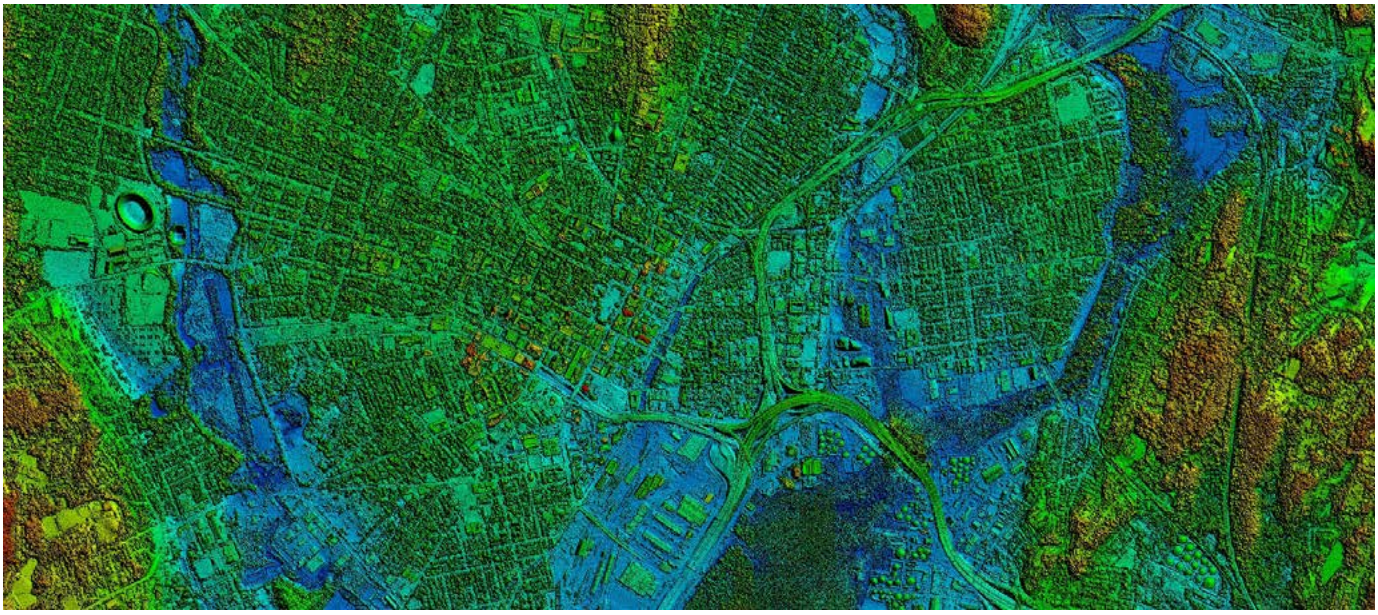
HEXAGON

Case study

5G wireless network design relies on 3D aerial data

The development of fifth generation wireless technology (5G) is spreading rapidly around the world. The initial improvement of up to 10x in speed and 400x in latency, as well as a much larger capacity for simultaneous users, will create endless opportunities for autonomous vehicles, virtual reality, smart cities and the Internet of Things (IoT). In the future, by using additional spectrum, speed improvements could reach 100x and enable applications that we have not even imagined yet. To maximize performance of new 5G networks, telecommunication operators require high-resolution 3D data to develop signal propagation plans and select ideal locations for small antenna systems.



DSM raw data derived from 15 cm orthophoto – New Haven

Optimizing 5G network performance

The exciting next phase of wireless technology will operate in the high to very-high frequency domains, with low-band 5G offered on a nationwide basis, and high-band 5G (also known as millimetre wave) offered in dense urban areas and centres with large crowd gatherings like sports stadiums. These high-band signals are easily blocked by obstructions, such as buildings and trees, so the network must consist of many small cells (radio equipment/ antennas about the size of a pizza box) located within line of sight to provide maximum coverage and capacity.

Radio frequency (RF) engineering models, based on geographic data including aerial imagery and digital surface models (DSM), are used to identify the best locations for the antennas to optimize network performance. At this time, high resolution (≤15 cm) aerial imagery products are the best data source to attain the levels of detail and accuracy required for high frequency 5G networks.

Increased demand from the 5G wireless market helped put Land Info Worldwide Mapping LLC on the 2019 Inc. 5,000 list of fastest growing private companies in the US. To meet the specific data requirements for 5G networks, Land Info invested heavily in object-based image analysis and artificial intelligence to build out models used by large 5G carriers. The efficient, automated workflow was developed using high-resolution aerial imagery from the HxGN Content Program.

“Hexagon removes all the hurdles so we can easily and quickly access the data and apply our value-added processing,” says Nick Hubing, president of Land Info Worldwide Mapping. “The high-quality imagery and digital surface models allow us to produce accurate 3D building footprints, trees and clutter (land cover) maps that meet the stringent requirements for 5G wireless network development.”

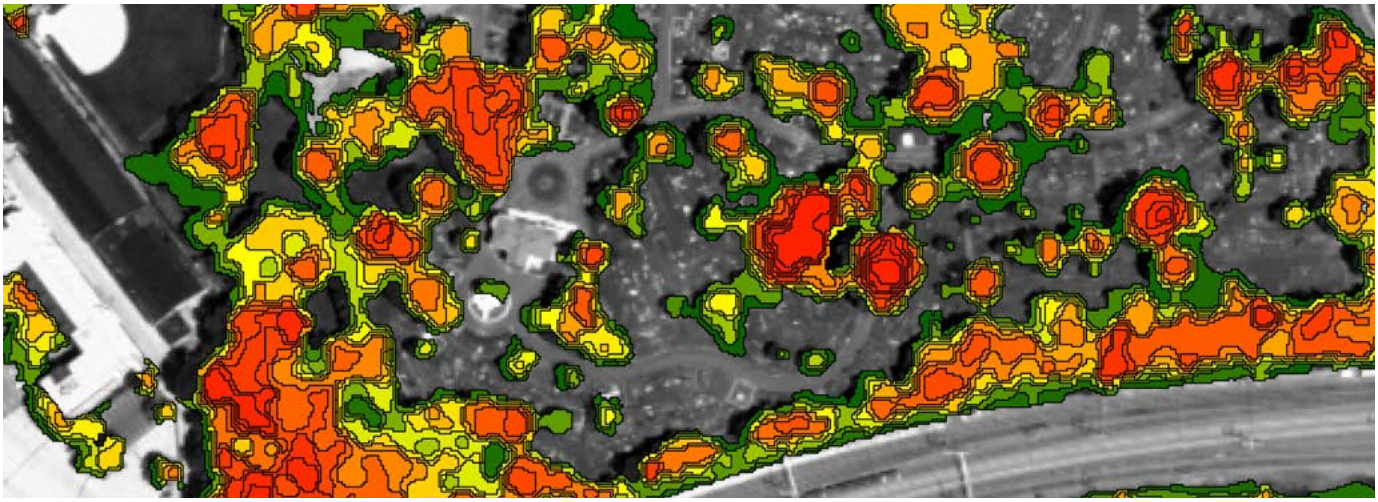
The HxGN Content Program has built a comprehensive library of high-resolution wide area, leaf-on aerial images and DSMs that now covers the contiguous United States and most parts of Western Europe. Wide-area coverage is available at 30 cm resolution, and cities with populations larger than 50,000 in the U.S. are available at 15 cm. Starting in 2020, wide-rea collects will be made at 15 cm resolution across the United States.

“Resolution is an exponential relationship – 15 cm aerial has over nine times more detail/pixels than 50 cm satellite,” explains Hubing. “The extra detail gives very noticeably improved edge definition, allowing us to best segment the smaller, multi-level (height change) features of a building.”

5G Challenges

Wireless providers are investing large amounts of money to stake a claim in the 5G wireless market. The winners of this race will have the fastest coverage for the greatest number of people, which makes signal propagation planning critical. Particularly in urban areas, the placement of small cells must be close together to avoid obstructions, which increases complexity and cost of the network.

Due to the increased sensitivity of the 5G signals to obstructions, which degrade performance, networks



3D tree vector polygons are created using proprietary morphological operators – Philadelphia

require the most accurate data available. Data layers must identify accurate height above the ground for individual buildings and trees. Four-band leaf-on imagery and associated DSM are used to perform vegetation and obstruction analysis. Land Info produces the most detailed 3D building models using high fidelity 15 cm aerial images and DSM from the HxGN Content Program.

"Aerial is always collected close to nadir, meaning looking straight down, which is what gives aerial better visibility than satellites to map all features in urban environments," says Hubing. "In areas of tall buildings, supplemental aerial flight lines are added to provide the best possible mapping in these critical, dense urban areas."

It is also important to have consistent coverage of the area of interest. Satellite data sets are typically produced using multi-view photogrammetry, a process that requires overlapping imagery of the same area. The images may be collected on multiple orbital passes, which occur on different dates spread over months/years and in varying weather and seasonality conditions. In contrast, aerial collection ensures consistency through tighter collection windows of days/weeks for large areas and meets the requirement to deliver cloud free data.

Creating geo-information

Hexagon employs an aerial collection strategy conducive to telco modeling by offering a library of data that is flown in the same season with the same equipment. The "wall-to-wall" coverage of the conterminous U.S. and most of Western Europe eliminates gaps and captures metro areas at a higher resolution, which is ideal for 5G networks focused on densely populated areas. The HxGN Content Program data is available on demand through a streaming service, and data is delivered ready to use to create a variety of products or be fed into machine learning engines. Fast delivery enables firms like Land Info to deliver on short turnaround deadlines.

Land Info differentiates itself by using proprietary techniques to quickly extract elevation and landcover at scale. High-resolution aerial images and DSM gives the best edge definition, allowing Land Info to map buildings and trees in 3D with the greatest detail. Buildings are segmented to capture different height levels, including roof top obstructions. 3D tree vectors are contoured to represent the different height levels of trees, and value-added Land Info processing can even map canopies, trunks and the tree understory.

"For 5G mapping there is never too much detail in the imagery," says Hubing. "We like to work with the highest resolution available, and the HxGN Content Program offers current and consistent coverage."

The telco industry is heavily invested in introducing extremely high-speed wireless coverage around the world. To meet the demand for detailed 3D maps that support network modeling, geodata providers like Land Info are developing more efficient and effective processes that accurately extract 3D buildings, trees and clutter that leverage high-resolution aerial imagery and DSM.

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Hexagon is a global leader in digital reality solutions, combining sensor, software and autonomous technologies. We are putting data to work to boost efficiency, productivity, quality and safety across industrial, manufacturing, infrastructure, public sector, and mobility applications.

Our technologies are shaping production and people-related ecosystems to become increasingly connected and autonomous – ensuring a scalable, sustainable future.

Learn more about Hexagon (Nasdaq Stockholm: HEXA B) at hexagon.com and follow us @HexagonAB.

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