Ultrasound as Non-Destructive Evaluation Tool

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I. Introduction

The increasing use of composite materials in critical structural applications demands reliable material evaluation techniques. Ultrasound has already proven its usefullness in non-destructive evaluation (NDE) of

Scan (Figure 1), which makes a "fingerprint" of the material under investigation in order to deduce the local material constants.

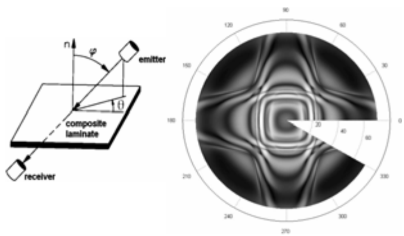

Figure 1: Polar scan, principle (a) and typical received patterns (b)

II. Current analytical modelling approach

Two analytical methods are currently being investigated to relate the experimental polar scan with the properties of the investigated material.

A. Slowness surface

Using the Christoffel equation, which links the slowness and the polarization to the propagation direction for plane harmonic waves, one can calculate (i) slowness, (ii) phase velocities, (iii) critical angles (iv) group velocities and (v) skew angles of bulkwaves in an arbitrary (an)isotropic solid. These features allow to identify the local material constants through inverse modelling.

B. Reflection coefficients (RC)

The use of RC incorporates the fact that

patterns recorded by a polar scan (Figure 1). This gives a more clear view of the physical concepts involved in a polar scan.

III. Current finite element model (FEM)

More complex models (Schoch-effect, mode conversions, ...) are simulated using FEM. The results are in accordance with analytical results and literature. In Figure 2 one can see the Schoch-effect and the corresponding Raleigh wave in the solid for an incoming harmonic 2D Gaussian beam, simulated with FEM. The leaky behaviour of the surface wave, due to immersion in the liquid, can be observed. The influence of several modifications in liquid/solid properties are investigated and validated.

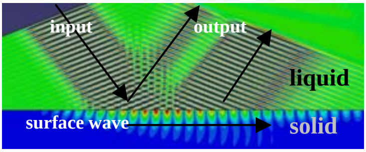

Figure 2: Schoch-effect on solid plate

IV. Conclusions

A treasure of information can be found in a single polar scan. Therefore, it is a great tool to investigate complex materials locally.

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