SUBJECT:

Advanced processing of Full-Matrix Capture datasets in ultrasound non-destructive testing.

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Project Description

Phased-Array Ultrasonic Testing (PAUT) is widely adopted by the industry for non-destructive testing (NDT). Many industrial sectors, such as construction, pipelines, and aerospace apply PAUT to detect discontinuities (i.e. cracks or flaws) during product quality testing, as well as under operating conditions. Phased-Array ultrasound probes are composed of tens of tiny piezo-elements that are used to generate steered, focused and scanned ultrasound beams.

In the recent years, novel methods exploiting Full-Matrix Capture (FMC) acquisition and Total-Focusing Method (TFM) have been researched and introduced in industrial applications [1, 2]. A few new portable PA systems with limited support for the FMC/TFM are now available. However, there is still many R&D topics to take full advantage of the FMC method in real-world applications – e.g. automatic adaptive focusing [3] or a quantitative testing of anisotropic weld joints [4], to name a few. The main objective of this work will be exploration of new signal and image processing algorithms working on the FMC datasets.

The FMC data can be a vital part of so called “Digital-Twin” technology [5], where NDT and other data are collected throughout the whole product life-cycle to enable creation of a digital/virtual replica of the system. This digital-twin can be used to enable predictive maintenance, product improvements, optimizing production technology, and is a key part of the “Industry 4.0” revolution.

We have developed research ultrasound systems dedicated for implementation and testing of complex processing algorithms on raw ultrasound echo signals. Our systems are optimized for a high-speed data transfer and real-time processing with embedded graphic processors (GPU). The platforms enable acquisition of both classical Phased-Array data and FMC data. The software can implement the traditional focal-law approach, as well as the TFM on the FMC data. The embedded GPU can be also integrated with open-source deep-learning frameworks to extend processing capabilities to machine learning – e.g. for automated flaws detection and qualification.

Our close collaboration with industrial partners will provide real-world topics, measurement data, and necessary feedback.

Bibliography

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