Addressing Government and Commercial Post-Disaster Responses Using Machine Learning

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Generating Intelligence with AI/ML
Introduction
Overview Generating Intelligence from AI/ML

- **Rapid data analysis**: AI/ML algorithms process large volumes of aerial imagery quickly, providing real-time insights and reducing manual labor.

- **Enhanced pattern recognition**: AI/ML can identify patterns and trends within geospatial data that may be difficult for humans to perceive, enabling more accurate decision-making.

- **Cost-effective review**: Automating analysis of aerial imagery can significantly reduce costs associated with labor-intensive manual processes.

- **Disaster response and mitigation**: AI/ML can identify risk and assess damage after natural disasters, enabling faster and more efficient response efforts.

- **Enhanced collaboration**: AI/ML can streamline data sharing and communication between organizations, promoting more effective collaboration on geospatial projects.
About Vexcel

30 years of photogrammetric excellence

Global leaders in aerial imaging

Vexcel Imaging
Designs and manufactures the marketing-leading UltraCam sensors, and all-in-one photogrammetry software UltraMap.

Vexcel Fleet
Captures aerial data utilizing dedicated aircraft equipped with various camera sensors. In-house and third-party fliers.

Vexcel Data
The most comprehensive and accurate library of aerial content in 30+ countries.
Global Footprint

Western Europe
Andorra, Austria, Belgium, Denmark, Germany, France, Italy, Ireland, Liechtenstein, Luxembourg, Portugal, Netherlands, Monaco, San Marino, Spain, Switzerland, and Vatican City

Canada
USA
Puerto Rico
United Kingdom
WIDE AREA COLLECTION

15cm GSD Orthomosaic Imagery
URBAN AREA COLLECTIONS
7.5cm GSD True Orthomosaic
Gray Sky Program
Elements

Machine Learning derived features and attributes from our imagery:

- **Property** – information about property including buildings
- **Building** – information about buildings
- **Building Footprint** – geometry only of buildings
- **Damage Assessment** – information about post-disaster damage to buildings
Elements

- 30+ property & building attributes
- Available in 30 countries
  - Precomputed for North America
  - On-the-fly compute for ROW

Property Attributes

- Footprint Area: 1605.06 m²
- Roof Height: 5.73 m
- Roof Solar: No
- Roof Condition: 4/5
- Roof Shape: Hip
- Roof Material: Tile
- Defensible Space Report: 30 ft: 19%, 100 ft: 36%
- Pool: Yes
- Enclosure: No
- Diving Board: No
- Water Slide: No
- Trampoline: Yes
- Sport Court: Yes
- Location: TX, USA
Damage Impact along Tornado Path
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

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

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<thead>
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<th>Trees</th>
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Aerial Imagery in Disaster Recovery
ML Algorithms Used for Post Disaster Analysis

- **Image Classification**
  - Uses training data to identify/categorize specific features
  - Used to classify damage levels of structures

- **Object Detection**
  - Identifies and locates specific objects (e.g. buildings)
  - Used to identify damaged structures and estimate extent of damage

- **Image Segmentation**
  - Used to identify and analyze specific areas of damage or distinguish between different types of structures
Image Classification
Structural Damage Assessment

- Advantages:
  - Rapid, comprehensive
  - Higher accuracy than manual
  - Ability to analyze large amounts of data

- Training Data:
  - High-quality aerial imagery before and after disaster
  - Labeled data to train ML algorithms

- Workflow:
  - Collection of imagery post disaster
  - Preprocess before imagery
  - Image classification using damage ML
  - Output damage scores for each structure
Performance Evaluation ML Models

- Key factors affecting performance false positives and negatives.
- **False Positives:**
  - Occurs when undamaged structures are classified as damaged
  - Leads to unnecessary and potentially costly activities
- **False Negatives:**
  - Occurs when damaged structures are classified as undamaged
  - Results in failure to address critical damage
- Strategies to minimize false positives and negatives:
  - Incorporating human SME knowledge into analysis process
  - Regular performance evaluation and fine-tuning of models
  - Incorporating diverse and representative training data
Performance Evaluation—False Positive
Performance Evaluation – False Negative
Case Study: Using ML for Damage Assessment
Hurricane Ian
Hurricane Ian 2022

- Cat 4 hurricane formed September 2022.
- September 12 made landfall in Caribbean.
- Tracked northward making landfall in Florida.
- Response and recovery efforts began immediately.
  - Aerial imagery and machine learning being deployed.
Data Collection and Preparation

- 10 planes engaged
- Multi-day collection
- Over 44,000 km² collected
- Damage Assessment for millions of buildings
- High-res Oblique & Ortho imagery available
Thank you for your interest

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