Digital Transformation of Non-Destructive Testing Using Artificial Intelligence Solutions and Cooperative Robots

Hyung Ju Yu[1], Chang Gyun KIM[1], Dong Jin Lee[2], Jun Sang Yu[3], June Sung Seo[3], Jung Min Lee[4]

[1]NDE team, Doosan Enerbility, Republic of Korea, [1]NDE team, Doosan Enerbility , Republic of Korea, [1]Data Analysis Team, Doosan Enerbility, Republic of Korea, [1]Data Analysis Team , Doosan Enerbility , Republic of Korea

The results obtained in the non-destructive testing are structured in which location information or indexing is loaded on photographs, images, videos, and RF waveforms. Even if the test object has various curvatures and three-dimensional shapes, the information acquired in the non-destructive testing is expressed in two-dimensions and delivered to the evaluator, requiring skilled evaluation techniques. This human factor-dependent evaluation method goes through a verification process in which management, training, and quality education must be continuously invested to prevent evaluation errors and final decisions are made through several stages of multilateral comparative evaluation. Non-destructive testing acquisition information is data that can be accumulated as big data without special processing, and can serve as a tool that assists human evaluation based on artificial intelligence models. It indicates defects during inspection, and classifying and predicting types of defects with high probability, and visualizes them in three-dimensions to assist in defect discrimination. To this end, we developed a Data-Vision system that acquires learning-data through a real mock-up specimens and automatically detects/evaluates defects through a deep-learning model based on Mask R-CNN(Mask Region-based Convolutional Neural Network)/MALSTM-FCN("ATTENTION" MLSTM-FCN). Meanwhile, non-destructive testing in large-square area is covered by several people through repeated scanning. In addition, the probability of industrial safety accidents is higher in narrow and aerial space. Therefore, attempts have been made to replace it using automatic/semi-automatic scanners or motorizing devices, but they have been limited to local areas and shapes. To expand this, we would like to introduce a method to replace non-destructive testing signal acquisition by deploying lightweight cooperative robots. As a result of applying it to field components by taking advantage of the cooperative robot's high spatial location recognition and accurate scanning even in repetitive work, there was a human/material/time saving effect of more than 40%. Furthermore, the system - input to the automatic evaluation AI solution as soon as a signal is acquired from a cooperative robot and allows the evaluator to know the results in real-time - shall quickly transforming the existing non-destructive testing method to digital, and the model performance of the developed data-Vision achieved 95% accuracy (recall) for RT and 91% for UT.