Reliability Analysis of Data Science-Based NDT Solutions through Round Robin Evaluation

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Recently, various Non-Destructive Testing (NDT) solutions incorporating Artificial Intelligence (AI) have been developed for defect evaluation. In the field of AI, performance metrics such as the Confusion Matrix are commonly used to assess the AI model's performance. The Confusion Matrix calculates performance metrics like accuracy, precision, recall, etc., based on values of True Positive, False Positive, False Negative, and True Negative. However, these metrics primarily quantify the data classification performance of AI models and do not necessarily reflect the interpretative skills of inspectors in non-destructive testing. In the realm of non-destructive testing, one widely used method for evaluating the overall reliability of inspection systems is the Round Robin Test (RRT). RRT consists of 'inspection' and 'evaluation' phases. Variables affecting the 'inspection' phase include procedures, inspectors, equipment, and test specimens, while 'evaluation' mainly depends on the skills (interpretation abilities) of inspectors. Since the core function of NDT solutions is data interpretation, it is necessary to analyze the results' variations based on 'evaluation' variables by fixing the 'inspection' variables for an accurate reliability assessment of the solution. In this study, we collect reference standard evaluation data and, through a Round Robin Evaluation (RRE), quantify defect detection and size measurement capabilities based on inspectors' experience and education levels. We also perform a reliability analysis to establish quantitative and qualitative evaluation criteria for NDT solutions. This research aims to introduce the results of these efforts and their implications. The study was supported by the Korea Institute of Energy Technology Evaluation(No.20217410100100) and Planning(KETEP) and the National Research Foundation of Korea(No.2021M2E6A1084980).