Kawasaki Geological Engineering Co., Ltd.

Using Artificial Intelligence to detect road cavities with the analysis time halved

Kawasaki Geological Engineering Co., Ltd. conducts road surveys for local and national governments using proprietary technologies that are able to detect cavities below the road surface. But this is time consuming work. The company decided to adopt Fujitsu's AI solution "Zinrai Deep Learning System" to analyze the vast amounts of data that were previously handled manually. Using Artificial Intelligence (AI) to learn and recognize the signature patterns of cavities, the company brought objectivity to the process and reduced the time taken to detect anomalies by 90% and the overall time for analysis by more than half.

> *Fujitsu understands our business very well. The rapid deployment of AI, and procedures for identifying highly accurate training data, were only possible because they fully understood every aspect of our business. Technical communication was effortless as well.*
>
> *Toshihiko Sakagami, CEO*
> *Kawasaki Geological Engineering Co., Ltd.*

Better instruments mean more data, but higher costs to analyze

As a pioneer in geological surveying, Kawasaki Geological Engineering Co., Ltd. conducts subsurface testing of roads at the request of national and local governments and others tasked with managing these assets.

When cavities form under a road, in a worst-case scenario they can result in catastrophic subsidence. An extreme example of this is a giant sinkhole that opened up near JR Hakata Station in the Kyusyu area in November 2016. While cavities can have many causes, the Ministry of Land, Infrastructure, Transport and Tourism in Japan explains that the majority are caused by deteriorating sewage pipes. Cavities might not be noticeable because Japanese roads are well maintained. But in 2015 alone, road subsidence was apparently found at 3,300 locations across Japan.

The company has developed a range of technologies for subsurface exploration for detecting cavities below the road surface, which their mobile engineers use as they travel around the nation's roads.

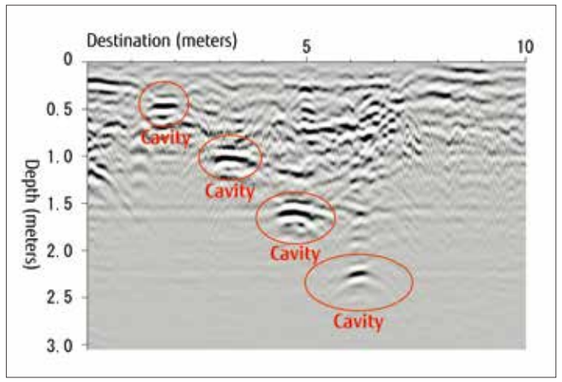
According to Toshihiko Sakagami, CEO of Kawasaki Geological Engineering, "Conventional methods only enabled us to survey down to a depth of 1.5 meters, but the cavities caused by deteriorating sewage pipes develop further down than that. We applied our technologies and expertise to the problem and succeeded in developing a 'chirp radar system' able to detect return signals at greater depths. This has enabled us to survey at depths of between 3 and 5 meters without losing any efficiency."

By more than doubling the survey depth, the company has found itself with vast amounts of data. The data, when printed out, needs between 1,000 and 2,000 A3-sized sheets per 100km of road. To determine the presence of cavities, a team of 5 or 6 people spend about a month, each time, poring over pages and pages of radar waveform data printouts. They search for potential cavities and other anomalies, and then identify the actual cavities. Checking for cavities therefore became more time-consuming and costly for them. They spent considerable time on these problems, and on reducing oversights as much as possible.

Improving accuracy and efficiency of analysis, where errors can't be tolerated

It takes experience to be able to identify cavities from the data. Beginners may sometimes overlook the cavities if the signal data is not immediately clear. More experienced people are therefore needed to crosscheck work and avoid oversights. At Kawasaki Geological Engineering, they focus most heavily on analysis to maintain the safety of the roads they survey.

Fortunately, the company currently has many highly experienced workers who can perform this role easily. However, according to Toshihiko Sakagami, "Considering manpower and other factors, we could not continue working like this. That is why we started looking at AI. Some of our engineers were knowledgeable about AI, so we had a fair idea that we could apply AI to detecting cavities in the same manner as crosscheck work done by experienced people. The problem was that there was no commercial application to do our job, which meant we were unable to adopt the technology."



Artificial Intelligence reduces anomaly detection time by 90%, while the total time engineers spend on analysis has been halved

Knowing they would be unable to quickly deploy AI by themselves, the company received a proposal to deploy Zinrai Deep Learning from the Fujitsu Traffic & Road Data Service Ltd., a company with which they were already working. During discussions, they found they could deploy the technology in less than one month, and it was that speed of delivery that was the deciding factor for them. Kawasaki Geological Engineering proposed to Fujitsu that the scope of AI be limited to identifying anomalies that could be potential cavities; in other words, that it be limited to the stage prior to final determination by the company's engineers. Through close communication between the two companies, they were able to efficiently accelerate the deep learning process.

Commenting on the company's main objective, Toshihiko Sakagami says, "Our prerequisite was to catch every anomaly, to not miss a single one." Starting from this pre-condition, AI development took shape in less than one month, with a large volume of training data being created and immediately loaded into Zinrai Deep Learning. Through additional training data and fine-tuning, they succeeded in reducing primary detection time by 90%. The system is now able to detect anomalies to an accuracy of close to 100%. So, including time spent visually checking the results, total time spent determining whether there are any cavities below the surface has been halved.

Shigeharu Yamada, General Manager of Maintenance at Kawasaki Geological Engineering, says, "Honestly, our engineers were doubtful at first but they are now very impressed with what AI can achieve." Toshihiko Sakagami quickly adds, "But that does not mean that we will not need people. Specialist engineers will always be needed. Developing AI and developing engineers are 2 sides of the same coin for our business." The most important thing is knowing how to use AI.

Shigeharu Yamada says, "Deploying Zinrai Deep Learning has enabled us to apply objectivity to the data. In addition to anomaly detection, if we can improve the accuracy of cavity identification itself, I expect we will be able to reduce analysis time by as much as 80% before long." The deployment has improved efficiency, more than halved the time taken for analysis and reduced costs. "And as a result we are able to take on many more jobs," comments Shigeharu Yamada.

Kawasaki Geological Engineering is already forging ahead with its next idea. They normally send out their specialized vehicles to take measurements. However, they are now considering installing sensors on the vehicles that local governments use for their daily patrols, which will make analysis much easier. Continually checking that data every day should enable discovery of dangerous cavities that much sooner.

Toshihiko Sakagami comments, "As professional geological surveyors, we not only detect cavities but closely examine the causes as well. Knowing those causes enables people to prevent the cavities from forming in the first place. We are proud of what we do." Using its own technologies in combination with Zinrai Deep Learning, Kawasaki Geological Engineering will continue making its contribution toward realizing a safer society for all.

Customer Profile

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