The helping algorithm hand

by Laurent Hentges, *Vice-President Operational Excellence, Bureau Veritas Marine & Offshore*

Artificial Intelligence (AI) is changing our world in multiple ways, from enabling medical breakthroughs through powering industry robots to facilitating our daily lives through smart applications. Advancements in AI are also transforming the maritime industry, including how we detect and address corrosion on ships.

Corrosion is an insidious enemy for vessels, costing the global industry an estimated $90bn to $330bn a year (depending on the scope of calculations) in repairs, maintenance, and off-hire downtime. The cost of inaction is also high: if left untreated, corrosion can cause considerable damage to hulls, structures and tanks, impact the ship's integrity, and even force the owner to scrap the vessel early, thereby losing a major investment. Therefore, the capacity to detect corrosion at the earliest and carry out the necessary works at the right moment is key to ensuring the ship's optimal maintenance and minimising repair costs.

Classification surveyors play a key role in the important decisions about what repairs are required to maintain the hull's structural integrity. They assess the severity of corrosion through periodic surveys, monitoring its evolution during the vessel's entire life cycle to decide if and when steel needs replacing. Given the value of the investments at stake, they must make the right calls to protect their clients' assets in the long term.

Surveyors used to rely on their own eyes and experience to make these delicate decisions. Now a new tool is being added to their arsenal: AI. In the short term, it can support decisions made by surveyors by improving safety and enabling quicker assessments, especially in areas that are difficult to access. In the long run, AI has the potential to magnify our collective knowledge and experience.

Teaching an algorithm to detect corrosion

One area of AI is of particular interest for corrosion detection: deep learning. It is a type of machine learning in which artificial neural networks extract and process information from data, such as images, videos, or text. An algorithm learns to recognise patterns and solve complex problems through deep learning, just like a human brain. In our case, we taught it to detect, localise, and pre-assess corrosion in pictures.

We needed lots of data and the experts to curate and label it correctly to achieve that. Fortunately, we have both at Bureau Veritas. We trained the algorithm with tens of thousands of corrosion pictures from our dataset, built over decades of work by our surveyors. Our experts carefully labelled each image to indicate the exact locations and nature of the corrosion. Over months of development, our algorithm has progressively learnt to identify, localise, and qualify corrosion.

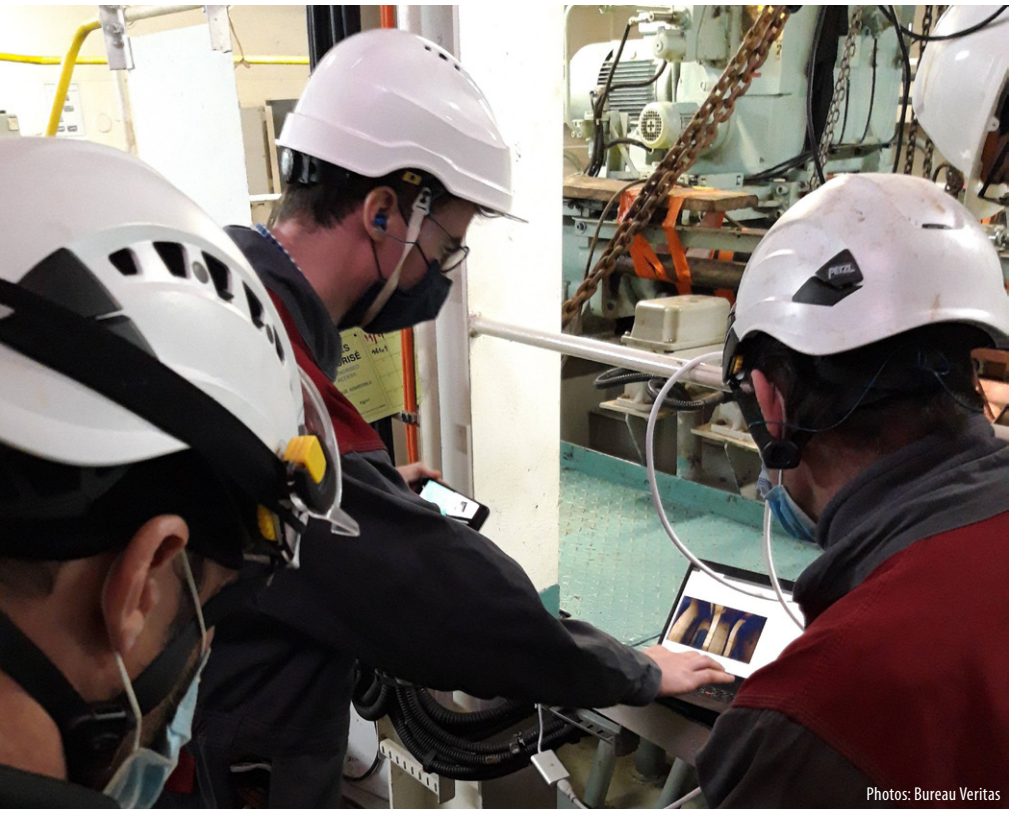
While the algorithm might work perfectly in a lab, the real test was to know whether it could bring value in actual survey conditions. Here, a key factor is the capacity to use the AI solution in real-time and offline. After all, surveyors do not benefit from long hours in their offices to assess corrosion. They must make decisions on the spot during the inspection itself, often finding themselves in confined spaces with limited access to the Internet. It means even the most high-performing software would be of no use unless it can work offline and deliver information instantly in the field.

Another significant benefit of the AI software was the capacity to install it on a drone, which can be used live during the inspection and provide a view of areas that are otherwise difficult to access. Here, the role of the algorithm is to support the visual inspection led by the surveyor and reinforce their assessment, not to replace human judgement and decision-making. If the algorithm could recognise corrosion, bring the surveyor's attention to areas of interest, and provide all this support in real-time, the test could be called a success.

The moment of truth

Earlier this year, we carried out a real-life inspection of a water ballast tank on a bulk carrier in Dunkirk in collaboration with MaDfly Marine Drone Services. During the test, video footage of the tank was captured by an aerial drone and fed in real-time to the algorithm, which performed the calculations live.

The test met the highest expectations: not only did the algorithm correctly identify all the corroded parts, but the system


Photos: Bureau Veritas

could also run offline, without any connection to the Internet or mobile networks, which confirmed its flexibility for use in a variety of conditions.

Most importantly, our surveyors confirmed that the algorithm is a helpful tool for them. By highlighting problematic areas, it enabled them to make the most of their allocated inspection time. Moreover, the objective assessment provided by the AI will back their decisions and support their recommendations to clients on the necessary repairs and investments to their ships.

Collective intelligence

The potential of AI for corrosion detection does not stop there. Surveyors and shipowners can benefit from it alike. For example, the next step could be a self-assessment corrosion detection tool that shipowners can use between formal surveys to better anticipate the repairs and optimise their assets' maintenance.

Ultimately, AI may also help optimise rules surrounding corrosion management. Deep learning can be used to connect more dots and find data-based patterns between the ship's design, structure and coating, the way it is operated (including routes, weather conditions, and maintenance efforts), and the resulting corrosion condition after a given amount of time. These insights may support our efforts to ensure that rules on corrosion margins, coatings, ship designs, and inspections reflect corrosion progression, helping shipowners protect their assets in the best possible way.

Beyond that, we hope that the algorithm will become a repository of knowledge that will endure for decades to come. Traditionally, surveyors have learned their profession through mentorship – by accompanying a senior colleague during inspections and learning from their experience. Like us humans, our algorithm will improve as it learns from the data and expertise provided by our surveyors. It will ensure that our team's formidable knowledge and expertise is preserved beyond this person-to-person shared learning, capturing what we call our collective intelligence and make it available for the next generations of surveyors.

In such a way, AI will take its place as part of the next generation of digital tools and techniques at the surveyor's disposal, becoming an integral element in our digital strategies that will shape the future of classification. ■