Improving Industrial Inspections Combining High-Frequency Flexible Ultrasonic Arrays and Coded Excitation

Elmergue Germano[1]; Morteza Tabatabaeipour[1]; Ehsan Mohseni[1]; Anthony Gachagan[1]; Koko Lam[2]; Dave Hughes[3]; Heather Trodden[3] Dave Lines[1]

[1]Electronic & Electrical Engineering, University of Strathclyde, Glasgow, UK
[2]James Watt School of Engineering, University of Glasgow, Glasgow, UK
[3]Novosound Ltd, UK

In this study, a commercial 20-MHz 64-element 1 mm-pitch flexible linear array, developed by Novosound Ltd, was evaluated using two different coded excitation techniques to enhance the signal-to-noise ratio and operability on flat and complex-geometry components. Chirp and Golay coded excitation techniques were employed with an arbitrary waveform generation tool to excite the array. A pulse compression technique consisting of a matched filter was implemented, weighted by a Chebyshev window for Chirp excitation.

Preliminary results were acquired with the array deployed on a 20 mm-thick flat aluminium test specimen with sided-drilled holes. An improvement of >17 dB for the backwall refection compared to a conventional pulse excitation was observed. The array offers flexibility to conform to complex geometry surface profiles. A curved sample, representative of piping found in nuclear industry, was next investigated using both direct coupling and through an attenuating rubber material, that is suitable to scan the array over rough surfaces. For all experimental scenarios, both excitation schemes were optimised and compared in terms of capability for defect detection.

The proposed approach, incorporating the flexible array with coded excitation techniques, has the potential to improve industrial inspection quality in terms of efficiency, accuracy, and reliability.

Keywords: High-frequency array; flexible array; complex geometry components; Ultrasonic NDE; Coded excitation