Improvement of Lockin-Thermographic NDT by an Iterative Adaption of Optical Excitation

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Abstract

Lockin-thermography is well suited for remote inspection of large areas of an aircraft’s outer structure. However, skilled personnel is needed to interpret the resulting phase images due to the large variety of effects contributing to the result. Especially low lockin frequencies are affected by lateral heat flow resulting in blurred phase images. This paper proposes a means to minimize lateral heat flow in optically excited lockin-thermography measurements. It is based on a new way of optical excitation, using an LCD projector instead of lamps.

The advantage of this approach is not only the more homogeneous excitation but, most importantly, the option of controlling every LCD pixel individually to generate a temporal and spatial intensity pattern of excitation. The proposed method starts with an ordinary optically excited lockin-thermography measurement, using the LCD projector as a light source. In a second step, the phase and amplitude image gained from the first measurement is computed into a new excitation pattern aimed at diminishing the differences in phase and amplitude of neighbouring pixels. After a few iterative measurement cycles a sufficient level of homogeneity in phase and amplitude of the thermal wave is achieved.

Ideally, at this point, the resulting phase and amplitude images are completely void of information. However, the actual result is the iteratively optimised pattern of the excitation signal where each pixel is assigned its own brightness as a function of time. As the lockin frequency is known and constant, the excitation signal can be Fourier-transformed into an image of phase lag and amplitude, making it possible to view the result of this new method in the same way as ordinary lockin-thermography results, but with a significantly improved contrast.