AI and Geospatial: A Private Sector Perspective

Alain Kabamba  November 18th, 2022
• Geography is one of the fields which has made serious use of AI, having adopted it in the early days.

• AI research has evolved from modeling formal logic to a more data-driven, deep learning-based approach better suited to analyze ever-increasing big data

• Geography is becoming a field of big data science (at least 80% of all data are geographic in nature, as the majority of information around us can be georeferenced) => 80% of the 2.5 exabytes (2,500,000,000 gigabytes) of big data generated everyday is geographic
GeoAI, or Geospatial Artificial Intelligence, is an exciting research area which applies and extends AI to support geospatial problem solving in innovative ways.

According to a study, the Geospatial Imagery analysis market alone was estimated to USD 61.5 Billion in 2021 and is projected to be USD 126.01 Billion in 2028, CAGR rate of 12.70%.
Tremendous momentum GeoAI in recent years: 3 factors

Breakthrough developments in deep (machine) learning, immense available computing power, and the pressing needs for mining and understanding big data

1. **Availability of AI frameworks and algorithms:**
   - Universities like Stanford and Silicon Valley University as well as innovative companies like Google, Amazon, Facebook and Baidu are developing frameworks - software libraries and languages - which greatly facilitate the work of developers in many company, helping them think and use Artificial Intelligence in their solutions. An example is IBM Watson, widely used to improve customer service and support services or Google Vision Transformer architecture particularly fitted to the geospatial business (providing parallel processing).

2. **Big Data:**
   - The volume of data freely accessible is infinitely greater than in the recent past. Big Data analyses are fundamental for the realization of experiments and tests, collaborating with the advance of many technologies, including the application of Artificial Intelligence. In Geospatial global observation systems, such as operational satellites monitoring of the environment, atmosphere, ocean, and other earth system components, are producing vast amount of remote sensing imagery at high or very high spatial, temporal, and spectral resolutions. Distributed sensor network systems deployed in cities are also collecting real-time data. Not to mention location-based social media, GPS-enabled handheld devices etc.

3. **Processing Power:**
   - There has been a very large development in hardware in recent years. Less than a decade ago, we had only CPUs (central processing units), which evolved into GPUs (graphics processing units), more conducive to the international intelligence market by accepting more complex calculations.
GeoAI to automate Location intelligence in Hexagon: from sensor to solutions

Sources
- HxGN Content
- Sensors
- Public information services

Technologies
- AI & spatial modeling
- HxDR Cloud technology & interfaces

Digital Twins
- Mesh
- Semantic
- Enterprise data

Software Solutions
- Government - SDGs
  - Municipalities
  - Smart cities
  - Smart nations
- Transportation
  - Asset management
  - Predictive maintenance
  - Safety
- Defense
  - Mission planning
  - Intelligence

AI & spatial modeling

HxDR Cloud technology & interfaces

Mesh

Semantic

Enterprise data
Project: City of Klagenfurt

• Provincial capital of Carinthia (Austria)
• 120km², 102.000 inhabitants
• 5 TB arial images (NADIR & Oblique) ground resolution 5 cm
• Goal: Quantify and Qualify Geo-Al results for selected categories against customer feature data (ground truth)
essential elements for City of Klagenfurt project
GeoAI

Landcover (25 classes)

Impervious from Landcover

Per-class Probabilities (0 – 255)

Impervious from Landcover & Probabilities

Arial images (NADIR & Oblique)
20% additional area via AI

=> "...we can look under trees and roofs..."
IMAGINE Spatial Model to generate vector features for impervious landcover
<table>
<thead>
<tr>
<th>Class / Theme</th>
<th>Ground Truth from City of Klagenfurt</th>
<th>GeoAI Results from Hexagon</th>
<th>Quality / Delta</th>
</tr>
</thead>
<tbody>
<tr>
<td>Roofs</td>
<td>29.387</td>
<td>28.648</td>
<td>97.5%</td>
</tr>
<tr>
<td>Roofs with Solar-Panels</td>
<td>1.938</td>
<td>2.058</td>
<td>93.8%</td>
</tr>
<tr>
<td>Grey-Space incl. impervious areas</td>
<td>n/a</td>
<td>delta 3D vs 2D analytics &gt; 20%</td>
<td></td>
</tr>
<tr>
<td>Green-Space incl. Trees</td>
<td>Total: not known</td>
<td>Total: 764.665</td>
<td>99.7% (on public parcels)</td>
</tr>
<tr>
<td></td>
<td>Public: 20.802</td>
<td>Public: 20.751</td>
<td></td>
</tr>
<tr>
<td>Railways</td>
<td>Length = 17.813m</td>
<td>17.597m</td>
<td>98.8%</td>
</tr>
</tbody>
</table>
Data-products resulting from Geo-AI based 3D reconstruction

- Landcover (25 classes)
- Digital Terrain Model (DTM)
- True Orthophotos
- LOD2 Buildings
- Per-class Probabilities
- Digital Surface Model (DSM)
- Digital Reality Mesh
- LOD2 Trees
### Photovoltaik

- Anzahl der Module: 184 Stück
- Modulfläche gesamt: 312.8 m²
- Installierbare Leistung: 69.92 kWp
- Jahrestromertrag: 36203.74 kWh/a
- spezifischer Jahresartrag: 517.79 kWh/kWp
- CO₂ Verminderung: 9666.4 kg

### Solarthermie

- Anzahl der Kollektoren: 153 Stück
- Kollektorfläche gesamt: 306 m²
- Brauchwarmwasser für: 72 Personen
- Wärme & Brauchwarmwasser für: 36 Personen

[EPSG:4326 - WGS84] 46°37'33", 014°18'40", Höhe: 491.97m
[EPSG:31255 - MGI/Austria GK Central] x: 745485.5, y: 165631.5, Höhe: 444.63m
Thank you

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