

An inverse model to enhance ultrasonic inspection of fibre-metal laminates

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The structure of a laminated material can be investigated by sending an acoustic wave through a target material, and recording the reflected signals. Due to the interaction of the wave with the different layers, the resulting signal may look very complicated. If the length of the source-signal is long compared with the thickness of the individual layers, the signal of the reflection of the frontwall of a layer will interfere with the backwall-reflection of the same layer. Using the measured source-signal and an appropriate deconvolution technique will shorten the length of the wavelet, enabling us to separate the different reflections. Internal multiple reflections – signals that are subject to more than one reflection in the structure – will interfere with each other, and are difficult to distinguish from the primary reflections. Since we know the principles causing multiple reflections, we can use an inverse method to eliminate them. The method is based on a two-step layer stripping procedure. First, the thickness and velocity of each layer are determined by locating and analyzing its primary reflection. Next, this information is used to strip the effect of the multiple reflections due to this layer. Repeating this process finally gives an image of all layers as well as their thicknesses and velocities. Moreover, delaminations can be accurately located in this image. Most of the processing steps described here are common in geophysical prospecting, and have been adapted to the field of non-destructive inspection of laminated materials.