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Keynote-2

ABSTRACT

PRESENTATION

PAPER

Roman Maev is distinguished university professor of the University of Windsor, Ontario, Canada and founding director-general of The Institute for Diagnostic Imaging Research, Canada - a multidisciplinary, collaborative research institute. The diverse range of disciplines encompassed by him includes theoretical physical acoustics, ultrasonic and nonlinear acoustical imaging, biomedical ultrasound, nano structural properties of advanced materials and its analysis. He has published over 600 peer reviewed items and holds 44 international patents. He is is a life fellow of IEEE and a fellow of ASNT, BINDT, CINDE and RSNTTD. He was the recipient of various fellowships and awards, including the Roy Sharpe Award, UK, and the ASNT Mentoring Award, USA. He has chaired numerous US, Canadian and international symposia and conferences and also is a distinguished lecturer of IEEE and has presented a number of keynote and invited lectures worldwide. He is the ICNDT International Specialist Groups (ISG) chair 'NDT Frontiers'.

NDE AND DEEP LEARNING: FASHION TREND OR THE FUTURE?

The future of NDE in light of the increasing use of artificial intelligence (AI) - particularly deep learning - is at least uncertain if not controversial. In many ways, deep learning has brought ground-breaking advancement in NDE data interpretation and downstream decision-making - and promises to continue to do so. On the other hand, widespread use of deep learning artificial intelligence in NDE systems is impeded due to some major challenges and concerns regarding its role, development, standardization, consistency, validation, generality, trustworthiness, coexistence with human experts, and ethical use - among others.

In this presentation, we will discuss some of these major challenges and concerns regarding the use of deep learning in NDE, along with case studies from our work and examples from works of others. In particular, we highlight results from our developments of advanced NDE technologies which enable zero-defect mass production of bonded joints through the integration of AI into real-time ultrasonic process monitoring systems. We will discuss use cases, including the implementation of resistance spot weld process monitoring using a deep learning approach which analyzes ultrasonic B-scans via semantic segmentation in real time. Our AI can assess throughout the weld process various weld properties including e.g. the amount of nugget penetration into each sheet in the stack up. These assessments are fed back to an adaptive weld controller so it can always produce high-quality welds that match production-level requirements. A key aspect of this problem is that spot weld cycle times are fast, so real-time assessments are crucial. The required performance, generality, and speed necessitate deep learning. Fast inference and communications are vital to feedback actionability; it must be fast enough that the weld controller can suitably adapt its parameters to produce high-quality welds.

Our approach is a great example of advancement in NDE 4.0. and is applicable beyond spot welding and ultrasonic NDE. We are confident that successful implementation of such technologies will revolutionize manufacturing including automotive and aerospace. These technologies have the potential to bring big savings in production, reduce labor costs, and eliminate unnecessary destructive tests which are still part of today's quality inspection process. Our goal is to achieve zero-defect mass production and our results demonstrate that this is achievable today.

We will discuss what is still needed from the NDE community to further facilitate widespread use of modern-day artificial intelligence in NDE. We will also highlight potential ways in which some challenges and concerns surrounding widespread use of artificial intelligence in NDE might be alleviated considering the broader ongoing artificial intelligence research and development, for example with respect to emerging learning paradigms, generative modeling, interpretability in artificial intelligence, and emerging model architectures. Finally, we will discuss what the future of NDE may hold, and whether deep learning artificial intelligence will have any part of it.