Ultrasound Visualisation Using Polymer Dispersed Liquid Crystal Sensors

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The acousto-optic effect in liquid crystals (LCs) has previously been exploited to build large area acoustic sensors for visualising ultrasound fields, opening up the field of acoustography [1]. There is an opportunity to simplify this technique and open new application areas by employing polymer dispersed LC (PDLC) thin films instead of aligned LC layers. In PDLCs, the normally opaque film becomes transparent under the influence of an acoustic field (e.g. when surface acoustic waves are propagating in the material under the film [2]). This is called acoustic clearing and is visible by eye, and there is potential for producing ultrasonic sensors which can be ‘painted on’ to a component, giving direct visualisation of the ultrasonic field without requiring scanning.

We demonstrate the effect by using PDLC films to characterise the resonant modes of a flexural air-coupled transducer [3,4]. Characterisation of the transducers requires measurement of the displacement amplitude across the transducer face, and is currently done within the research group using laser vibrometry, with each scan taking around eight hours. A PDLC film was produced on the face of a transducer and regions with the largest displacement showed acoustic clearing, enabling identification of each mode. Visualisation was quick, with a switching time of a few seconds. The effect shows promise for ultrasound sensing applications for transducer characterisation and NDT.

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References: