1.5.28. CHARACTERIZING CRACKS WITH ACTIVE THERMOGRAPHY

Schlichting J., Kervalishvili G.N., Maierhofer Ch., Kramer A., Kreutzbruck M.,
BAM Federal Institute for Materials Research and Testing, Berlin, Germany

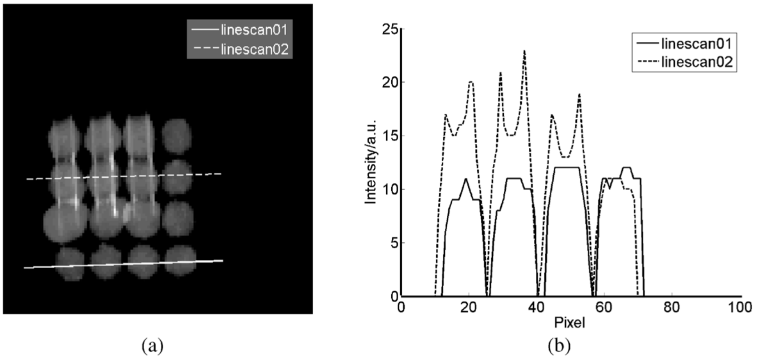
Due to the fast development of the technology of infrared cameras, active thermography has become widely available. Now it is a standard tool for various fields of NDT problems, allowing fast non-contact spatial-resolved and image-guided testing. In the most common setups a heat flow perpendicular to the surface is induce by heating large surface areas.

In this work, we focus on the detection of vertical cracks starting at the surface, which is an important indication of structural failure. By using different local excitation-techniques it is possible to induce a lateral heat flow while the temporal surface temperature data is recorded with an infrared camera.

From the regional transient behaviour of surface temperature, it is possible to draw conclusions to the heat flow. Thus, anisotropies in the lateral diffusivity can be detected, which can provide quantitative information about crack parameters. Here, we present an advanced technique for the determination of the crack depth.

The experimental set-up is based on a NdYAG laser. The required lateral heat flow is induced by focussing the beam on the test sample using an optical scanner. The time resolved temperature distribution is recorded with an infrared camera (InSb FPA, 3 to 5 μm, 128×128 pixels at 200 Hz frame rate). The measurement is carried out in a chamber, which can be evacuated allowing realizing different ambient conditions.

In fig. 1, the result of an experiment is shown, in which a 4×4 laser spot pattern was drawn to the sample surface within a time interval of 4 s using a laser power of 25 W. The resulting temperature distribution was recorded at 200 Hz. Six vertical cracks can be easily detected. In addition we report on numerical simulation to investigate the concept of local heat excitation for a quantitative estimation of crack parameters. The modelling also includes the influence of thermal conduction, radiation and convection. We obtained a good consistency between experimental and theoretical data.



(a) (b)

Fig. 1. Detection of vertical cracks with laser excitation:
(a) – colour coded image depicting how often each pixel exceeds a certain threshold after laser excitation. Six vertical cracks are clearly visible; (b) – plots of the two linescans marked in the left image. The pixels between the cracks exceed the threshold more often,

because the vertical heat flow is lowered due to the cracks. This gives a good starting point for crack characterisation