SMART WATER WATCH

Keeping heads above water with satellite image analysis

Satellite image analysis companies such as Utilis and Satelytics are offering utilities a new perspective on their networks. Can this small step offer utilities new insights or is it a giant leap too far?

While many utilities turn to permanent sensor installations to monitor their networks, some are taking a step back and getting a broader view, using satellites in outer space. Two leading players in the space, Utilis and Satelytics, have developed algorithms to analyse satellite images and provide valuable insights into water catchments and networks.

Israel-based Utilis is one of the first movers in using satellites for leak detection, claiming to have detected 5,000 leaks in 2017 alone. Utilis deploys satellites to take images from space, effectively renting air time from the satellite owners. The satellite sends out electromagnetic waves, in this case microwaves, which can penetrate the earth and are reflected by electrically conductive materials such as wet ground. The satellite measures the reflected waves to create an image based on reflected energy (*see figure, right*). After analysing the image, Utilis delivers a web-based map to its client, narrowing down the location of leaks to within around 20 metres.

"Drinking water has a different signature to other kinds of water. Because drinking water is treated it has a distinct amount of salts," explained Lauren Guy, CTO of Utilis. The unique signature of drinking water can be identified using algorithms. "We can tell the difference between different kinds of water and say whether it's drinking water. If it's underground but not in a pipe, it's leakage." Leaks as small as 0.1L/minute can be detected while a single image can cover almost 3,500km^2. In August 2017, Utilis conducted a pilot with the city of Albstadt, Germany, where 106 leaks were detected within 21 days, saving Albstadt $1.1 million a year in non-revenue water according to Utilis.

Before images can be analysed for leaks, they have to be cleaned using radiometric corrections. "Microwaves are close to radio frequency. Instruments inside the city like cell phones and radio towers create noise in the image," explained Guy. "One of the best parts of the algorithm is not actually finding the water but removing the noise from the image."

Utilis offers its service on a monthly or bi-annual basis, and it has already been adopted by utilities in the UK, Germany, Romania and South Africa. Despite scepticism from competitors regarding the infrequency of data, Guy explained that more regular data would not benefit its customers as the number of leaks detected in a single image usually exceeds that which the utility has the resources to correct in a single month.

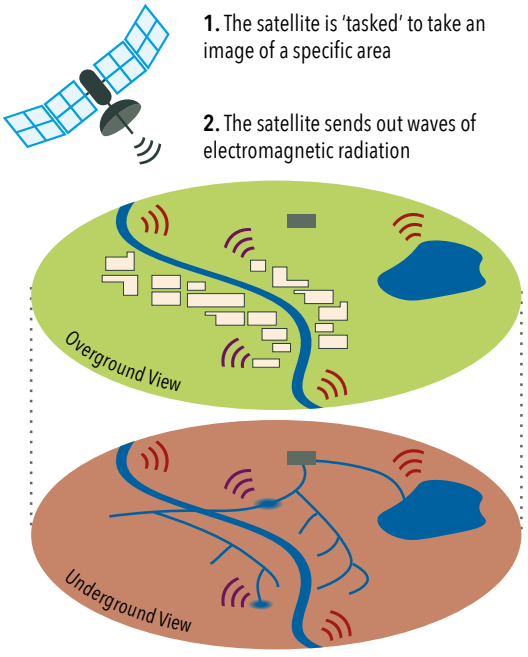
Geospatial image analysis is not solely used for detecting leaks. In the US, Toledo, Ohio-based Satelytics uses data from satellites, nanosatellites, drones and planes to monitor water quality in watersheds. "What they all have in common is that they all output hyper or multispectral data," explained Sean Donegan, president and CEO of Satelytics. The company started out working in the water and wastewater industry participating in a green infrastructure project with Veolia and the Greater Milwaukee Sewer District, where it monitored the health of vegetation sites using bi-monthly satellite image analysis and raised alarms if vegetation became damaged or decayed.

Unlike Utilis, Satelytics measures the unique characteristics of infrared signatures rather than microwaves. "We look at every pixel whether it's land or water. Not only can we tell you what's going on in the water, but we can also tell you what's caused it," explained Donegan. The data Satelytics extracts can be used to monitor water quality throughout water catchments, helping utilities to fulfil regulatory compliance and alert them to potential issues.

"Being able to understand the cause and effect relationship provides much more operational intelligence than we've been able to have historically," said Jim Schlaman, director of water resources at Black & Veatch, which has partnered with Satelytics. "The biggest advantage [of satellite technology] is understanding the watershed system much more holistically. You ▶

DOWN TO EARTH

Satellite image analysis can detect leaks because treated water has a different reflectance signature to untreated water.



Source: GWI

can look at the entire watershed and say, for example, where the hotspots of phosphorus are that could cause an algal bloom and what are the unique signatures. Historically, to figure that out, you would have to send crews of people into the field to do blind samples on both land and water."

Satelytics analyses images using machine learning algorithms hosted in the cloud. "Each algorithm takes about three to four months to develop," explained Donegan. Satelytics currently has 25 algorithms and is planning to add a further 33 algorithms in the near future. "We hope to soon have algorithms for mercury and E. coli," said Donegan, who added that Satelytics' ability to rapidly develop and improve algorithms gives it a competitive edge.

Although satellite technology can significantly improve efficiency for utilities, requiring no upfront investment in equipment, it is not without limitations. It takes around two weeks for Utilis to process satellite images, a timeframe that is useless in emergencies, and 30-40% of identified leaks are false positives. Furthermore, leak locations must be narrowed down manually using acoustic methods. "One of the biggest challenges that our R&D teams is working on is reducing the suspected location as much as possible," said Guy, adding that the company plans on adapting the technology for leak detection in the wastewater industry.

External investments in the space industry are likely to benefit companies such as Utilis and Satelytics according to Schlaman. "There's a goal of having revisit times everywhere in North America down to 15 minutes every day, maybe even 5 minutes. Currently it's more like a week."

While Utilis and Satelytics focus on improving their algorithms, satellite-based analysis may get a popularity boost as satellite hardware technology becomes more advanced and cheaper to use. "Right now, you pay a premium for the images, especially if you're tasking a satellite," said Schlaman. "I suspect that in ten years, the price to task a satellite will be much less expensive, just due to technology prices coming down." Nanosatellites are a cubic metre in size and cost up to $300,000 – significantly less than their full-sized counterparts. Nanosatellites are launched as constellations into low-Earth orbit, meaning they pass over specific geographical locations more often than traditional satellites. "By the end of this year, you'll be able to revisit any site in the world every two hours, and by 2020 every two minutes," said Donegan. "In the future, this data will be at every corporation's fingertips."

Satellite leak detection companies may also benefit from coupling their broad network overviews with more targeted leak pinpointing technologies. For example, Utilis is currently in the process of partnering up with Aganova, whose Nautilus solution detects leaks from within pipes to an accuracy of 1.5 metres (*see GWI May 2018, p64*). ■

CONFERENCE TALK

All for one, and one for all in smart water

The 8th Smart Water Networks (SWAN) forum revealed a growing frustration among utilities wanting to combine digital solutions. Standardisation will be the crucial next step for the smart water market, writes Sophie Redfern.

A wise author once wrote, "All for one, and one for all." This may be the famous catchphrase of Alexandre Dumas' *The Three Musketeers*, but judging from presentations given at the 8th Smart Water Networks Forum in Barcelona last month, it is also a motto which smart technology vendors should be looking to make their own.

With a wealth of evidence amassing from smart solution pilots worldwide it is clear that utilities, at least for the most part, are embracing the promises of digitisation. However, it is also now clear that the best solutions will arise from combining offerings. With such a mismatch of products and services on offer, and no standards to ensure their compatibility, utilities are struggling to optimise their investments. Lack of standardisation between solutions makes utilities wary of commitment, as they fear becoming 'locked in' by larger, early-moving companies who make it difficult for other technologies to be mixed with their own.

The importance of standardisation was underlined by numerous speakers, with the truth behind existing claims of interoperability questioned. Suez touted its Wize Alliance, an international standard for the Wize communications network, while speakers from the Formentera Council (responsible for drinking water supply on the Spanish island) presented a 'universal system' for advanced metering infrastructure (AMI) that can read smart water meters from several different providers through various communication protocols. While many open standards-based communications protocols are being developed by various alliances, there is a distinct lack of interoperability between hardware and software solutions for networks, and platforms are rarely able to seamlessly integrate with sensors from different providers.

One speaker from Catalunya's technology centre, Eurecat, highlighted the factors necessary to achieve interoperable solutions: homogenising data from multiple sources to make it available throughout the value chain; creating smart platforms with hybrid architectures that enable integration of data, smart objects, services and other software and analytical tools; and the need for a catalogue of standards outlining best practices. However, the newness of most smart water solutions and the subsequent lack of data regarding them makes evidence-based development of standards a challenge.

Furthermore, standardisation is not the only difficulty faced by technology vendors. Return on investment is often ambiguous as solutions are increasingly used for multiple applications, or combined with other solutions to enhance their benefits. For example, the primary motivation for installing AMI systems is to enhance billing, however, when combined with other solutions, data from AMI smart metering can be used for leak detection and customer engagement.

It is now clear that in order to avoid stagnation of the smart water market, technology providers and utilities must collaborate widely to develop standardised protocols that will enable the optimisation of networks to their fullest. A poll revealed that 55% of delegates believe the municipal water industry will have entered the standard phase of adoption in 10 years' time, while 34% believe the industry will still be in the early adopter phase. Undoubtedly standardisation will be a key challenge and influencing factor for advancement of the smart water market in coming years. ■