EMAT Phased Array Probe for Detecting Surface Cracks

Julio Isla[1*], Frederic Cegla[1]
[1]Department of Mechanical Engineering, Imperial College London
Exhibition Road, London, SW7 2AZ
*Julio Isla: j.isla13@imperial.ac.uk

Electromagnetic-acoustic transducers (EMATs) consist of a magnet and a coil. They are desirable for non-destructive evaluation (NDE) because no direct contact with the specimen is required. However, most EMATs use excitation peak powers greater than 1 kW and hence the driving electronics and the EMAT coils have to be bulky. This has affected the development of EMAT phased arrays with functionality and dimensions similar to those of conventional piezoelectric phased arrays, which are widely used in NDE because they offer superior defect characterization in comparison to single-element transducers. Here, we report an EMAT phased array that performs similarly to conventional piezoelectric arrays, uses excitation peak powers of less than 4.8 W (24 Vpp and 200mA) and racetrack coils as narrow as 3mm; this is possible due to the use of coded excitation. The racetrack coils are laid out overlapping 1/3 of their area in their shortest dimension to reduce the crosstalk between the coils, i.e., the array elements, to less than -15 dB. An 8-element prototype that operates at a central frequency of 1 MHz can be shown to detect defects which have a cross-section area of $0.2 \times 0.8 mm^2$ and are located on the surface opposite to the array.