**Neural Nets for Performing Specific Tasks in the Analysis of Ultrasonic Data**

**Abhishek Shukla, Future Hu, Doug Mair**

UTEX Scientific, 2319 Dunwin Drive, Unit-8, Mississauga L5L 1A3, Ontario, Canada

+1-905-828-1313; ashukla@utex.com; dmair@utex.com

ABSTRACT

Neural networks can be helpful in evolving traditional rules-based methods of analysis towards a more sophisticated process, while maintaining transparency and visibility. The performance of neural networks was studied using several architectures to train models for specific tasks during the analysis of ultrasonic inspection data.

Selecting an appropriate architecture is critical for achieving the desired performance and efficiency. Often, models may need to be used in conjunction with one another to achieve a desired result.

For the first study we focused on identifying Regions of Interest (ROI’s) in Time-of-Flight Diffraction (TOFD) data from weld inspections. A combination of multiple Convolutional Neural Network (CNN) models, MobileNet and U-Net was used to develop a hybrid approach for ROI detection. MobileNet is used to identify the approximate locations of the lateral and backwall signals. Multiple U-Nets are then used to trace out the precise boundaries of these regions. By accurately defining the boundaries of the geometric signals, automated amplitude-based detection methods can be used in the included regions. This mechanism improves, for example, near surface indication detection that would be missed using a simple gate. Additional neural nets can be used to detect features within the region of interest.

The second study focused on evaluating the ability of neural nets to detect features within noisy C-Scans. Ultrasonic data in forged metals and polymer composites often have textural and granular responses that can mask potential indications of interest. In our study we used an algorithm to mark indications based on their Signal-To-Noise (SNR) response. The training data contained natural indications and did not include any artificial defects. Neural net models were then trained on the amplitude C-Scans using the output generated by the SNR algorithm. The trained models were then tested on two types of data sets:

a) C-Scans similar to the training datasets,

b) C-Scans generated from other materials/UT parameters.

**Keywords:** AI/ML, Ultrasonic inspection, TOFD, noisy C-Scans, feature detection