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A combined integral transform asymptotic expansion method for the characterization of interface flaws through pulsed infrared thermography

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Abstract
This work is devoted to the non-destructive evaluation of materials using stimulated infrared thermography. The proposed approach provides simple analytical solutions to evaluate the lateral extent, and the thickness of a plane flaw in a three-dimensional (3D) heat transfer configuration. It is based on the application of a Laplace transform on the time variable t, then a double Fourier transform on the space variables x and y. Reduction of the models is obtained through an asymptotic expansion method. This mathematical formalism leads to the construction of explicit relationships that are very convenient for quantitative inversion. An experimental validation of the inversion procedures is performed on calibrated carbon-epoxy laminates. A particular attention is dedicated in the second part of this work to the experimental analysis of the impact of the definition of the experimental thermal contrast and the sane (i.e., non-defective) area on the inverted parameters. The analysis is carried out through a comparison between two classical definitions of the thermal contrast and a new method, the DAC contrast, developed recently by our team. The impact of a hyper parameter of the inversion procedures (i.e., the Laplace variable) is also analyzed. Both analyses are illustrated through an experiment aiming to estimate the depths of some calibrated flaws in a CFRP laminate.

Keywords
Non destructive evaluation, infrared thermography, DAC thermal contrast, flaw characterization, 3D heat transfer, mathematical perturbations, thermal quadrupoles.

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Visible and infrared imagery for surveillance applications: software and hardware considerations

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Abstract
In this text, we summarize recent works done in the use of visible and infra¬red imagery for surveillance applications. Moreover, we also present latest devel¬opments that have occurred in three partner institutions of the Québec, Canada area in this field. Our focus is on both hardware and software. Hardware here con¬cerns

channel registration and innovative optical systems while software is related to high level information extraction. Extensive literature review is provided.

Keywords
Infrared imagery, surveillance applications, target tracking, background subtraction, visible/infrared image fusion

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Heat transfer measurements in a rotating two-pass square channel

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Abstract
The aim of the present work is to perform detailed measurements of the convective heat transfer coefficient map nearby an 180-deg sharp turn in a rotating square channel by means of infrared (IR) thermography. Measurements are performed in order to study the effects of rotation on the heat transfer distribution in the internal cooling passages existing in the blades of modern gas turbine. Results are reported either in local form, or as averaged Nusselt number profiles along the channel. Data shows different behaviors of the convective heat transfer coefficient distribution in the stationary channel with respect to those of the leading and of the trailing walls of the rotating channel.

Keywords
Infrared thermography, rotating channel, gas turbine cooling, convective heat transfer

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Stereo techniques for 3D mapping of object surface temperatures

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Abstract
In this paper, we present two stereo methods to obtain 3D mappings of object surface temperatures. The first method uses a pair of trichromatic cameras to recover the 3D geometry and then maps the temperature data from a thermal camera onto the recovered surface. The second method recovers the 3D surface temperature map using a pair of thermal cameras by exploiting isotherms and epipolar geometry. The former setup is cheaper while the latter has the novel advantage of estimating object depth in a dark environment. Both methods make use of a simple technique to calibrate thermal cameras, which makes the calibration approach akin to that of trichromatic systems. Finally, we conduct a comparative study of the two proposed approaches focusing on the accuracy of the results, applicability and robustness.

Keywords
Thermography, 3D thermal map, infrared imaging, stereo vision, depth map

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Unsteady-state lock-in thermography – Application to shunts in solar cells

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Abstract
This paper presents the fast implementation of Lock-in Thermography (LIT) before reaching steady-state conditions. The errors caused by the initial temperature drift are compensated by a simple correction formula based on the measurement of the temperature drift image. The effect of this correction has been studied on the in-phase, quadrature, amplitude and the phase signals of lock-in thermography. Simulations and experiments have been performed for this study while considering a specific application of LIT for the investigation of solar cells. This study shows that in our case the error caused by the temperature drift is basically a baseline shift in the in-phase and the quadrature signal, and does not significantly affect the relative shape and spatial resolution of these signals. However, for the amplitude and phase signal this correction is more significant and affects also the relative shape of the signals. Experimental results validate the correction method and its effectiveness in eliminating errors from LIT data measured before thermal equilibrium has been established.

Keywords
Lock-in thermography, solar cell, temperature drift correction.

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Active dynamic thermography in cardiosurgery

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Abstract
The aim of this study is development and analysis of applicability of new tools for continuous inspection of open-heart cardio-surgical interventions, suitable in clinical environment. Our notice is concentrated on IR-thermal imaging for monitoring of invasive surgical interventions as CABG in treatment of ischaemia and other heart malfunctions. In this presentation preliminary results of in-vivo experiments on animals with the use of IR thermal camera and newly developed procedures of active dynamic thermography are discussed.

Keywords
Infrared-thermal imaging, cardiosurgery monitoring