Pixel-Variable IR Excitation - A quantum leap in active thermography Imaging

Marc Kreutzbruck[1], Johannes Rittmann[2], Jonas Hufert[1]

[1]Institute of Plastics Technology, University of Stuttgart, Germany, [1]-, Precitec GmbH, Germany

The naturally diffusive heat flow in solids often results in differences in surface temperatures. Active thermography (AT) uses such differences to gain information on the internal structure, morphology, or geometry of technical components or biological specimens. In contrast to sound or light waves, thermal waves are lossy; consequently, it is difficult to interpret measured 2D temperature fields. Most AT evaluation methods are based on 1D approaches, and measured 3D heat fluxes are frequently not considered, which is why edges, small features, or gradients are often blurred. Herein, we present a method for reducing the local temperature gradients at feature areas and minimizing the induced lateral heat flux in optical lock-in thermography (LT) measurements through spatial- and temporal-structured heating. The method is based on transferring the temperature contrast measured by the IR camera to an IR projector. Surface areas with a higher temperature are now illuminated with a lower intensity. In addition, the measured phase shift between excitation and detection is compensated for by a time-adjusted excitation. This process takes place iteratively for about 2-10 iterations, whereby the temperature contrast on the component disappears more and more after each iteration, but now reappears more and more clearly in the illumination image of the beamer with a very improved spatial resolution, as the lateral heat flows have been physically eliminated. The vanishing lateral gradients convert the problem into a 1D problem, which can be adequately solved by the LT approach. The proposed compensation method can bypass the blind frequency of LT and make the inspection largely independent of the excitation frequency. Furthermore, the edge sharpness and separability of features are significantly improved, ultimately improving the feature-detection efficiency.