A Race to Answers: AI/ML based insights using high resolution aerial data

Texas GIS Forum

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Vexcel Government Solutions

Shawnee, OK
Data Needs and Challenges

• Geographic scale of parcels
• Timeliness/Cost of data collection
• Keeping records up-to-date
• Accuracy
• Reactive / Proactive information
• Compliance assurance
• Extracting insights & priorities
# Expanding Data Options & Insights – No “Silver Bullet”

<table>
<thead>
<tr>
<th>Data Source</th>
<th>Coverage &amp; Refresh Rate</th>
<th>Positional Accuracy &amp; Ground Truthing</th>
<th>Data Repeatability; Consistent Quality</th>
<th>Low Cost per Mile</th>
<th>Notes</th>
</tr>
</thead>
<tbody>
<tr>
<td>Satellite Imagery</td>
<td>7</td>
<td>1</td>
<td>4</td>
<td>7</td>
<td>Good for broad roadway network overview info</td>
</tr>
<tr>
<td>Aerial Mapping</td>
<td>6</td>
<td>6</td>
<td>6</td>
<td>5</td>
<td>Expanding use of AI/ML on high resolution imagery for inventories, conditions, safety</td>
</tr>
<tr>
<td>Mobile Mapping</td>
<td>2</td>
<td>7</td>
<td>7</td>
<td>1</td>
<td>Ideal for engineering survey</td>
</tr>
<tr>
<td>Photologging</td>
<td>3</td>
<td>5</td>
<td>5</td>
<td>3</td>
<td>Good for historical records, and specific area recall</td>
</tr>
<tr>
<td>Fleet &amp; Dashcam Data</td>
<td>4</td>
<td>3</td>
<td>3</td>
<td>4</td>
<td>Growing uses for street level AI/ML insights</td>
</tr>
<tr>
<td>OEM Connected Vehicle Data</td>
<td>5</td>
<td>2</td>
<td>2</td>
<td>6</td>
<td>Good crowdsourced telematics info for driver behaviors &amp; safety</td>
</tr>
<tr>
<td>Manual Field Collection</td>
<td>1</td>
<td>4</td>
<td>1</td>
<td>2</td>
<td>Traditional approach for project specific data collections per a user spec</td>
</tr>
</tbody>
</table>
Growing Utilization of High-Resolution Imagery & Analytics
Imagine if you could prioritize top issues across your entire County
About Vexcel

30 years of photogrammetric excellence
Aerial content across 30 countries
Data histories back to 2016
Growing AI/ML library (w/80+ features)

Vexcel Fleet

Vexcel Data Program

Vexcel Imaging
About Vexcel

Data Collection and Coverage

Uses Cases
- Property Assessment
- Emergency Management
- Roadway Assessment

Analytics and Change Detection
Existing U.S. Footprint: 3 million sq mi

Largest collection of its kind with:
✓ Unmatched accuracy
✓ High-resolution aerial imagery
✓ Consistency across imagery

49 states
Urban & rural collections
99.6% U.S. population
127 million U.S. households

Urban: 7.5cm resolution
Wide Area: 15-20cm resolution
Orthomosaic Imagery Products

TrueOrtho
- No building lean or seamlines; color balanced; top-down
- Urban area collection
- Insight for rooftops and property surroundings
- 7.5cm resolution

Urban Ortho
- Straight-down aerial view
- Urban area collection
- Increased frequency, greater currency in U.S. urban areas
- 7.5cm resolution

Wide Area Ortho
- Straight-down aerial view of buildings, parcels, and farmlands
- Urban and rural collection
- Insight for rooftops and property surroundings
- 15-20 cm resolution
Oriented Imagery Products

**Oblique**
- Collected at a 45° perspective
- Detailed views—north, south, east, west—of properties, neighborhoods, buildings
- 7.5cm resolution

**Nadir**
- Top-down oriented images
- AI/ML applications
- 7.5-20cm resolution
Aerial Imagery & Data

**Multispectral**
- Near-infrared channel on camera sensors
- Optimal for classification on vegetation and fire risk
- Wide and Urban Area collection programs

**Elevate**
- Digital Surface Models (DSM)
  - Urban and Wide Area collection programs
- Digital Terrain Models (DTM)
  - Wide Area collection programs

**Disaster (Gray Sky)**
- Natural disaster collection program
- Imagery delivered typically within 24 hours after capture
- Before/after comparisons
Growing Utilization of High-Resolution Aerial Data & Analytics

Scottsdale, AZ
January 2023
AI/ML based Insights - Building and Property Attributes
Building Elements
Access 40+ attributes for better, more precise property analysis

Building Footprints
- Geometry of building footprint

Building Attributes
- 20+ building and structure attributes
- Available for current and historical imagery

Property Attributes & Reports
- 20+ attributes for properties
- See footprint area, roof condition, solar panels, pools, hardscape information, and more
- Available for current and historical imagery

Damage Assessment & Reports
- Post-disaster analysis on impacted properties
- Available for all Gray Sky disaster collection from 2022 and forward

Find out where attributes are available at vexceldata.com
<table>
<thead>
<tr>
<th>Building Attributes</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Footprint area</td>
<td>4,626.65ft²</td>
</tr>
<tr>
<td>Ground elevation</td>
<td>527.03 ft</td>
</tr>
<tr>
<td>Roof elevation</td>
<td>553.08 ft</td>
</tr>
<tr>
<td>Roof height</td>
<td>28.15 ft</td>
</tr>
<tr>
<td>Roof Centroid</td>
<td>-74.287889 40.800163</td>
</tr>
<tr>
<td>Tree cover over roof</td>
<td>0%</td>
</tr>
<tr>
<td>Roof solar</td>
<td>No</td>
</tr>
<tr>
<td>Chimney(s)</td>
<td>1</td>
</tr>
<tr>
<td>AC unit(s)</td>
<td>0</td>
</tr>
<tr>
<td>Roof vent(s)</td>
<td>11</td>
</tr>
<tr>
<td>Satellite dish(es)</td>
<td>0</td>
</tr>
<tr>
<td>Skylight(s)</td>
<td>6</td>
</tr>
<tr>
<td>Roof shape</td>
<td>Hip</td>
</tr>
<tr>
<td>Roof material</td>
<td>Shingle</td>
</tr>
<tr>
<td>Missing roof material</td>
<td>0%</td>
</tr>
<tr>
<td>Roof condition</td>
<td>4/5</td>
</tr>
<tr>
<td>Roof discoloration</td>
<td>1.35%</td>
</tr>
<tr>
<td>Vent staining</td>
<td>No – 0%</td>
</tr>
<tr>
<td>Algae staining</td>
<td>No – 0%</td>
</tr>
<tr>
<td>Water pooling</td>
<td>No – 0%</td>
</tr>
<tr>
<td>Roof tarp</td>
<td>0%</td>
</tr>
<tr>
<td>Debris</td>
<td>0%</td>
</tr>
<tr>
<td>Property Attributes</td>
<td>Value</td>
</tr>
<tr>
<td>---------------------------</td>
<td>------------------------</td>
</tr>
<tr>
<td>Pool</td>
<td>Yes – 1013.96 ft²</td>
</tr>
<tr>
<td>Pool: In ground-area</td>
<td>Yes – 908.04 ft²</td>
</tr>
<tr>
<td>Pool: Above ground</td>
<td>No - N/A</td>
</tr>
<tr>
<td>Hot tub – area</td>
<td>Yes – 106.99 ft²</td>
</tr>
<tr>
<td>Diving board</td>
<td>No</td>
</tr>
<tr>
<td>Water slide</td>
<td>Yes</td>
</tr>
<tr>
<td>Deck</td>
<td>Yes</td>
</tr>
<tr>
<td>Playground</td>
<td>Yes</td>
</tr>
<tr>
<td>Trampoline</td>
<td>No</td>
</tr>
<tr>
<td>Sports court</td>
<td>No</td>
</tr>
<tr>
<td>Hardscapes</td>
<td>Yes – 5898.62 ft²</td>
</tr>
<tr>
<td>Vehicles: automobile</td>
<td>1</td>
</tr>
<tr>
<td>Vehicles: boat</td>
<td>0</td>
</tr>
</tbody>
</table>
AI/ML based Insights - Disaster Response and Recovery Damage Assessment

Lahaina, Hawaii
Damage Assessment

Our AI analysis identified a total of 2,760 structures within the Lahaina collection area.

- **1,718 structures were completely destroyed**: 62% of all the structures in the collection area.

- **363 structures had slight to moderate damage**, ranging from some fire damage to missing shingles possibly caused from the severe winds that fanned the fires.

- **678 structures had no damage** identified in the imagery.
Damage Assessment

Before
Hurricane Ian

After
Home impacted by Hurricane Ian

CAT Score: 50/100
Property Level Analysis of Damage

Compare PIFs against this data to identify properties in greatest need

Blue Sky
Footprint area: 526.7m²
Roof condition: 5/5
Roof material: metal
Roof discoloration: 0%
Roof shape: gable
Roof solar: no
Tree cover over roof: 0%
Defensible space report:

<table>
<thead>
<tr>
<th>Trees</th>
<th>Buildings</th>
</tr>
</thead>
<tbody>
<tr>
<td>0-5 ft: 0%</td>
<td>0-5 ft: 0%</td>
</tr>
<tr>
<td>0-30 ft: 14%</td>
<td>0-30 ft: 5%</td>
</tr>
<tr>
<td>0-100 ft: 14%</td>
<td>0-100 ft: 13%</td>
</tr>
<tr>
<td>0-200 ft: 0%</td>
<td>0-200 ft: 0%</td>
</tr>
</tbody>
</table>

Damage Assessment

- CAT Score: 50/100
- Roof structure damage: 1.4%
- Roof missing material: 0.2%
- Tarp covering roof: 0%
- Debris on roof: 0%
- Roof discoloration after damage: 0.07%
- Approximate FEMA classification: FEMA 3
AI/ML based Insights - Roadway Attributes
Roadway Elements
Access 30+ attributes for better, more precise roadway analysis

Pavement Markings
- Crosswalks
- Bicycle symbols
- Arrows
- Words
- Available for current and historical imagery

Infrastructure
- Pedestrian refuge islands
- ADA truncated domes “curb mats”
- Intersection-junctions
- Available for current and historical imagery

Condition Assessment
- Pavement marking quality score for prioritizing maintenance
- Available for current and historical imagery
Roadway Data from High-Resolution Aerial Imagery

1. Roadway Inventories for Bike and Pedestrian Facilities
   • Crosswalks (standard and high visibility) at intersections and midblock
   • Bicycle lanes (symbols, words and green painted lanes)
   • ADA detectable curb mats (truncated dome) and pedestrian refuge islands

2. Roadway Inventories for intersections and approaches
   • Exclusive Left-turn and Right-turn lanes
   • Presence/Absence of crosswalks
   • Presence/Absence of bicycle facilities

3. Condition Assessment of Road Markings for Maintenance Prioritization
   • Identification of faded or worn pavement markings
   • Development of prediction models based on historic imagery

4. ADA Compliance Assessment
   • Mapping of required detectable warnings on curb ramps per DOT ADA standards

5. Confirm and Document Installation of Countermeasures
   • Creation of as-builts for FWHA proven Pedestrian/Bicyclist countermeasures (e.g., high-visibility crosswalks, advance stop and yield lines, ped. refuge islands).

https://highways.dot.gov/safety/proven-safety-countermeasures
Pavement Marking Condition Comparison

November 19, 2020

October 22, 2022

Atlanta, GA
Roadway Inventories, Condition and Change Over Time

November 19, 2020

Atlanta, GA

October 22, 2022
Pavement Marking Condition Scoring

Scored between 1-4 based on pavement marking imagery classified using subjective condition assessment markings.

- 4 = Great. No visible signs of defects.
- 3 = Good. Minimal signs of defects.
- 2 = Fair. Pronounced signs of defects that affect the function of the marking.
- 1 = Poor. Pronounced signs of defects that significantly affect the function of the marking.
Pedestrian and Bicycle Markings

Atlanta, GA
### Crosswalk Identification and Classification

<table>
<thead>
<tr>
<th>Standard</th>
<th>Solid</th>
<th>Zebra (Continental)</th>
<th>Ladder</th>
<th>Diagonal</th>
</tr>
</thead>
</table>

- **Standard**
- **Solid**
- **Zebra (Continental)**
- **Ladder**
- **Diagonal**
Crosswalk Compliance Assessment: Low vs. High Visibility

Standard Crosswalks

High Visibility Crosswalks
Crosswalk Condition Assessment

Poor Condition

Good Condition
Bike Lane Mapping using Bicycle Pavement Markings

Greensboro, NC
Bike Lane Mapping using Bicycle Pavement Markings

Atlanta, GA
Roads with Bicycle Pavement Markings

Atlanta, GA
Comparison:
Roads with Bicycle Markings 2022 and 2020 Inventory
Bicycle Facility Improvements: Before
Bicycle Facility Improvements: After
Intersections
FHWA MIRE ELEMENTS

136. Number of Exclusive Left-Turn Lanes

Definition: Number of exclusive left-turn lanes that accommodate left turns from this approach.

Recommended Attributes:
Numeric

140. Number of Exclusive Right-Turn Lanes

Definition: Number of exclusive right-turn lanes on approach.

Recommended Attributes:
Numeric

41. Presence/Type of Bicycle Facility

Definition: The presence and type of bicycle facility on the segment.

Recommended Attributes:
1. None
2. Wide curb lane with no bicycle markings
3. Wide curb lane with bicycle markings (e.g., sharrow)
4. Marked bicycle lane
5. Separate parallel bicycle path
6. Signed bicycle route only (no designated bicycle facility)
7. Other

147. Crosswalk Presence/Type

Definition: Presence and type of crosswalk crossing this approach leg.

Recommended Attributes:
1. Unmarked crosswalk
2. Marked crosswalk
3. Marked crosswalk with supplemental devices (e.g., in-street yield signs, in-pavement warning lights, pedestrian bulb outs, etc.)
4. Marked crosswalk with refuge island
5. Marked with refuge island and supplemental devices (e.g., in-street yield signs, in-pavement warning lights, pedestrian bulb outs, etc.)
6. Raised crosswalk
7. Pedestrian crossing prohibited at this approach
8. Other

## FWHA MIRE Reporting - Approaches

<table>
<thead>
<tr>
<th>MIRE Element #</th>
<th>Element Name</th>
<th>Attribute</th>
</tr>
</thead>
<tbody>
<tr>
<td>147</td>
<td>Crosswalk Presence/Type</td>
<td>Marked crosswalk</td>
</tr>
<tr>
<td>136</td>
<td>Number of Exclusive Left-Turn Lanes</td>
<td>1</td>
</tr>
<tr>
<td>140</td>
<td>Number of Exclusive Right-Turn Lanes</td>
<td>0</td>
</tr>
<tr>
<td>41</td>
<td>Presence/Type of Bicycle Facility</td>
<td>None</td>
</tr>
</tbody>
</table>
Access & Delivery
Use Vexcel data how and where you want it

- Vexcel APIs
- Vexcel Viewer
- Image Services for ArcGIS
- WMTS
- MapControl SDK
- Select Partners
In Summary

- Market leading camera sensors
- Dedicated fleet
- 30+ countries
- Mapping-grade accuracy
- World-class imagery processing
- 40+ Property attributes
- Optimized for AI & ML
- API & GIS Integrations
- Urban + Rural areas
- Top-class support
- Elevation data
- Damage Assessment
- High-res orthos & obliques
- Disaster imagery
- Cloud-based data
Request a demo at vexceldata.com

Thank You

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