Computational intelligence approaches for data analysis, the next step of innovation for advanced UT techniques in NDT

Alicia Gonzalez Rodríguez1, André Gosselin2, Richard Rhéaume2, Neil Harrap3
1 TWI, Mexico, alicia.gonzalez@twi.co.uk
2 Ondia, Canada, andre@ondiande.com, richard@ondiande.com
3 TWI, UK, neil.harrap@twi.co.uk

Abstract

There is no doubt in how the advanced ultrasonic testing (UT) techniques such as Phased Array Ultrasound (PAUT) and Time of Flight Diffraction (ToFD) have taken over the non-destructive testing industry (NDT). The benefits of using these techniques are countless. Worldwide, there has been an increase in companies from different sectors taking advantage of the available technology for these methodologies. As a result, the equipment is becoming more affordable, data processing for real time and automated applications is more powerful and the amount of data being produced is substantially high. Regarding this last subject, nowadays, the data acquired relies mainly on humans for its analysis, assessment and decision-making which are critical tasks that humans are more than capable to execute. However, when the data available for PAUT and ToFD goes from one simple data set (scan) to hundreds of data sets for just a single project, critical errors can occur.

For most NDT specialists, interpretation of signals as well as analysis of data in large amounts can lead to mistakes such as missing defects, incorrect sizing or false identification of a defect. Furthermore, the amount of time operators dedicate in data analysis is increasing for these advanced UT techniques. The NDT industry relies on consistent and reliable data analysis which, with the technologies available now, is incompatible with the amount of data to be analysed. For these reasons, Ondia and TWI have gathered a group of specialists in NDT, software development and artificial intelligence to implement advanced Computational Intelligence (CI) techniques and develop algorithms to better harness the data available in order to enhance the quality of data analysis. This innovation will reduce the time invested in a single analysis, whilst addressing the challenges that large data analysis and processing bring about for advanced NDT methodologies.

1. Introduction

NDT inspection is a critical evaluation to ensure the integrity of materials and joining processes during manufacturing and in-service. For any NDT technique, the consistency of the results and the reliability of the findings depends heavily on the personnel performing the inspections and evaluating the results. As more advanced NDT techniques are developed, especially in the areas of ultrasound, digital radiography and eddy current, the NDT industry is facing the challenge of efficiently use the generated digital data to develop advanced tools which can assist the user for data analysis. This collaboration project introduces CI-based algorithms in order to address the complexity of ultrasound
data and other factors that influence its analysis such as noise produced by grain structure, indications that can give false results amongst other challenges. These algorithms can process large amounts of data, classify complex information and learn patterns within the data which is a critical part during analysis of PAUT data.

The well-known benefits of advanced UT techniques have established them in a good position within the industry. The equipment is becoming more affordable and the training for certification of personnel is more accessible. Despite the great success of advanced UT techniques, challenges remain such as the analysis of large amounts of ultrasound data that are collected from a single scan, as a result, large amounts of data analysis for a single user becomes impractical and time consuming. The aim of this collaborative project is to address the challenges that NDT personnel face during analysis of PAUT data by developing an innovative analysis software based on CI techniques. The implementation of this software will increase the working capacity of personnel by reducing the time needed for a single analysis and will produce more consistent results by providing tools and insightful feedback to improve the quality of the analysis.

2. An innovative software for data analysis of advanced NDT techniques using CI cloud-based approaches

Figure 1 illustrates the stages of the proposed CI cloud-based software. The process is initiated when the data collected by the inspector is sent via internet connection to web-based servers. During the second stage, the data must be verified for quality; if any data is missing or poor-quality is detected, the software will inform the inspector that data must be resubmitted. Once the verification of data is completed, the data analysis is then performed by CI-based algorithms which can recognise and classify features within the data such as geometry indications, anomalies and defects. Following the CI-based analysis, a complete report will be generated by the software and the results will be available to the user via a 3D visualization interface. This report will include details of sizing, characterisation, location of defects, geometry indications and other relevant information related to the analysed data. The information contained in the interface and generated by the software will be available to the final user for validation and approval.

![Figure 1. CI cloud-based software for data analysis of advanced UT techniques](image)

3. Conclusions

There is a lack of reliable tools available to PAUT experts which can facilitate the task of analysing data. The proposed software offers an innovative approach which takes advantage of existent CI-based techniques and expert knowledge to address this issue. Furthermore, our approach offers a high degree of consistency for identifying defects; improves the quality of the analysis and reduces the time invested in such critical NDT duty.