Total Focusing Method (TFM) and Phase Coherence Imaging (PCI) applied for weld inspection and HTHA assessment

Frédéric Reverdy[1], Michael Monette[1], Paul Hillman[1], Guy Maes[1]

[1]Sales & Applications, Eddyfi Technologies, Canada

Imaging techniques based on ultrasonic Total Focusing Method (TFM) are more and more applied for industrial applications. Adoption of the technique has been made easier with the publication of the revised ASME V and ISO 23864 and 23865 standards. TFM is an inspection technique that involves two steps: the first one is the data acquisition process called Full Matrix Capture (FMC) and the second one is the data reconstruction itself called TFM. FMC/TFM can be done in post-processing or in real-time, but it is really the latter that allowed the democratization of the technique. The FMC consists in recording all possible signals from every transmitter-receiver pair of elements in the array. By using a delay and sum beam-forming operation of the FMC, TFM is able to produce to focus the energy at every pixel within a region of interest providing a high-resolution image. Efforts have been made to improve the productivity of the technique using various excitation modes such as Plane Wave Imaging (PWI) to reach scanning speeds comparable to standard phased-array inspections while maintaining code compliance. While TFM is based on the extraction of the amplitudes of the signals of the FMC matrix, another technique called Phase Coherence Imaging (PCI) uses the phase information from those signals. The PCI image shows high values when all the elements contribute in phase. This is the case for small diffractors that tend to send energy in all directions such as very small defects, cracks (HTHA, porosities…), and tips from cracks and other planar reflectors. At the opposite, specular echoes tend to be minimized since few elements contribute to the echo. In this presentation, the advantages of both techniques on various industrial cases will be shown. Keywords: TFM, PCI, HTHA