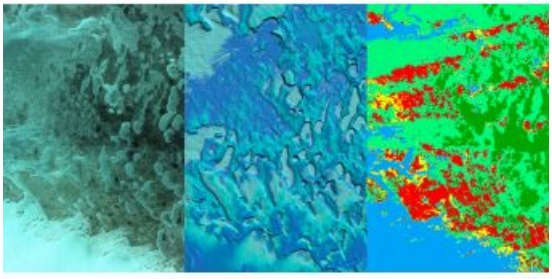
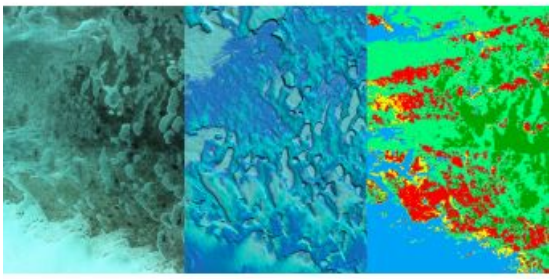
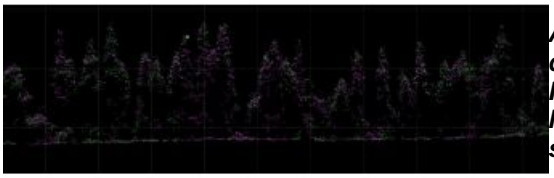
INSIGHTS FROM HEXAGONÂ€™S GEOSYSTEMS DIVISION INTO AI AND MACHINE LEARNING APPLICATIONS IN THE GEOSPATIAL INDUSTRY

Towards the new normal in surveying and engineering







Russell Bollig and John Welter from Hexagon's Geosystems division recently sat down with '*GIM International*' to discuss the impact of AI on the geospatial industry. The conversation focused on hot topics such as the role of AI in speeding up data analysis and decision-making for 3D laser scanning and aerial mapping, and also shed light on the rapid advancements in scanning and modelling services. Further, Bollig and Welter noted how improvements in computer vision have revolutionized imagery analysis and extraction. The insights emphasize the growing importance of AI and machine learning in geospatial applications, and their potential to revolutionize operational approaches in the construction and infrastructure sectors.

Artificial intelligence (AI) seems poised to drive unprecedented developments in many areas of life and business. To what extent has Hexagon's Geosystems division already incorporated AI/machine learning into its product offering, and which other opportunities do you see to capitalize on this trend?

Russell Bollig (RB): The geospatial industry is comprised of many disciplines such as 3D laser scanning and uncrewed aerial vehicle (UAV or 'drone') mapping, which can collect very large datasets. Analysing, aligning and rendering these datasets are all optimal places where we can utilize AI technology to both speed up processing and decrease costs. The speed and accuracy of the data analysis also allows our customers to make better, faster and more informed decisions every day.

John Welter (JW): If we think about aerial mapping and the large areas and volumes of data collected, AI is an obvious solution. For example, we currently use AI extensively for Lidar point cloud classification, mesh creation and orthophoto mosaic seamline

generation. AI is an enabler that makes generation of certain products possible, in addition to accelerating the workflow and improving the overall quality of other products.

John Welter and Russell Bollig, Hexagonâ€™s Geosystems division.

You acquired Multivista in 2016. What role has Multivista played in driving innovation in the construction industry since then?

RB: As a provider of cloud-based construction documentation software, as well as construction imagery services using a variety of sensor technologies, Multivista has substantial synergy with many Hexagon entities. This has led to significant collaborative efforts that have driven a lot of innovation. Connecting technologies to build better client workflows and reduce the costs of solutions have been a real driving force. Specifically focusing on building information modelling (BIM) adoption, we partnered with Leica Geosystems, part of Hexagon. Through this relationship, Multivista built Multivista BIM Program, a scanning solution enabling us to offer scanning and modelling services to our clients. Just last year alone, we scanned and modelled over 21 million square feet (approximately two million square metres) of construction space. Scanning and modelling are still quite new to many of our clients, so education is critical as well. In the area of AI and machine learning, we have started to incorporate computer vision AI models into many areas of what we do. These models can analyse an image to extract information from it. Geospatial Content Solutions (GCS) is another amazing Hexagon business with 15-plus years of artificial intelligence experience with whom we have partnered to develop and implement these AI solutions. Our first adventure was using AI to identify quality control issues within firestopping: specific designs and materials used to slow and stop fires within a building. When correctly installed, firestopping can save lives but it is an aspect of construction that is always hard to manage. Within the firestopping analysis solution we released in late 2021, we capture above-ceiling images, analyse them within 24 hours and provide our clients with a task list of all the deficiencies found. We have already captured and analysed millions of square kilometres in a little over a year.

JW: We see AI and machine learning usage rapidly becoming the new normal in BIM, architecture, engineering & construction (AEC) and other geospatial applications, so you can expect us to release more AI tools this year.

Which new frontiers are being opened by attention-grabbing inventions such as cameras on helmets and robot dogs? Are there any other 'hidden gems' related to AI that have the potential to make a difference to operational approaches in the construction and infrastructure industry?

RB: AI-powered solutions are a fantastic way to help fill the gaps in today's labour shortages. AI solutions can also help us save time while performing our regular responsibilities, either in the field or in the office. Computer vision, a form of AI that can analyse regular 2D or 360-degree images to provide insights, is very well suited to help drive operational efficiencies within construction. Today, we can analyse images to find if specific materials have been installed and then perform a quality control review on those materials. Very soon we will be able to report back on construction progress. Weekly and monthly construction schedule updates and field coordination and logistics will benefit directly from more accurate and consistent information being delivered from the field. The consistency and quality of the data are critical for this technology to be successful, which is why we help our clients by capturing progress photographs and performing the analysis of those images as a service. I have seen these insights transform how project teams plan, execute and pivot, which is really exciting.

JW: Anything that makes it easier to consume geospatial information, or to interact with it, helps grow the demand. A great example is virtual tourism driving the need for updated and accurate digital twins for popular tourist destinations. This helps the traditional users, such as municipal governments, better justify the investment in these datasets. Our Blue Economy effort in the Bahamas is a project that wouldn't be possible without AI to unlock the seagrass information used to support its protection.

Airborne survey results from the Blue Economy project in the Bahamas. Thanks to deep-learning AI classification algorithms, the seabed was classified by type, species of vegetation and density of vegetation coverage.

In the context of business, does AI play a role in driving the demand for data?

JW: Sure, AI has enabled entirely new business models to fund projects previously not possible. I referenced the Bahamas project where R-evolution, Hexagon's sustainability business venture, has teamed up with the non-profit organization called Beneath The Waves to map one of the world's biggest natural carbon sinks. As the Bahamian government plans to issue 'blue carbon credits' for preservation of its seagrass meadows, R-evolution and Beneath The Waves have deployed Hexagon's airborne bathymetric Lidar sensor, the Leica Chiroptera-5, to map seagrasses. AI drives the financial model that funds the project by enabling us to detect and delineate the seagrass beds. The traditional users of this bathymetric data are benefiting greatly from better data being available than conventional budgets would allow.
RB: Similar projects can be performed elsewhere, involving different natural CO2 storage ecosystems, but they will require the collection of geospatial and other data of sufficient quality to be analysed with AI.

How can AI contribute to the reduction of the construction industry's sizable carbon footprint in line with sustainability goals?

RB: There are many ways the industry can incorporate more sustainability practices on-site. Quality control and reducing rework are two solutions being implemented today. For example, AI computer vision can be used to analyse images and detect potential problems early in the building process. This improves quality and reduces rework by remediating issues before they become exceedingly expensive to fix. And as I mentioned earlier, AI can also help to calculate construction progress. More accurate and timely progress updates can greatly benefit field coordination during a project, which in turn reduces waste and shrinks the build timeline.
JW: Fed by digital twin and traffic information, AI is extremely effective at determining when and how to move large objects and where to stage materials, which is especially beneficial during complex construction projects in dense urban areas. Our

MetroHD product, the premium City-Scale Digital Twin, is a great example of a foundation for such AI applications.

3D mesh of the city of Munich, Germany, derived by combining aerial imagery and Lidar point cloud captured with Leica CityMapper-2.

Besides construction, what is Hexagon's view on how AI-based geospatial solutions can benefit society as a whole in terms of the challenges we are facing, such as climate change?

JW: There are countless other applications that can be unlocked and realized with AI. If we think about geospatial data, the primary usage has typically been to drive a GIS – but this also means so much value sits unlocked. AI can harvest all this critical information so we can see trends before they become critical issues – such as forestry areas decreasing in size, drainage issues contaminating critical water supplies, and vegetation encroaching on powerline infrastructure. All these information streams can move from manual processes to near-real-time automation, in essence giving us a modern-day 'canary in the coalmine' advance warning for many important environmental topics.
RB: Combating a challenge like climate change requires the acquisition and processing of massive amounts of data. But 'You can't manage what you don't measure', as we like to say within Hexagon's Geosystems division, and this is especially true for climate change. AI has already played a key role in speeding up the processing of data and in modelling that data, and will continue to do so. In fact, most of the key weather models already use AI to combine multiple large datasets and formulate their results or predictions.

How do you anticipate that the implementation of AI technologies can make a difference for data processing?

RB: Implementing AI is essentially implementing automation, which gains efficiencies by reducing costs and staff hours. In construction, the best examples of this are the uses of AI to process 3D laser scanner data to detect deviations and data alignment problems when comparing as-built scans to planning documents. In the geospatial profession, of course, we already see AI analysing tens of thousands of images per day to create aerial maps, extract features and ensure quality standards. These are often examples of AI adding logic to the image processing to answer queries that may be too costly or time-consuming for a human to perform.

JW: The human brain uses multiple senses to better interpret the world around us, so it should be no surprise that AI results get better by having multiple data streams to inference. Our hybrid sensors are a perfect example of combining different data streams – imagery and Lidar – to get better results from AI. Our future aerial sensors will be focused on this. Lidar adds an entirely new dimension to the AI input data.

SPL100 point cloud for a forestry resource inventory management project in Ontario, Canada, showing a 1m cross-section profile, coloured by flightline.

Which advancements in geospatial data and machine learning are still necessary for AI technology to reach its full potential?

JW: The entire ecosystem needs to continue to mature. We see the open-source frameworks, such as PyTorch, continuing to move forward rapidly, while the cloud providers offering these services in an easy-to-use 'platform as a service' will help to remove the IT hurdles. We also see companies like Nvidia working to introduce better hardware that allows even faster AI development and generation of results. Specific to geospatial data, we need standards that support further expansion of the use of AI. Currently, many standards are optimized for machine-to-human use cases, such as the traditional GIS for streaming data, but machine-to-machine standards have not been defined and rolled out. That will be the next big thing to help grow geospatial AI and optimize the overall ecosystem.

RB: The construction industry can be called a late adopter as it is using AI mainly for descriptive analytics – identifying what has happened by analysing images or a dataset that has previously been captured or created. However, the use of AI in construction is now starting to answer more intelligent questions that can help to make more informed and proactive decisions. This starts with diagnostic analytics, then moves to predictive analytics, and finally to prescriptive analytics. This opens up the ability to identify why something happened, how to avoid or ensure something happens in the future, and laying out a prescriptive path to achieve those goals. AI in construction needs time to mature and gain further adoption. I know the Hexagon family is – and will continue – working hard to develop and provide these solutions.

The use of AI is in itself a learning process; it can't be implemented overnight. What advice would you give to businesses who are looking to utilize AI to improve their operations?

JW: The process of growing up is about acquiring parcels of knowledge that all compound, with each lesson being the foundation for the next. You should approach AI in a similar way. Start now. Start small. Set reasonable goals. And measure the results as you progress.

RB: I couldn't have said it better!

Biographies

John Welter is president of geospatial content solutions at Hexagon's Geosystems division. With three decades of extensive and demonstrated experience in the information technology and services industry, Welter is an expert on topics including geospatial services, airborne mapping technology, big data concepts and IT strategy.

Russell Bollig is senior director of solutions at visual documentation technology company Multivista, part of Hexagon. In this

role, he leads the company's AI development and image analysis efforts and manages strategic partnerships and integrations