

# Thermal Imaging Analysis of Stimulated Heat Diffusion in Sheet Metal for Non-Destructive Metrology and Testing

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**Abstract.** Recent developments in infrared camera technology, testing methods and data processing algorithms have brought significant progress for high resolution spatial and temporal analysis of thermal radiation. Together with industry standard automation technology and specific infrared image data processing it became possible to non destructively inspect laser welded seams and other types of joints using heat flux analysis subsequent to thermal stimulation. High thermal diffusion coefficients of the usually metallic samples under test make the availability of high-speed infrared cameras as a key hardware component indispensable. Since high-speed infrared cameras with frame rates of at least 500 Hz have become available for commercial applications, non-destructive testing systems with a new class of performance were designed, manufactured, and implemented at industrial sites. Heat flux analysis as a new and robust method of non-destructive testing has been implemented for various types of equipment, ranging from off-line tools for laboratory use to automated robot based systems enabling fast and operator-free in-line inspection. Depending on environment, implementation surroundings, and geometry of objects to be inspected, different types of pulsed or continuous operating heat sources (e.g. flash light, laser, ...) are selected. Due to its outstanding industrial relevance non-destructive testing of laser welded seams in automobile manufacturing is shown in detail in this paper.