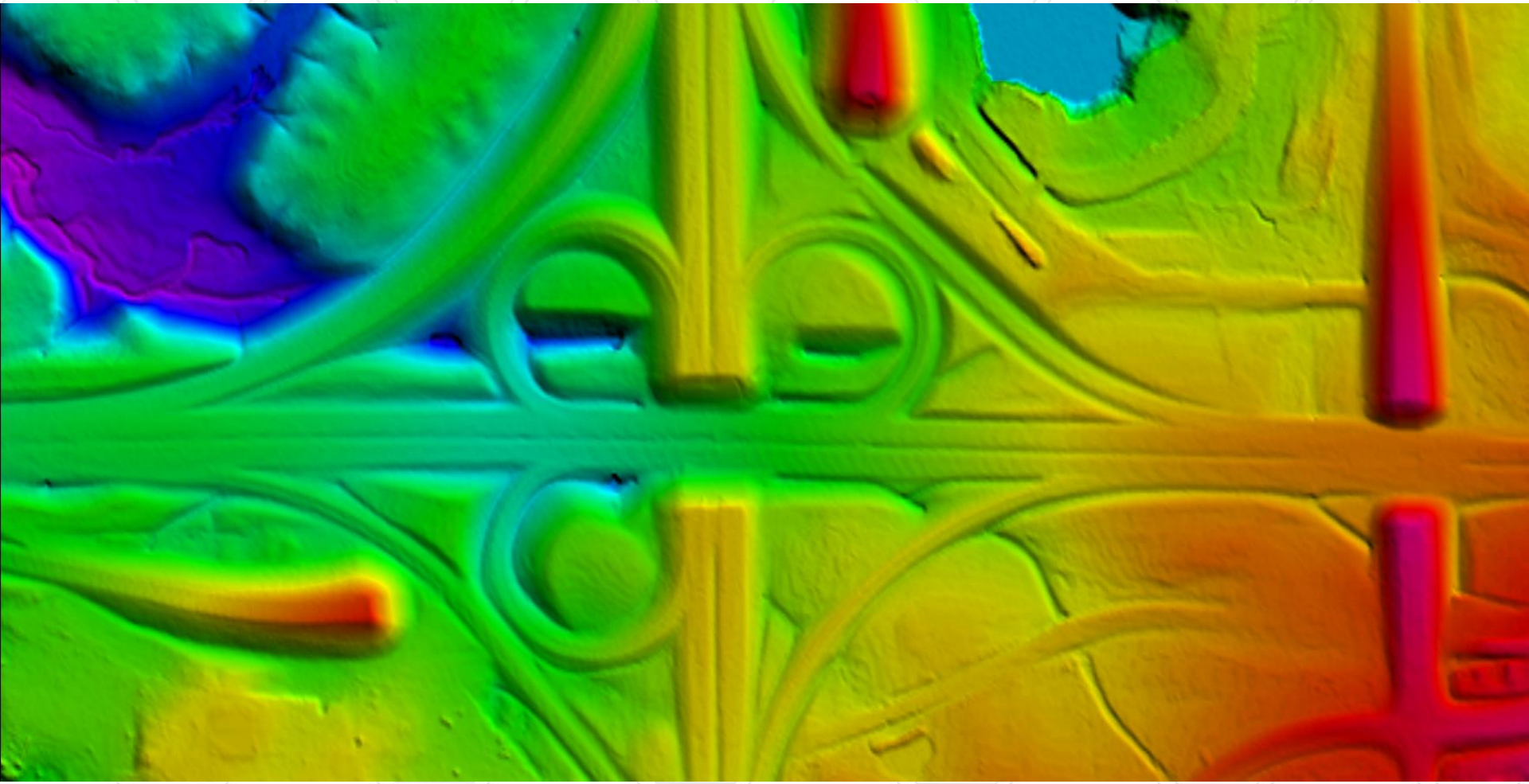
Digital Terrain Model (DTM)



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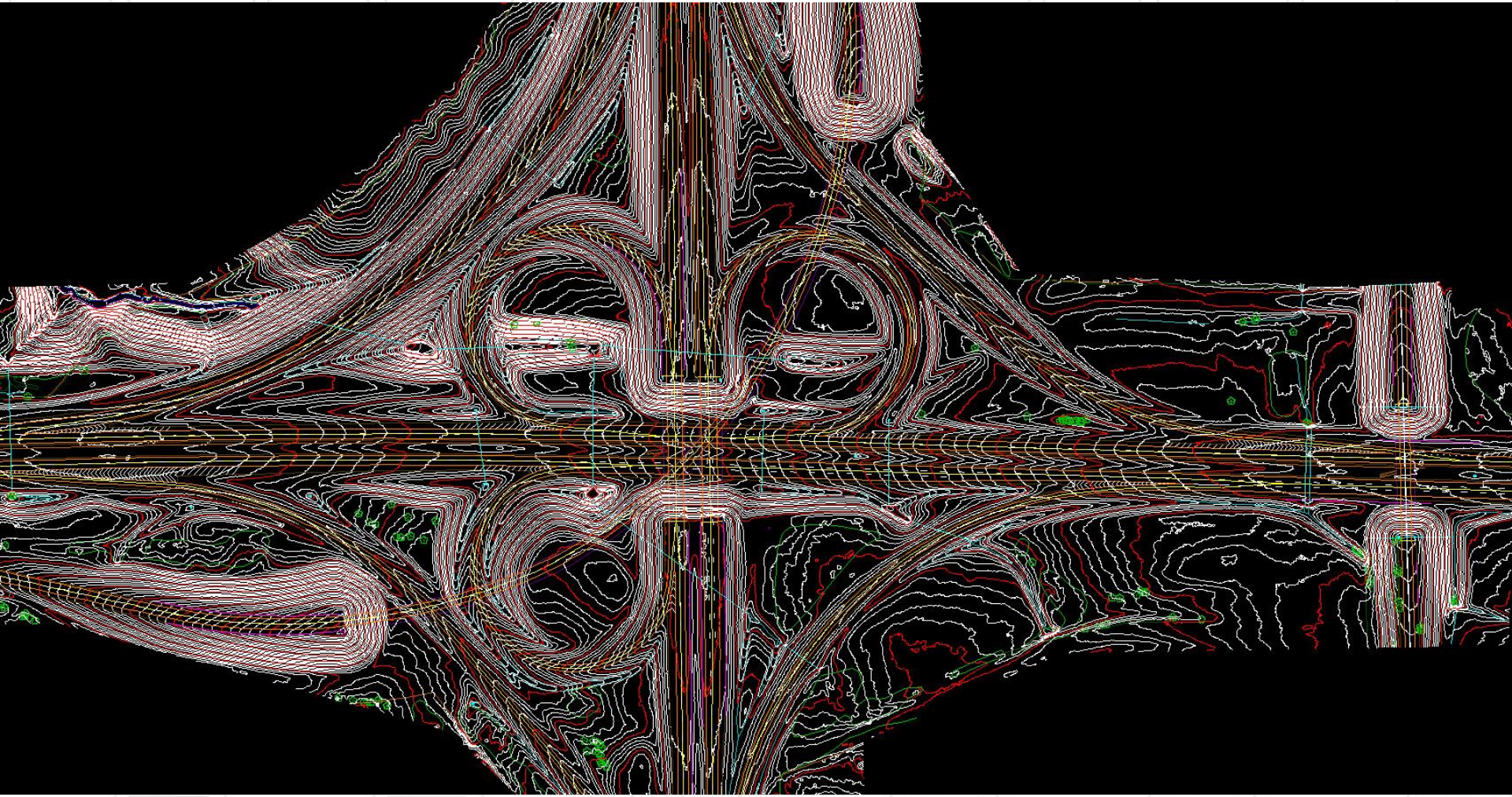
Contours and Planimetric Features



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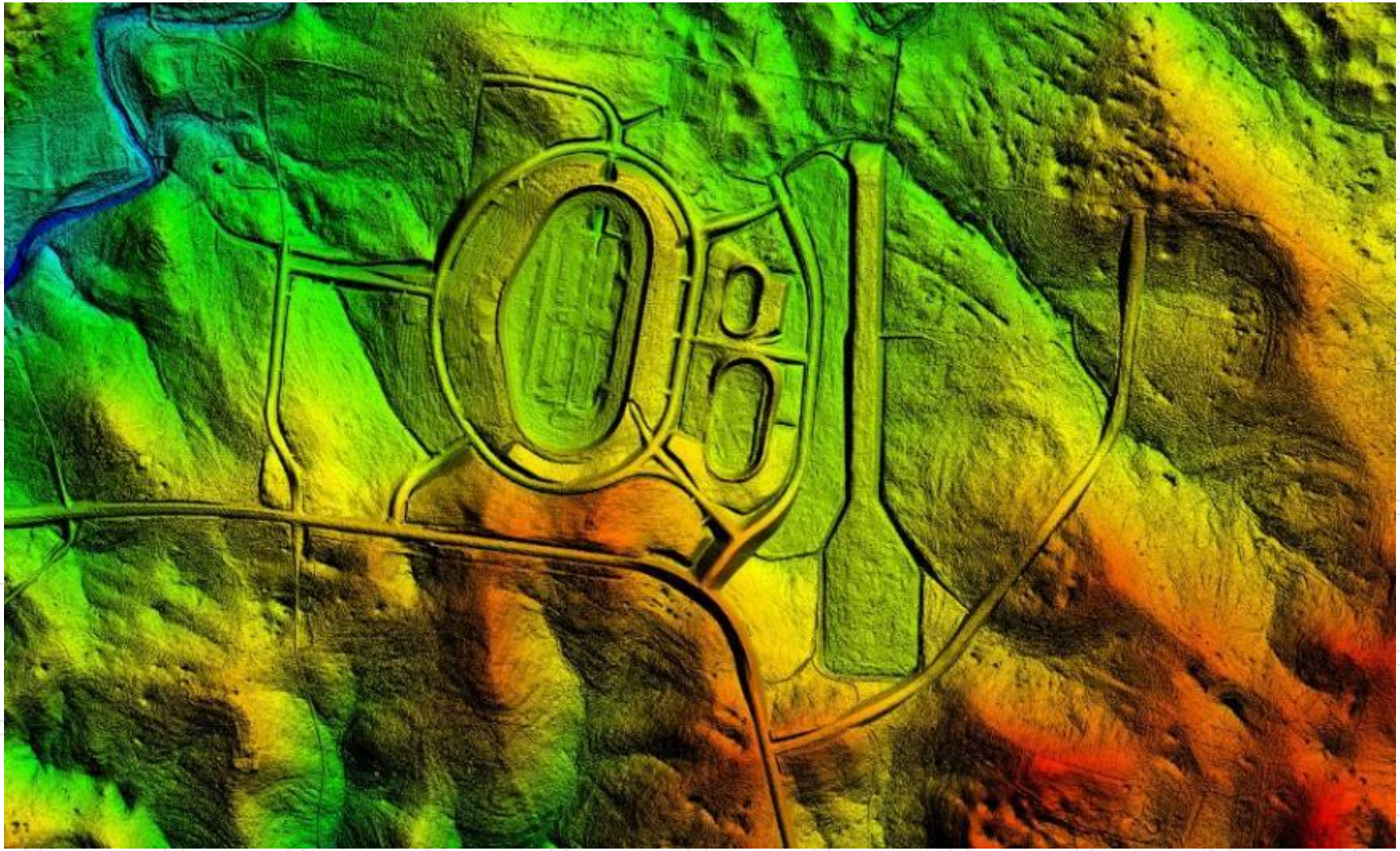
DTM – Bare Earth Surface Data



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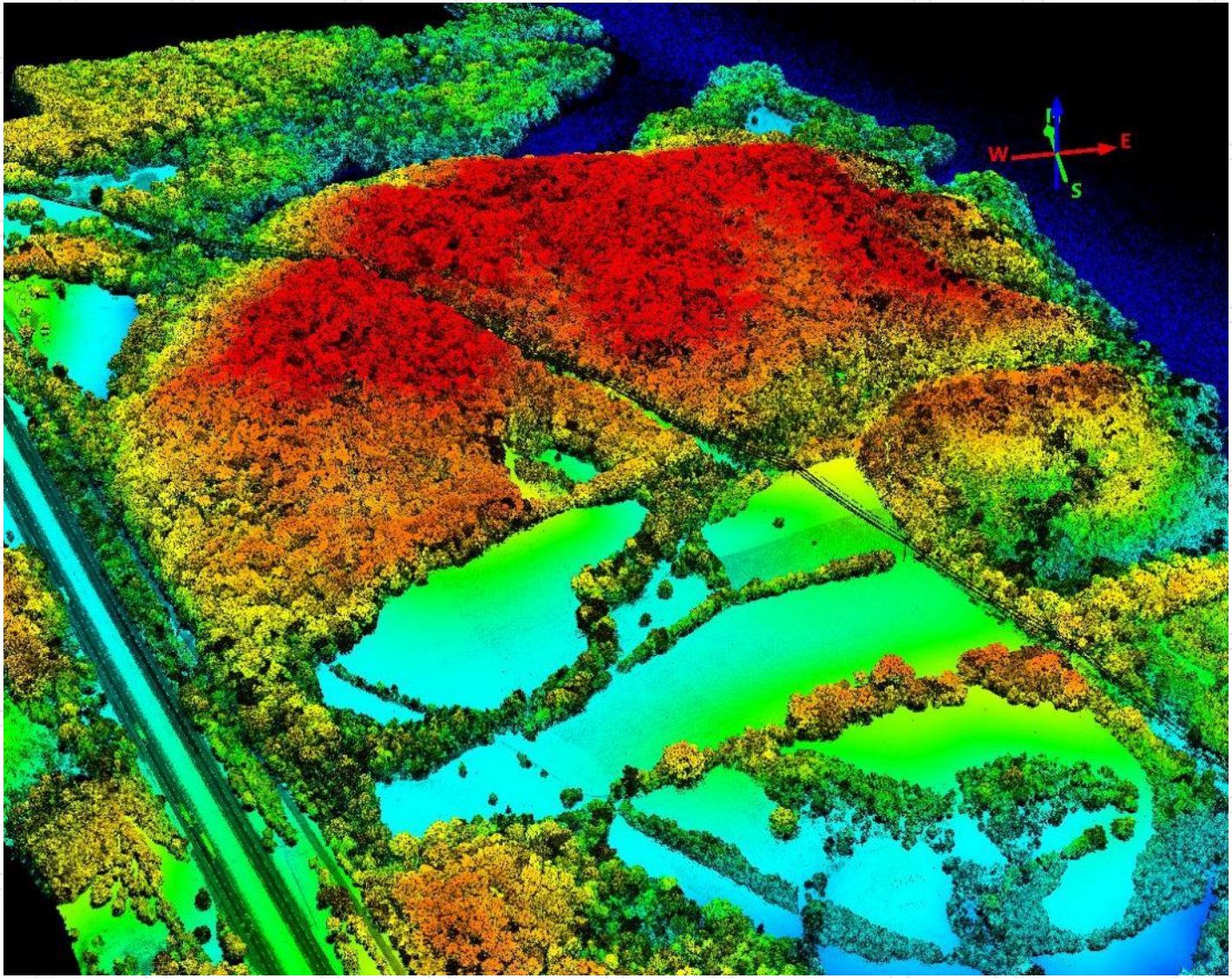
Lidar



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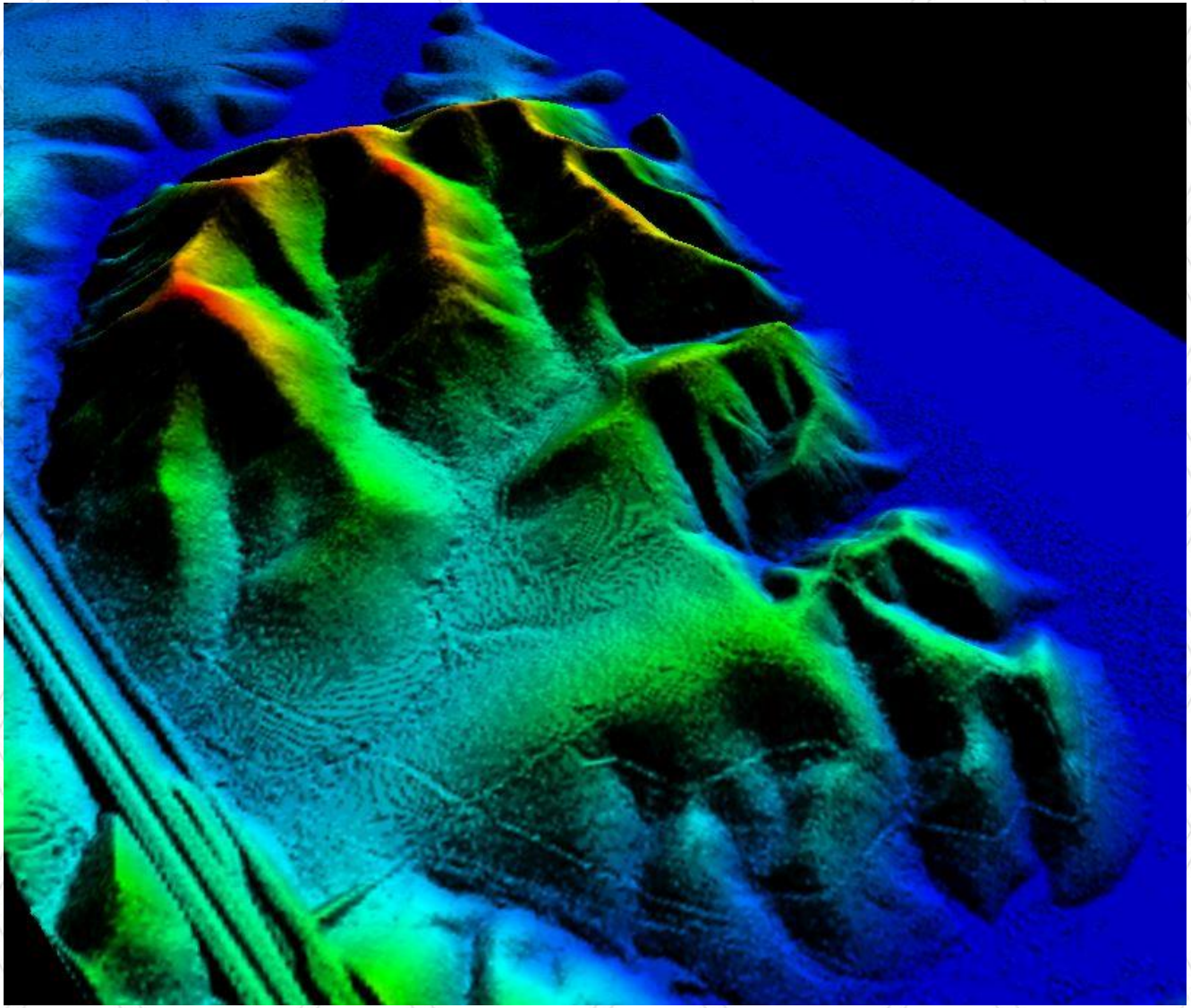
Lidar



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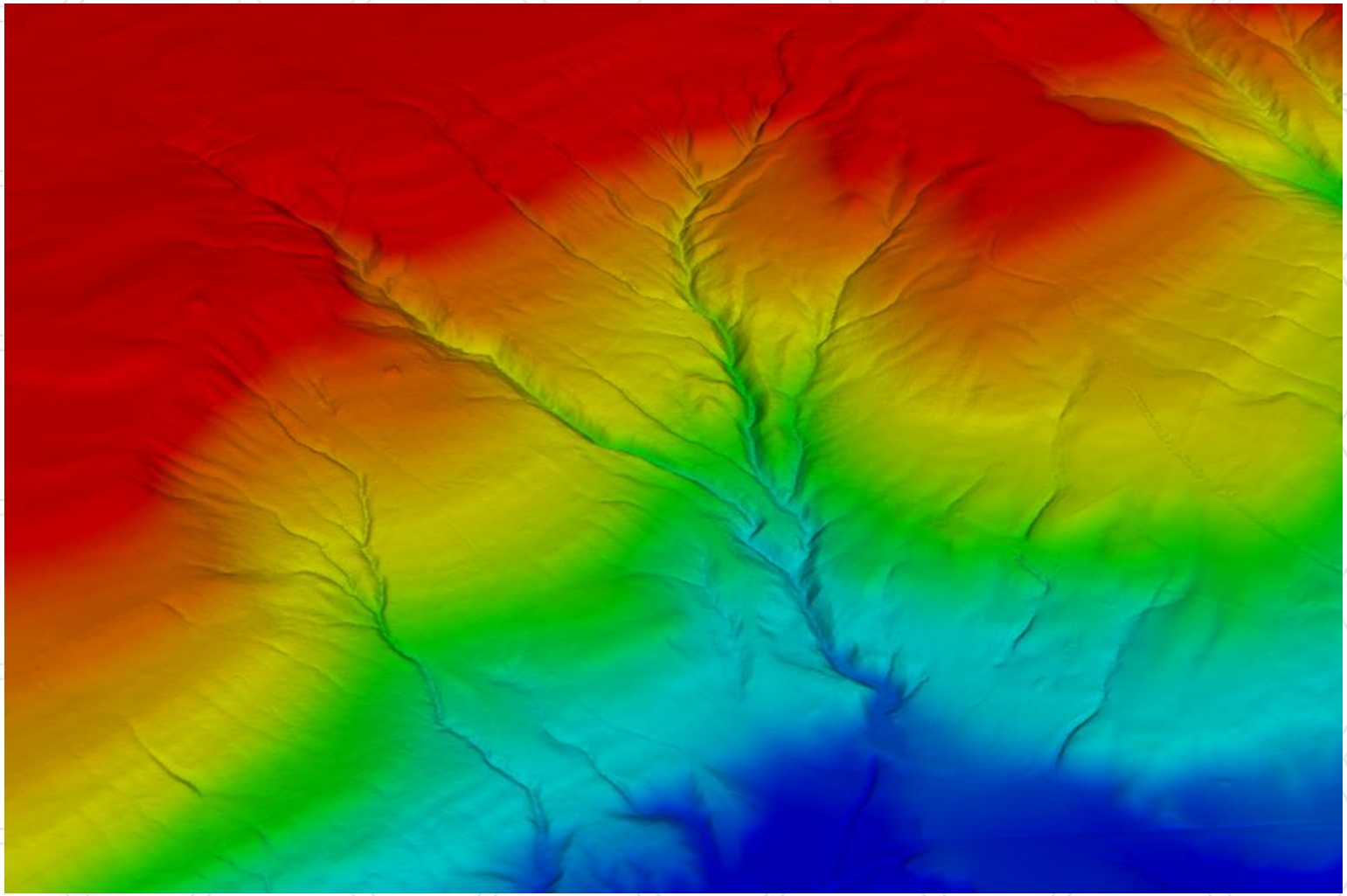
Surface Model Examples



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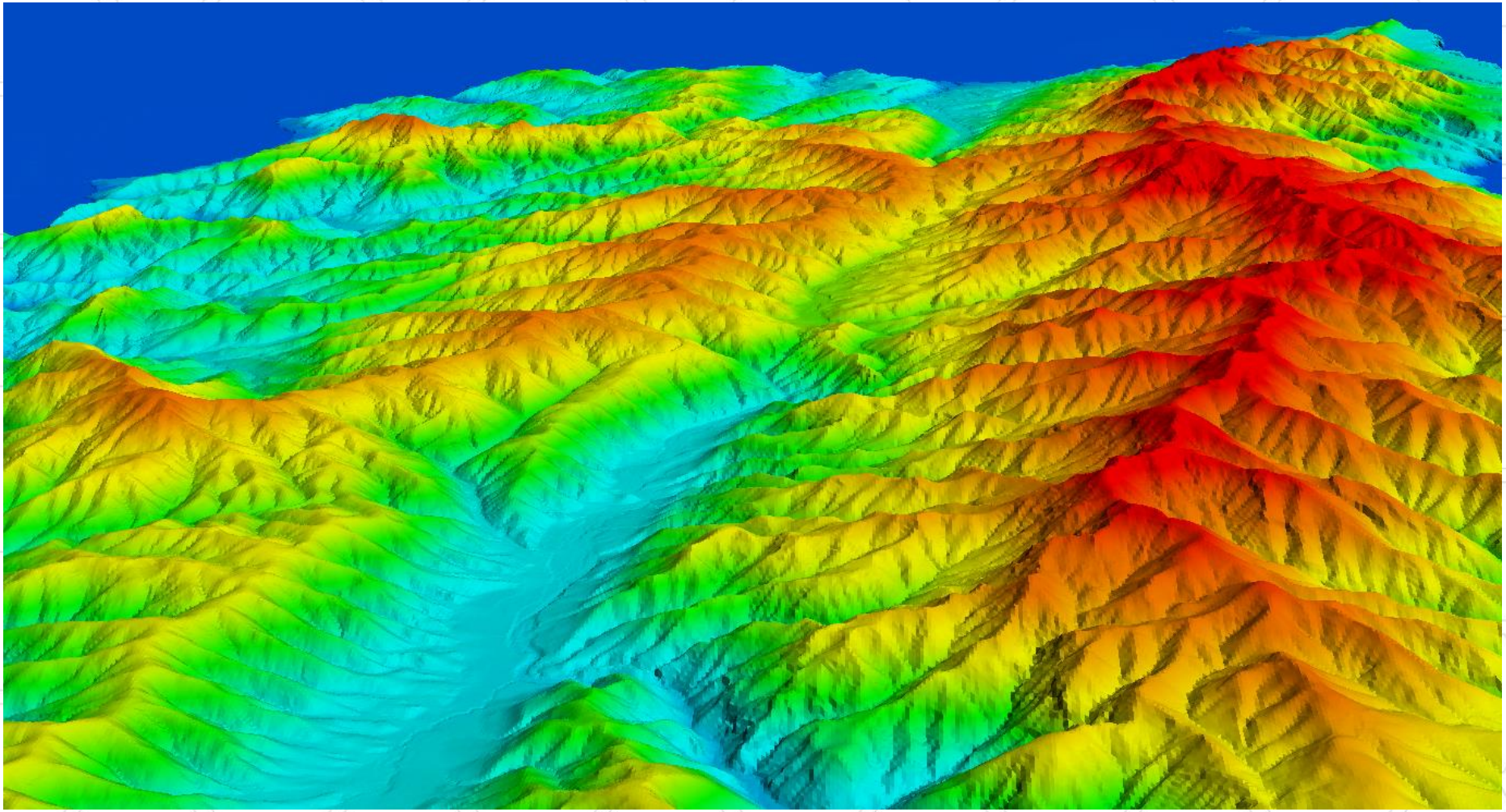
Surface Model Examples



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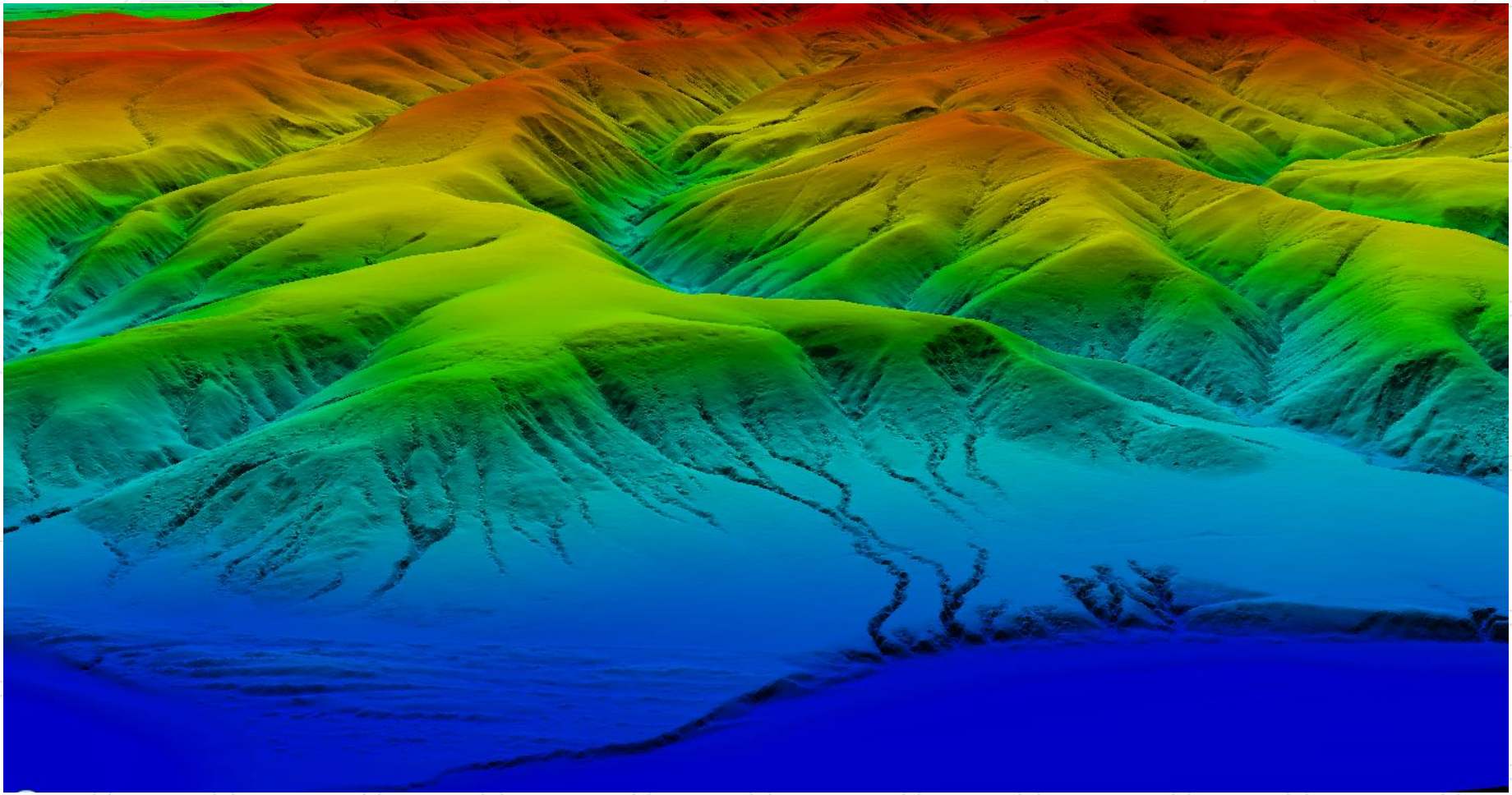
Surface Model Examples



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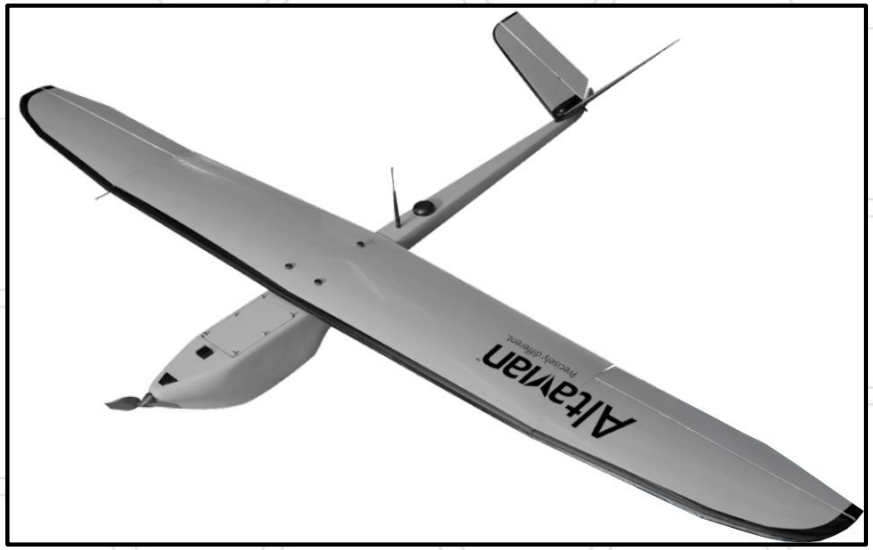
Unmanned Aircraft Systems (UAS)



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Images courtesy of Aeryon Labs, Altavian, senseFly, and Pulse Aerospace

Unmanned Aircraft Systems (UAS)

- Emergence as a mapping technology in 2010s
- FAA 333 and Part 107 regulatory advances
- Part 107 rules for operation
  - Elevation – < 400ft. AGL
  - Daylight Operations Only
  - Maintain Visible Line of Sight
  - Aircraft < 55 lbs.
  - Airspace
  - Non-participants – can't fly over general public

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Unmanned Aircraft Systems (UAS)

- Short flying times
  - Most UAS average between 20-40 minutes per flight
  - Possibility of multiple flights for a small project
- UAS must be visible to operator – line of sight
- Must receive permission to fly UAS over project areas containing civilians and assets that are not involved in the project
  - Not able to fly prospective sites or competitor sites
  - Until regulations change, not allowed to fly over streets and highways
  - More paperwork = longer project period

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Unmanned Aircraft Systems (UAS)

- Surface data
  - Lidar systems for UAS are expensive
  - Most UAS use small format cameras and traditional photogrammetric methods to generate ground surface data
  - No ground surface data for areas underneath vegetation
  - Large amount of photos; can be difficult to process
  - Can lead to multiple re-flights – not cost-effective if AOI requires a great deal of travel

Unmanned Aircraft Systems (UAS)

- Being sold as a “black box” or “turnkey” mapping solution
  - Not necessarily valid for all applications
  - Must have background and experience in flight planning, photogrammetry, data processing, aerial triangulation, surveying, and GIS in order to achieve accurate data for every mission
  - There is no easy button!

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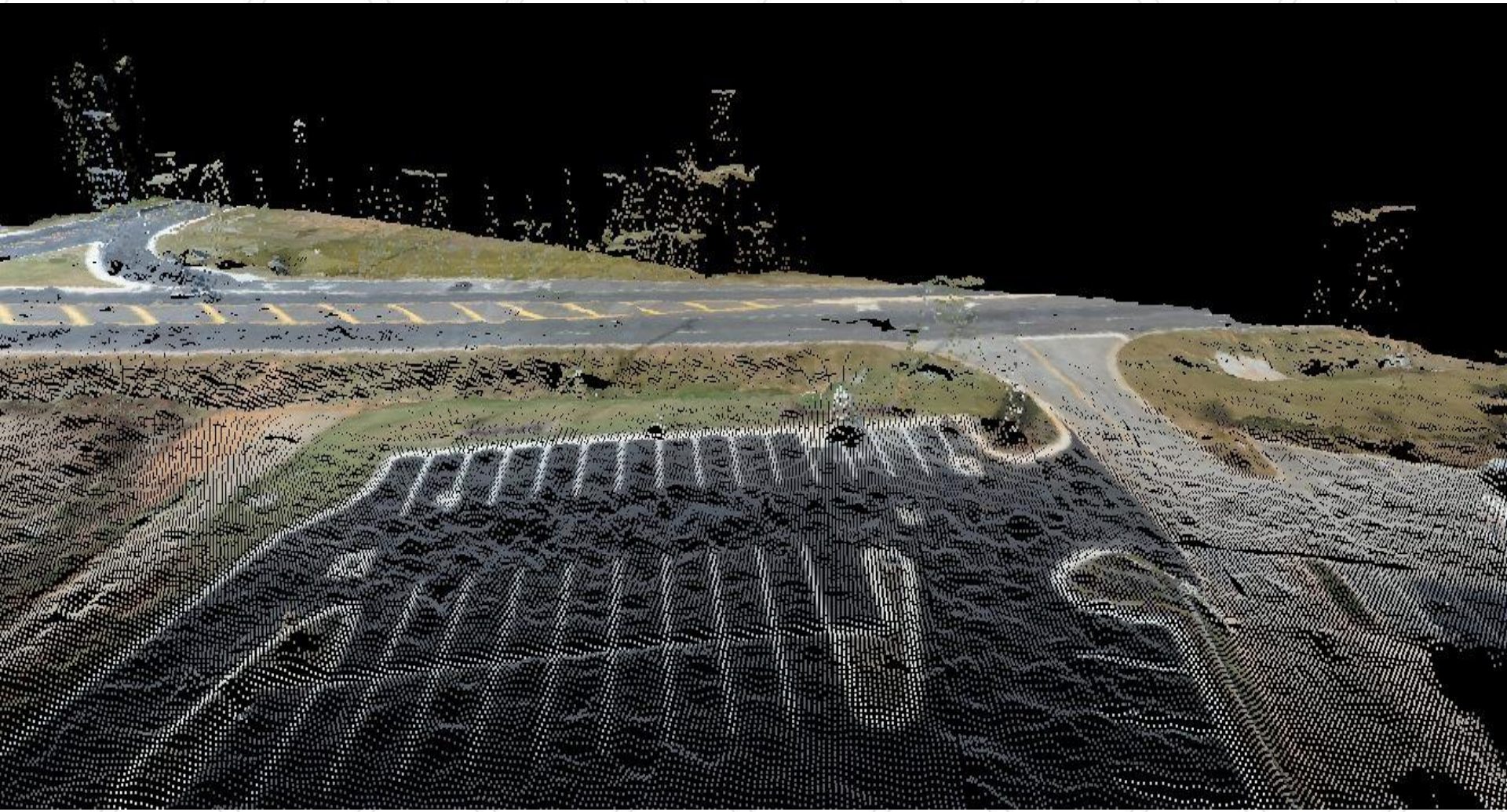
Geospatial Experience Matters



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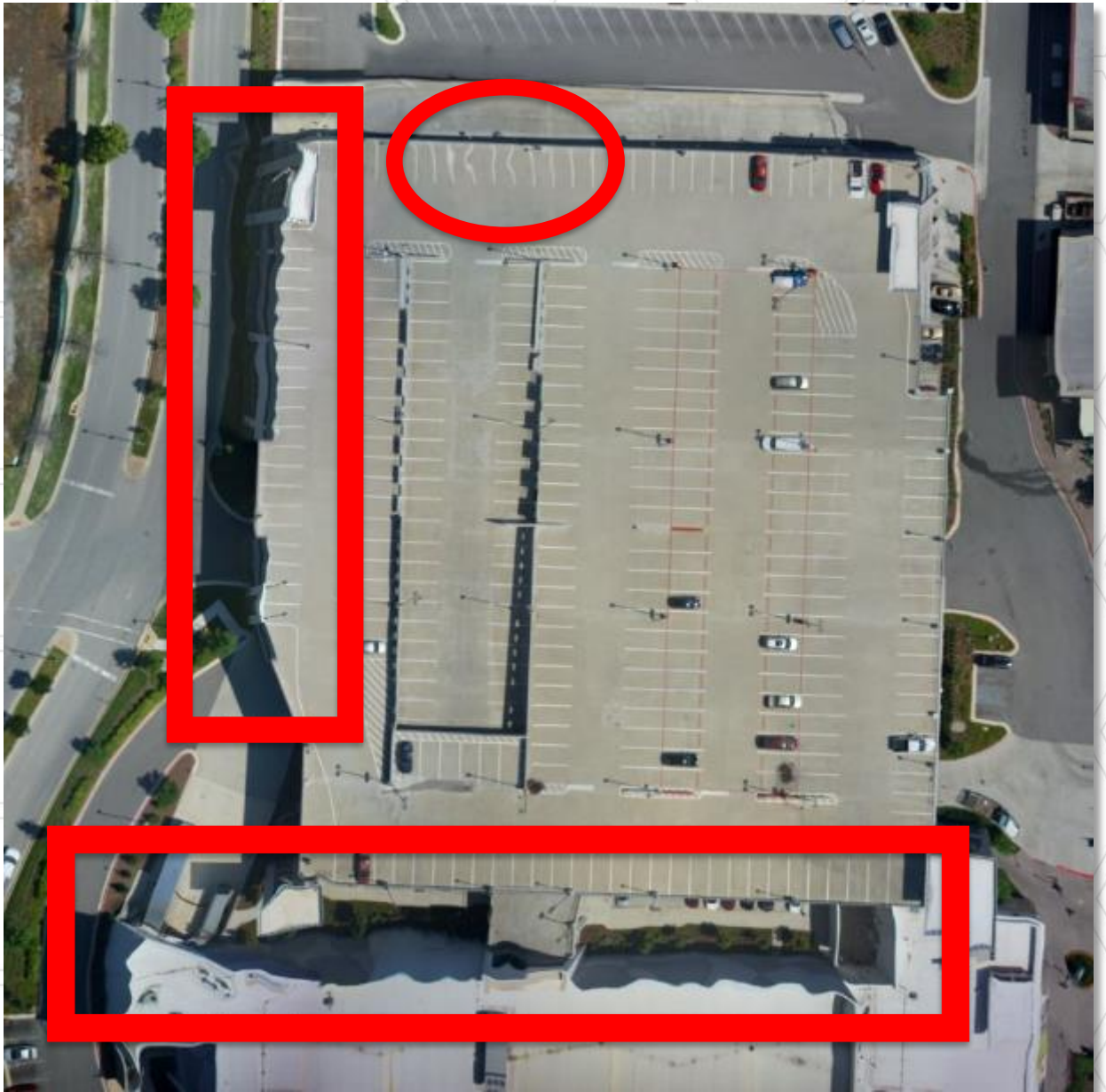
Geospatial Experience Matters



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In Conclusion

- Aerial Surveying and Mapping is an effective tool for all types engineering projects
- If using a UAS for data acquisition, make sure your field team is experienced
  - **Quality in, Quality out!**
- Know your project's needs before aerial acquisition
  - Size, airspace restrictions, vegetation, deliverables
- Never be afraid to ask for help!

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Questions

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