PWI applied on large foundry blocks

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Ultrasonic testing is currently one of the main techniques used in many industries (metallurgy, foundry, aeronautics, etc.). This technique consists in generating ultrasonic waves in the parts to be inspected in order, if necessary, to detect and size defects from the analysis of the backscattered signals. Multi-element probe technology allows ultrasound images to be reconstructed from a fixed position of the probe. The first so-called conventional imaging methods (Phased Array) emerged decades ago and consist in delaying and then electronically summing focused signals in order to limit the data rate. They allow for quick inspections at the cost of very reduced resolution. Nowadays, UT acquisition devices are more and more efficient and customizable, it is now possible to transfer large amounts of data to a computer for real time processing. The Full Matrix Capture (FMC) acquisition has thus been developed and makes it possible to measure the entire matrix of inter-element signals. Using FMC data, the Total Focusing Method (TFM) algorithm performs a software calculation to reconstruct images that are much better resolved than conventional images (Phased Array). However, the acquisition process is slow because all transducers in the multielement array must be sequentially excited. This paper presents the benefits of Plane Wave Imaging (PWI), which consists in sounding the medium with several plane waves emitted by exciting all the transducer elements. PWI bridges the gap between conventional and FMC/TFM technologies: merging the speed of conventional methods with the accuracy of FMC/TFM. PWI imaging offers many advantages for CND inspections: high energy level in emissions, even high number of elements in emission and reception, ability to sound large parts. Quality images close to the FMC/TFM can be obtained with a limited number of plane waves, thus allowing high inspection rates. In this paper, the principle of technology is presented. Next, a concrete application case showing improvement over conventional and FMC/TFM techniques will be presented. From a complete ultrasonic instrumentation (ultrasonic device, specific probe, software integrating PWI, accelerated computation algorithms on graphics card) provided by TPAC, the application was developed with Dynamic Concept Europe for the detection of cracks on large scale cast raw aluminum plates produced by Aluminum Dunkirk. In this application, we show that PWI enables improved crack detection and characterization. This technique guarantees an imaging rate compatible with industrial applications and offers new possibilities for the automatic detection of defects.