2.1 Classification and Reconstruction of Defects by Combined Acoustical Holography and Line-Saft

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Summary
For the purpose of defect location, sizing and characterization a couple of analyzing nondestructive testing methods have been developed. Here a data acquisition system is presented which is based upon data collection within a synthesized aperture. US-Holography with digital reconstruction algorithm is used to describe the extension of flaws parallel to the surface (C-scan) whereas the Line Synthetic Aperture Focusing Technique (LSAFT) is applied to get the information of depth location, depth extension and flaw inclination. Specially in the case of weld defects, an exact position determination is of great importance. It is shown that in the case of shear wave insonification the LSAFT-processing is essentially to get the exact depth location, a parameter which has to be known exactly as input value for the holographic evaluation to avoid a wrong location in x- or y-direction.

Introduction
In NDT a correct description of material defects is most important. Existing imaging systems can be compared concerning localization accuracy, lateral and axial resolution, classification and signal-averaging capability. US-Holography is known to have both lateral resolution and signal-averaging capability, but little emphasis was directed towards the localization accuracy. This should be intrinsically optimal because of the backward propagation capability. It has been shown in /1/ that the approximation in the Fresnel algorithm causes strong localization errors and can be avoided by the Rayleigh-Sommerfeld algorithm, especially using shear wave insonification. In this contribution a second reason for localization errors will be discussed and shown that with the proper depth information of the defect distribution obtained by LSAFT the shear wave holographic defect analysis results in a localization accuracy within 1 wavelength.
In addition, information about flaw inclination and depth distribution which could not be extracted from the holographic reconstructions are obtained with the concept of LSAFT.

System description

The HOLOSAFT imaging system, as shown in Figure 1, consists of three major components, the mechanical manipulator, the data acquisition system and the software to evaluate the images. A synthesizer generates a sine wave within a frequency range of 0.5 to 10 MHz. Bursts of 1 to 3 cycles are used if the LSAFT algorithm is processed, bursts of 3 to 99 cycles if the Rayleigh-Sommerfeld algorithm (RS) is applied. A line-amplifier with 25 watts power into a 50 ohm impedance drives the probe via a cable up to 100 m length. A scanner control unit moves either a probe for longitudinal or for shear wave insonification with two step motors in step sizes of multiples of 0.04 mm within

![Diagram of HOLOSAFT system](image)

Fig.1. Analyzing defects with HOLOSAFT