SmartUTX – Smart Ultrasonic Analysis

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1. Introduction

Non-destructive evaluation (NDE) is a set of techniques used for material testing and defect detection. Ultrasonic testing (UT) is one of many NDE methods, commonly used due to its simplicity and ability to precisely determine defects' locations and sizes. Ultrasonic testing is used in various power plants, aeronautics, and oil and gas industry.

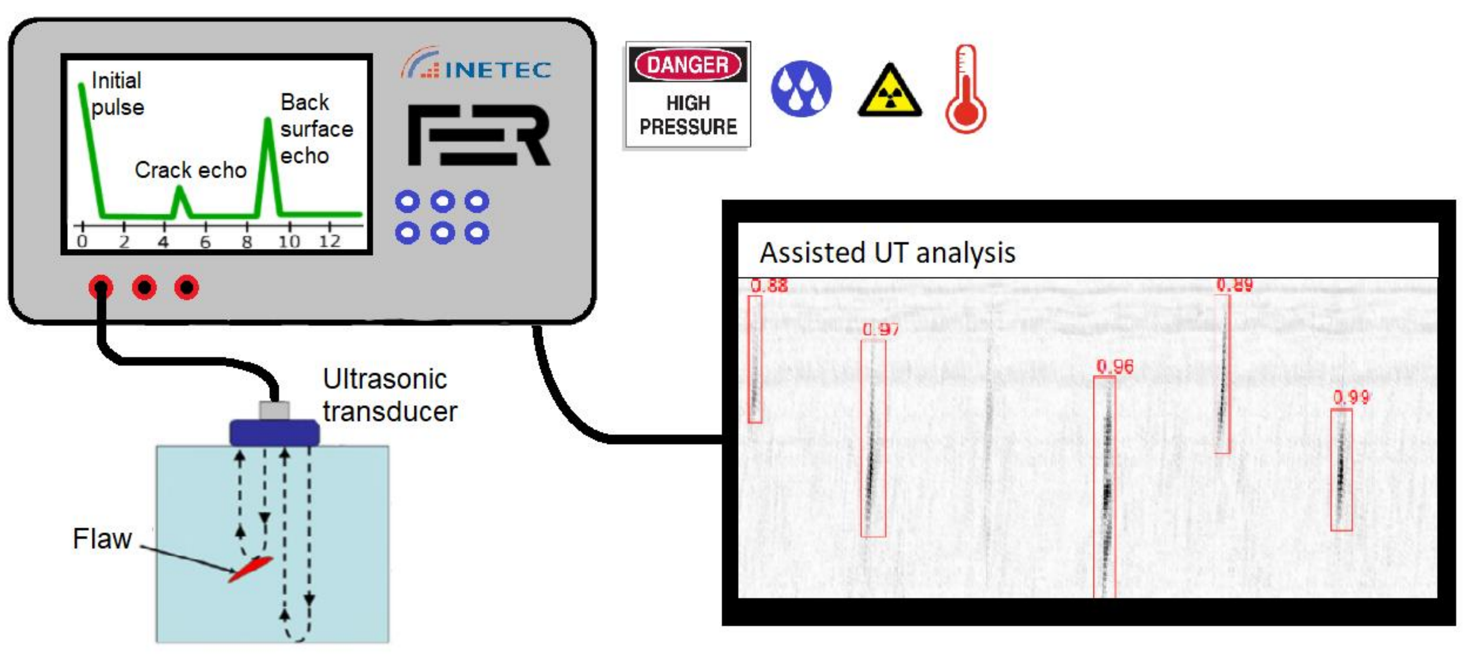

Figure 1. Ultrasonic testing illustration

2. Problem description

Ultrasonic testing data analysis is currently done manually by trained experts. Automating this process would make the analysis faster, objective and more reliable. Deep learning-based approaches can be used to accomplish this. Three main tasks that can be done using a deep learning approach are: defect detection, anomaly detection, and ultrasound B-scan generation.

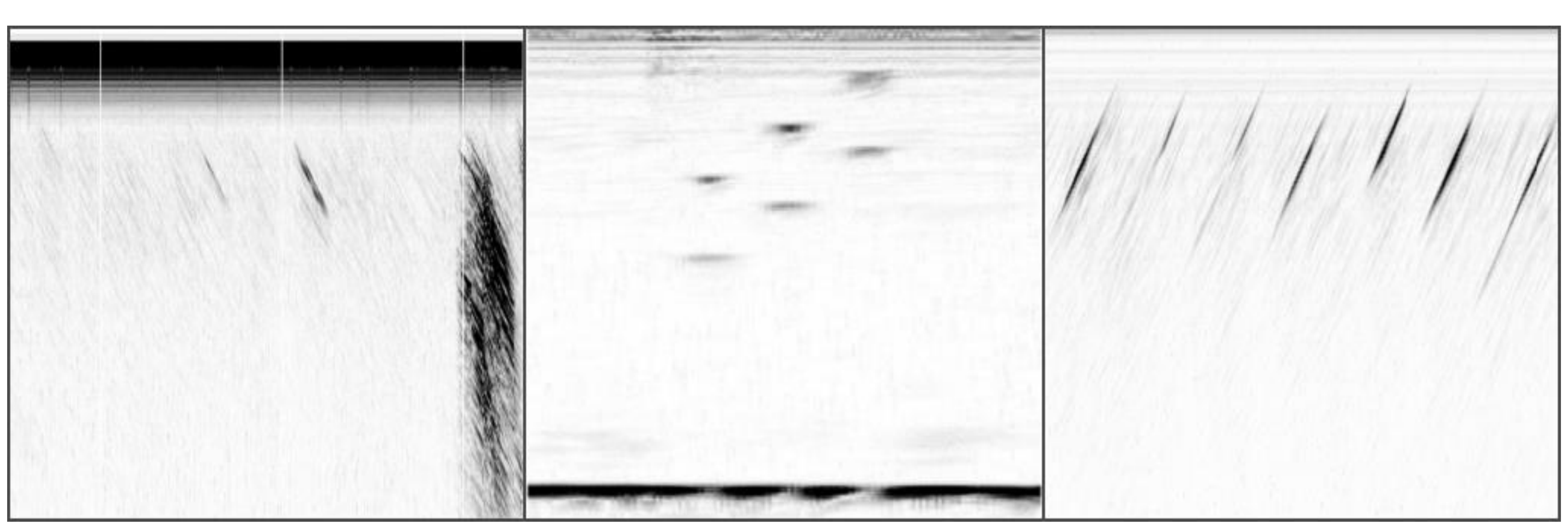

Figure 2. Examples of ultrasonic testing images

3. Developed methods

1. **Method for defect detection** by merging ultrasound B-scans from different scanning angles was developed. This way the analysis does not need to be performed separately for each scanning angle. The proposed architecture for rapid defect detection achieves similar mean average precision as the baseline model for separate analysis of ultrasonic B-scans while being 15 times faster in real-life scenarios.

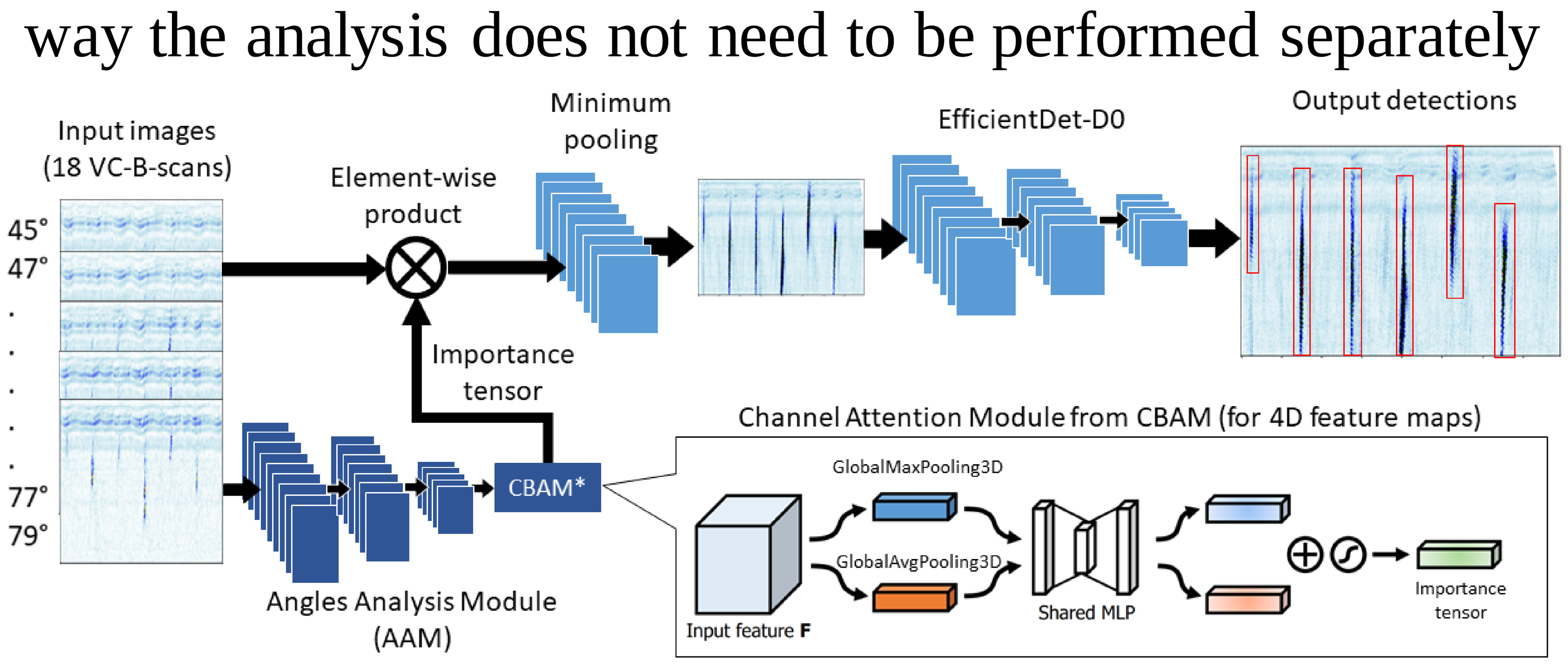

Figure 3. Rapid defect detection by simultaneous analysis of different scanning angles

2. **High performing VAE-based method for anomaly detection** is a challenging unsupervised task of detecting differences in defective scans when compared to normal scans. We developed a high-performing VAE based method.

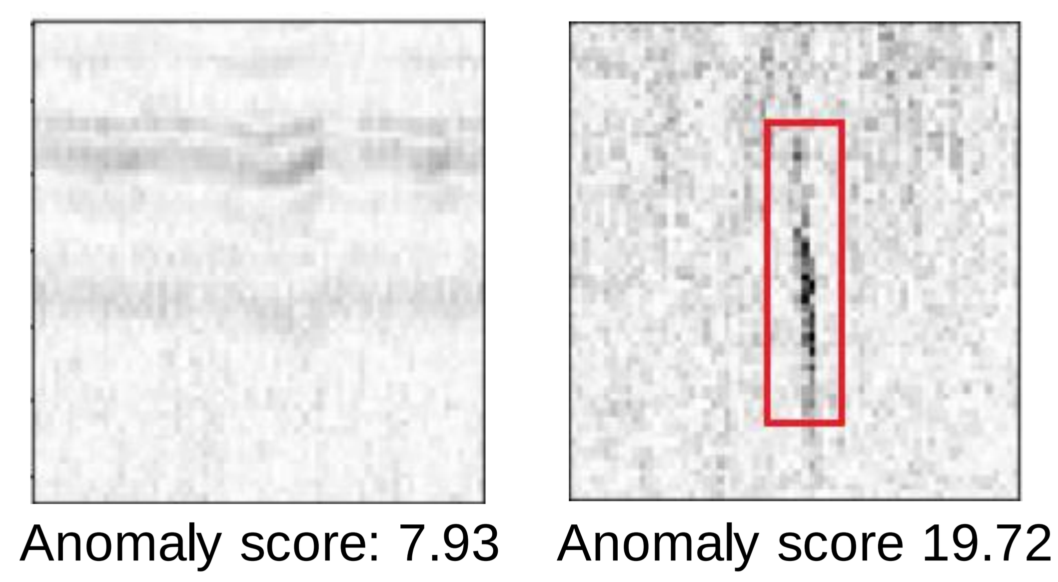

Figure 4. Normal and anomalous scans with predicted scores

3. **Synthetic image generation method** that can be used as an augmentation technique or as a tool for generating new images used for educating human experts on ultrasonic image analysis. We are able to generate 3D data with defects on exact predefined locations. We are utilizing the custom Generative Adversarial Network – DetectionGAN for this task.

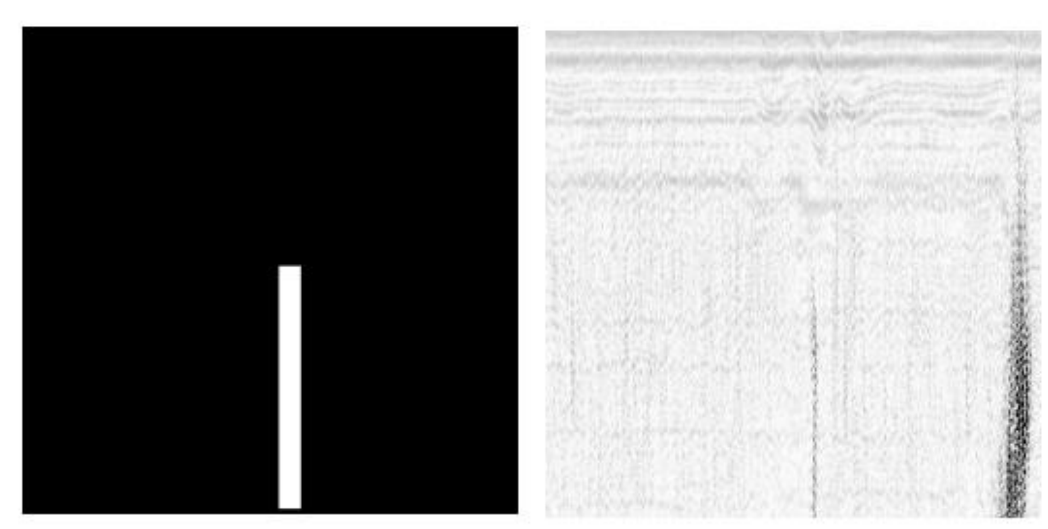

Figure 5. Position mask and the corresponding generated scan

5. Conclusion

With the increase of UT applications and the advancements of UT devices, data analysis is becoming a bottleneck of ultrasonic inspection. The developed methods can improve efficiency and make a significant impact in the area of non-destructive evaluation in the future. Some of the developed methods are already being deployed in computer software for ultrasonic data analysis and are helping inspectors around the world to perform more reliable and fast analysis.

6. Acknowledgments

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