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3D FLEXIBLE UT ARRAYS FOR INSPECTION OF COMPLEX COMPONENTS: SIMULATION AND APPLICATION

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ABSTRACT

The performance of inspection of components of complex geometry (welded pipes, nozzles, elbows, etc.) using standard contact probes (single crystal with wedge) may be very limited due to loss of coupling between the specimen and the probe, inappropriate matching or orientation of the probe, or even inaccessible areas and thus non-insonified zones. Development of 3-D ultrasonic flexible phased array techniques have been carried out at CEA in order to solve those industrial problems which may arise in many different fields (power generation, petrochemical, oil and gas production, etc.). This technique is based on a phased array comprised of a flexible radiating surface (which can therefore fit any 3D complex shaped component), associated with a profilometer integrated inside the probe housing, which allows to measure the irregular surface of the specimen under test, so that delay laws can be computed and applied, at real-time, to preserve the orientation and/or focusing depth of the beam in spite of surface irregularities or modifications. These developments include simulation modules integrated into the NDT expertise software, CIVA, to conceive and to design appropriate phased arrays splitting and delay laws settings. In addition, those tools allow to predict the inspection performances of such probes, which can be compared to standard probes inspections. In addition to description of simulation skills, this paper presents applications of 3D flexible arrays over 3-D geometry mock-ups, including artificial flaws, to assess the performance of the "3-D smart phased-array transducer" for various multi-shot configurations (i.e. angular scanning, several points focusing). Experimental and simulated results of various complex inspection cases are given and discussed.