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QIRT Journal, 2, 2, pp. 133-151.

High-level radiance calibration method applied to jet plume of thrusters

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Abstract
This paper presents a specific calibration method developed in order to measure high-level radiances provided by a flame thruster during its combustion period. The main originality lies in the fact of measuring reference sources at low temperature and implementing an adapted neutral density thereafter in order to calculate the high-level radiances of the plume. The validation of the method and some measurement results got by analysis of plume jet thruster radiance cartographies are shown.

Keywords
Infrared, Calibration, Plume

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Calorimetric analysis of polymer behaviour using a pixel calibration of an IRFPA camera

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Abstract
A pixel calibration of an IRFPA camera was developed to detect very small temperature variations induced by quasi-static loading of materials. The thermographic data were then used to estimate heat sources accompanying the deformation of PMMA and PC polymers during cyclic tests. The calorimetric balance analysis led us to define several possible ways of introducing the thermoelastic coupling effects in viscothermoelastic models.

Keywords
Thermography, IRFPA camera calibration, Polymers, Viscothermoelasticity, Calorimetric balance

QIRT Journal, 2,2, pp.173-190.

Local heat transfer coefficient distribution on a plate cooled by an array of confined impinging round jets

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Abstract

The present work deals with the cooling of a plate using an array of staggered round air jets. The aim of the work is to produce a specific database related to the measurement of the convective heat transfer coefficient distribution along the plate. The work is devoted to a particular configuration in which spent air is ejected through holes placed between the jets. The experiments covers the Reynolds number range in [8000, 54000] and a classical thin foil technique associated with infrared thermography was used. This particular configuration is also simulated using the FLUENT 6.0 CFD code. The numerical results are compared to measured local heat transfer coefficients.

Keywords
IR camera, Convective heat transfer, CFD, Round jets.

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Ultrasound-lockin-thermography NDE of composite plates with low power actuators. Experimental investigation of the influence of the Lamb wave frequency

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Abstract
Ultrasonic vibrothermography, also called ultrasound–thermography or thermosonics, is a nondestructive technique that is based on the application of a modulated mechanical stress on the tested structure, while an infrared camera is mapping the surface temperature. Regions of imperfection convert energy to heat through enhanced viscoelastic dissipation, collisions and/or rubbing of internal free surfaces present in delaminations and cracks. Surface defects and internal defects appear hotter when the surface temperature is mapped. In the case of plate-like structures, Lamb waves are interesting as they can propagate over long distances. The objective was to evaluate if ultrasound-thermography could be successfully applied by means of small piezoelectric transducers clamped or stuck to the tested piece. The ultrasound frequency ranged between some tens of kHz to 200 kHz. The amplitude was modulated at very low frequency (some tens of mHz) and lock-in thermography was performed in order to increase the thermal signal to noise ratio. The influence of both frequencies on the thermal contrast induced by impact defects was analyzed. A very high sensitivity to the ultrasound frequency was observed. Ultrasound-thermography can be applied with success with low power actuators provided the ultrasound frequency is properly selected.

Keywords
Thermography, Ultrasound, Lock-in thermography, Dissipation, Plate wave, Lamb wave, Vibrothermography, Delamination, Crack

QIRT Journal, 2, 2, pp. 207-222.

An image registration method for infrared measurements

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Abstract
Heat flux measurements are one of the main purposes of tests carried out in hypersonic wind tunnels. They are performed at Onera mainly with Infrared Thermography (IRT), while sensors as thermocouples enable to check its reliability. Image processing tools are used to recognize the model position in images and to extract information from them. Methods doing these actions are called resection methods. The Onera's method requires markers, which are recognized automatically. The relative position of the camera is identified and the model motion can then be corrected in a 3D manner. The resection method is now widely applied for wind tunnel testing both for infrared or visible applications.

Keywords
Convective heat flux, Hypersonic flows, Resection methods, Wind tunnel testing

QIRT Journal, 2, 2, pp. 223-236.

Direct infrared measurements of phased array aperture excitations

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Abstract
A thermographic imaging technique has been developed to measure electromagnetic (EM) fields. This technique is applied in this paper to measure the aperture plane fields of large phased array radar antennas and to determine the aperture (source) excitations of the array, i.e., the distribution of the radiated energy over the elements in the aperture plane of the array. These IR measurements, therefore, can be performed on-site at the remote location of the antenna in-the-field to produce a non-distorted image of the field excitations in the aperture plane of the array, which control the overall radiation characteristics of the array. In general, these images can be used for field diagnostics to evaluate the electrical characteristics of the elements of the array, i.e., the state (strength) of the aperture excitations and the condition of the switching circuits (phase shifters and attenuators), which control the radiation pattern of the antenna. The aperture field distribution can be compared to a standard "test pattern" to quickly determine the operational state of each individual element of the array. Individual attenuators and/or phase shifters that produce incorrect element intensities can be easily and quickly identified with this technique. Short-circuited elements at various positions in the array are used to simulate faults in the elements and to test the feasibility of the thermal technique to determine the operational state of the array. Therefore, the overall "state of health" of the array and the need for repair can be determined in-the-field using the IR measurement technique to avoid the expensive and time consuming alternative of dismantling the array and shipping it to a maintenance depot for testing, calibration, and repair on a standard, planar, near-field antenna test range. In this paper, the IR technique is tested in a controlled environment to determine the feasibility of using the IR images as an array diagnostic tool to measure the aperture excitations of large phased array radar antennas.

Keywords
Phased array radar antennas, Infrared thermograms, Aperture distributions, Array diagnostics

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Performance of FPA IR cameras and their improvement by time, space and frequency data processing. Part II: Application to the thermographic measurement of microwave fields

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Abstract
The characterization of focal plane array infrared cameras is more complex and time consuming than it was for single detector cameras. In the part I of this paper, numerous calibrations have been performed quantifying the improvements of the thermal resolution by time, space and frequency (lock-in) processing. In the present and last part, time and space accumulations and lock-in processing are applied to the improvement of the radiation pattern characterisation of a microwave source using the ElectroMagnetic-InfraRed (EMIR) technique. The interest of lock-in thermography compared to CW measurements is quantified by the comparison of the

sensitivity, the space resolution, the Noise Equivalent Electric Field Difference (NEEFD) - a proposed new parameter – and the maximum dynamic range.

Keywords
FPA camera, Data processing, EMIR technique, Lock-in thermography, NETD