Artificial Intelligence in Action:

GeoAI: Extracting Intelligence from Geospatial Data & Imagery

Case Study: Orbica

April 2019

TOWARDS OUR INTELLIGENT FUTURE TE ARA MŌ TĀTOU ATAMAI O ĀPŌPŌ aiforum.org.nz

forum NEW ZEALAND
Te Kāhui Atamai Iahiko o Aotearoa

IDC
ANALYZE THE FUTURE

forum NEW ZEALAND

Te Kāhui Atamai Iahiko o Aotearoa

Special Study

GeoAI: Extracting Intelligence from Geospatial Data & Imagery

Monica Collier Meredith Jeory

April 2019

A Geospatial Information System (GIS) stores, analyses and presents geographic and spatial data. This allows scientists to study and analyse information about the physical world and how people use the physical space around them. Often this involves data, such as mapping information and also imagery such as satellite views of the earth.

For example, scientists can map rivers and waterways and overlay information about how nearby farms or industrial areas affect waterways. Google maps is a GIS mapping solution commonly used for personal navigation. Mapping buildings and roads alongside geographic features can be used for urban planning.

GeoAI is the intersection of geospatial data, geographical imagery, and artificial intelligence. While satellite imagery or aerial photography provide data, GeoAI extracts intelligence from the imagery, such as detecting and classifying features, faster and with more accuracy than humans.

FIGURE 1

GeoAI

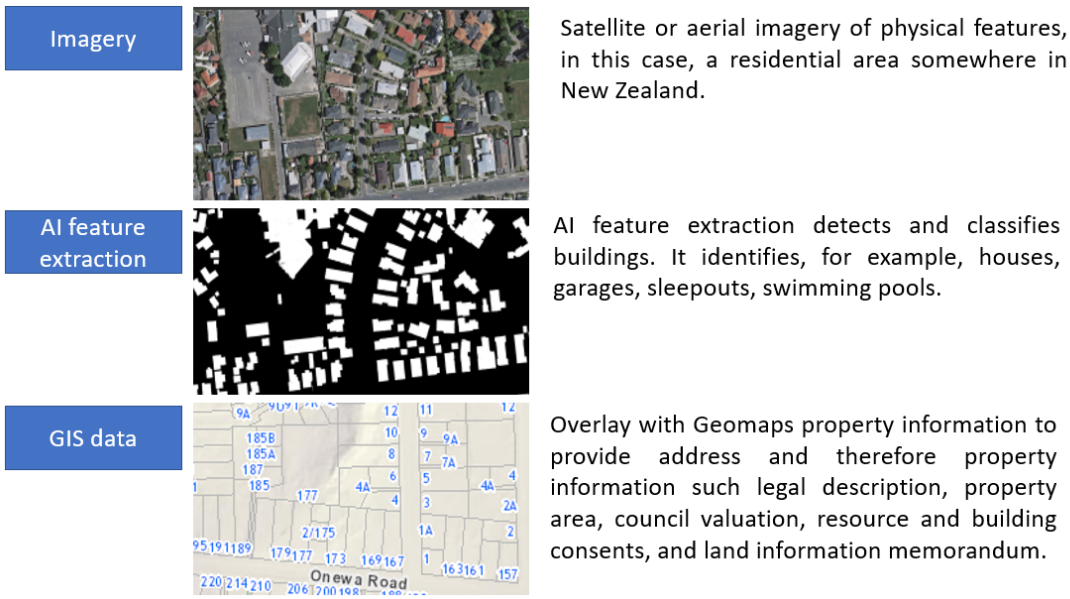

Image Source: Orbica, Auckland Council Geomaps, 2019.

Figure 1 illustrates how GeoAI can identify and classify buildings, such as houses and garages from imagery. Once overlaid with GIS data about a property this dataset enables use cases in the private and public sector. For example, local councils can automate the process of ensuring new buildings have appropriate building consents.

There are many applications of GeoAI, for example:

- Construction companies can monitor build progress against their plan.
- Developers can identify building roof sizes to calculate solar potential. Planners can use roof sizers to understand the impact of water run off, or understand roof quality.
- Chimney identification lets councils understand how the volume of chimneys affects air pollution in a given area.
- Environmental agencies can use the data for habitat protection and flood management.
- Real estate agencies and other people interested in address information can use an accurate buildings database.
- Maritime agencies can watch suspicious vessel movements. For example, to counter illegal fishing, reduce illegal immigration, counter drug smuggling, and manage environmental impacts.

Example: Esri Predicts Traffic Accidents Using Geospatial AI

Esri, the Environmental Systems Research Institute, supplies geospatial information system (GIS) software. Esri is using machine learning with its software, ArcGIS, for predictive analysis. In 2018 Esri built a model to predict traffic accidents in Utah. The model uses several data sets. For example, weather factors such as temperature, temporal aspects such as time of day, spatial aspects such as road curves. Esri overlaid 7 years of vehicle accident data into the model. Using machine learning, Esri could determine the highest risk factors for accidents in the area. For Utah, the top risk factors are temperature, time of day, and visibility. Esri can predict where accidents will occur on any given day.

This insight has many potential uses:

- Emergency services know where best to place resources on standby.
- Road planners can better understand how to reduce risk on roads with high accident rates.

- Traffic management systems can take preventative actions. For example, digital signage messaging or reducing speed limits in predicted high risk areas.

CASE STUDY: ORBICA HELPS THYSSENKRUPP UNDERSTAND CONSTRUCTION SITE BUILD PROGRESS

Christchurch based GeoAI business Orbica won a pitch to solve a challenge for engineering firm Thyssenkrupp. The challenge was how to manage and forecast build progress against schedule on large construction sites. As an example, *Figure 2* shows the scale of a €900 million concrete plant build in Saudi Arabia.

Orbica proposed a solution combining its 3D geospatial and mesh models combined with AI. Drones capture 3D imagery of the construction site. Orbica grafts the images together into a coherent picture. It then runs AI models to determine the objects in the imagery. The model can identify building construction and ignore irrelevant features such as scaffolding. ThyssenKrupp can understand build progress since the last check, the delta between forecasted progress and actual progress and the risks of continuing to build in a given area if another area is behind schedule.

FIGURE 2

Concrete Plant, Saudi Arabia

Source: Orbica, 2018

The Orbica Solution

Orbica runs a data agnostic, platform agnostic, full stack solution for GeoAI. The company uses high quality, high resolution imagery. It runs this imagery through an AI model to derive intelligence, such as feature extraction. Orbica feeds this intelligence through its geospatial analytics system. Here the data is turned into formats that customers can ingest into their systems.

Orbica trains the AI system to identify physical features such as bodies of water or buildings. The model can identify and distinguish between different types of features, for example:

- Bodies of water: a lake, a lagoon, a pond, a stream, or a braided river.
- Buildings: a house, a commercial building, a sleepout, a garage.

Orbica aims to create a universal model that it can apply globally. Orbica's goal requires extensive machine learning against sophisticated and complex datasets. Development is ongoing; Orbica is continually gathering data sets and training its model.

Orbica needs above-the-ground imagery for feature extraction. But for other predictions, such as weather or pollution modelling, the company does not need imagery data. Orbica can use sensor data sets instead.

Product development and customer onboarding is "Agile but iterative", according to Orbica's Geospatial Innovator Santosh Seshadri. "It's not like we do one sprint and then it's hands-off, we do one sprint and then we figure out what went wrong, go back and fix it and in that sense its iterative." The point is to do a quantity of work and then learn from it and determine what to do better. Orbica has its own AI feedback loop: The company feeds back completed data sets, where humans may have corrected some errors, into the AI system. This effectively enables the AI to learn from its mistakes.

OVERCOMING CHALLENGES: ORBICA'S LEARNINGS AND GUIDANCE

Orbica spoke to research firm IDC about customer challenges and learnings. Their guidance to organisations considering a GeoAI project includes:

- At the beginning of any GeoAI project it's important to do a proper discovery phase. This will identify whether the project requires AI or a different solution, such as a statistical analysis project. AI projects require a larger commitment in order to succeed. Therefore, it's important to understand whether AI the right solution.
- Clients need to understand AI projects are long term projects. AI is like teaching a baby to walk. The more data fed into it the more useful it becomes. The cost, in the long term, reduces exponentially. Less work is needed in the long term as the algorithm gets better, but initially there is a lot of preparation and discovery work at the start with the client.
- The best customers are those that are interested and willing to come along on the journey. Orbica has learned it needs to have strong engagements with customers around their domain and the data they have. Understanding what the data is, the problems with it and how the customer wants to use the data are key aspects to a successful solution.
- The customer should bring domain knowledge but not AI knowledge. Traditionally, if organisations want to build AI, they need in-house technical capabilities. Orbica has learnt from its clients that their expertise is within their domain/vertical. The company is building a vertical-agnostic platform, enabling anyone to access the tech without needing to understand AI.
- Simplification and sculpting of data are key when it comes to clients. The more Orbica can isolate what the client wants and the scale, the better. Masking off unimportant areas reduces time taken and cost of processing unnecessary data sets. For example, if a client wants to look at South Island farmland, that could be terabytes of info. But finding out the client is not interested in sloped areas makes a difference. Orbica can build a smaller model run on the smaller area. The client can select to expand later on.
- Garbage in, garbage out. The machine can only learn with the data you provide it; good quality data is important. If you want good outputs, you need good inputs.
- What works here, won't work over there. The machine learning needs lots of training data to make a universal model. If Orbica develop a geographic product for Christchurch and a customer wants to use it in Brazil, it is unlikely to work. This is because of differences in image quality, light and shadows, types of buildings, types of environments, for example.
- Cost of data can be an issue. Clients might suggest using Google Earth data but there is a significant cost involved in accessing that data. Also, there are currently no New Zealand observation satellites. Orbica must buy high resolution data from overseas.
- New Zealand can improve its data policy. Currently, Orbica says public data is not always easy to access and does not come in easy to use formats. Not all data is standardised in a set framework. In the U.S., for example, public data is near real time and it is free to access and use.
- Government or Crown Research Institutes purchase data but can only provide it to educational or nonprofit organisations. This means small to medium commercial enterprises can't develop because they can't afford to source data to determine idea feasibility.

WHAT THE FUTURE HOLDS

Orbica plans to bring in more GIS principles and more remote sensing rigour to models to make its models more powerful. It will move away from desktop-based applications into an online distributed environment.

The company says that both artificial intelligence and remote sensing are expanding rapidly. This prompts new questions that GeoAI can answer and new problems that GeoAI can solve. Orbica says the industry is 5 to 6 years away from having the technology enabled to achieve this. For example, greater data update frequency and better imagery resolution.

The company intends to focus on environmental applications. It will train its models to extract features such as irrigated land, roads, forests and vegetation. Orbica can then classify those features and develop insight on how those features change over time. This lets, for example, organisations understand how a change in a river impacts local environment and farmlands.