QIRT'2002: Quantitative InfraRed Thermography 6

~ Abstracts ~

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IR Thermography Applied to Historical Buildings

by E. Grinzato

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Abstract

Different kinds of discontinuities affecting historical building structures are detectable by thermal analysis of the surface temperature when submitted to suitable boundary conditions. The use of a quantitative approach is illustrated according to particular requirements of works of art. Principal sources of errors and failures in the interpretation of thermographic data are considered.

Applications to massive masonry buildings are reported to illustrate recent results applying advanced processing algorithms to frescoes.

Uncooled IR focal plane arrays: worldwide review and state-of-the-art at ULIS

by J.L. Tissot

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Abstract

Uncooled infrared focal plane arrays are being developed for a wide range of thermal imaging applications. Developments are focused on improving the sensitivity to enable the possibility to manufacture high performance small pixel pitch detectors or radiometric detectors with internal "cold" shield. Commercial infrared is now a well-established business with several competitors. We review the state-of-art of the main competitors and we describe the work which is being done in France.

After the development of an amorphous silicon based uncooled microbolometer technology, LETI and ULIS, a subsidiary of SOFRADIR and CEA, are now working to make easier IRFPA integration into equipment in order to address a very large market. Achievement of this goal needs the integration of advanced functions on the focal plane and the decrease of manufacturing cost of IRFPA by decreasing the pixel pitch and simplifying the vacuum package. We present the new design for readout circuits taking into account the user needs by introducing analog to digital converter on the chip to provide 12 bits video digital output. We present also the introduction and the characterization of radiometric device obtained from 320 x 240 uncooled microbolometer arrays with a f/1.4 limited field of view. Then, we present the new ceramics microbolometer package developed to decrease the package cost of versatile smaller devices like the 160 x 120 pixels with a pitch of 35µm.

Infrared Astronomy for Infrared Engineers

by Ž. Ivezić

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Abstract

Astronomical observations at infrared wavelengths are important because they provide information about celestial sources that is inaccessible at visible wavelengths. Here I discuss the main factors contributing to the importance of infrared astronomy, and present an overview of some of the recent and future observational efforts.

Application of quantitative impulse thermography for structural evaluation in civil engineering - Comparison of experimental results and numerical simulations

by A. Brink, Ch. Maierhofer, M. Rö11ig and H. Wiggenhauser

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Abstract

The cooling-down process of building structures after heating-up with an external radiation source was analysed to detect voids inside and below the surface. Here, the results of a concrete test specimen containing voids with different sizes at various depths will be presented. These experimental investigations were compared to the results of simulations performed with a Finite Difference program.

Enhancement of open-cracks detection using a principal component analysis/wavelet technique in photothermal nondestructive testing

by S. Hermosilla-Lara [1,2,3], P.Y. Joubert[2], D. Placko[2], F. Lepoutre[3], M. Piriou[1]

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Abstract

In this paper, the images provided by a flying-spot camera dedicated to open-crack detection are considered. In this contribution, the authors focus on the enhancement of open-crack detection performances in the case of severe surface conditions. 'After a short description of the principle of the device, the tested structure and the obtained photothermal images are presented. The images are then processed thanks to a modified principal component analysis which allows to separate the thermal and optical effects from the raw images. The detection is then carried out and the performances are characterized thanks to Receiver Operating Characteristic curves.

Thermography with excitation by elastic waves: comparison of techniques (pulse, burst, lockin)

by Th. Zweschper, A. Dillenz, G. Riegert, G. Busse

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Abstract

Ultrasound thermography or sonic thermography is being used for defect-selective imaging where the background of intact structures is suppressed. This concept is helpful in terms of reliability and speed of inspection. However, as compared to optical excitation the method implies high power ultrasound injection, which is a considerable load on the inspected structure. Hence one needs to consider which technique provides which information at which load. Our paper discusses these topics on the base of various examples.

New Absolute Contrast for pulsed thermography

by M. Pilla[1], M. Klein[2], X. Maldague[3], A. Salerno[1]

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Abstract

In this paper, a new absolute thermal contrast method is proposed for pulsed infrared thermography. It is based on the computations of reconstructed defect-free images so that no a priori knowledge of a sound area on the sample is necessary. Moreover, a correction is applied to take into account possible delays in the acquisition time. Results are presented both on Plexiglas™ and graphite-epoxy specimens. Comparisons with Pulsed Phase Thermography phase images are also presented along with a discussion on the advantages of the proposed method.

Studying the phenomena related to the IR thermographic detection of buried landmines

by V.P. Vavilov and A. G. Klimov

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Abstract

Some theoretical and experimental problems related to the IR detection of buried landmines are discussed to express a rather pessimistic conclusion on the statistical reliability of this technique.

Advanced analysis of thermograms of buried objects in non-homogeneous environment

by I. Boras, V. Krstelj, M. Malinovec, J. Stepanić Jr. and S. Švaić

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Abstract

The application of thermography to detect buried objects (e.g. antipersonnel mines in the humanitarian demining) has been limited to mine-contaminated regions with homogeneous and vegetationless soils. Realistic non-homogeneity induces considerable noise superposed to the thermal response of the buried object. One source of noise is surface non-homogeneity, interpretable as a quasi-random signal, which screens the thermal response of the buried object. This interpretation allows for noise reduction using advanced thermogram processing algorithms, such as *Independent component analysis*. We apply it to thermograms obtained using controllable experimental conditions and a realistic three-dimensional, non-stationary heat transfer program. Numerical estimates of the degree of soil non-homogeneity, which can be reduced in thermograms, are obtained for a particular, representative class of buried objects and soil surface non-homogeneity. In particular, the dependence of the results on concentration of surface point-like nonhomogeneities is determined.

Mines detection using the EMIR® method

by D. Balageas and P. Levesque

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Abstract

The ElectroMagnetic-InfraRed technique (EMIR®) is used for the detection of buried mines. First we discuss the principle and the advantages of the technique as compared to more classical stimulated thermographic techniques applied to this problem. A simple test bed is presented and first results are given that show at least in the present case a good sensitivity where the ground consists of coarse sand. Influences of lift-off sensor, sand humidity, nature, size and depth location of mines are experimentally studied.

Nondestructive evaluation of aircraft components by thermography using different heat sources

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Abstract

In this paper we present the comparison of diagnostic NDT (non-destructive testing) techniques based on infrared thermography for the detection of water in composite materials used in aviation. There are different sources for thermal stimulation used in these methods. Research was performed both on a specially prepared test-sample and on a real aerospace component. The obtained results indicate the potential of IR thermography methods for the detection of water in aerospace components which is important because its presence even in small quantities may cause defects in these elements.

Significance of buried object orientation variation in their detection using thermography

by V. Krstelj, M. Malinovec, J. Stepanić Jr. and S. Švaić

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Abstract

Landmines are part of a complex system with variable characteristics that may change with time. If thermography is applied on such a system, the most significant characteristics of resulting thermograms is overcritical noise which has severely suppressed the application of thermography for landmine detection for humanitarian demining. The attempts to realise as much as possible of the thermography potential motivated concentrating onto sources of noise in buried objects thermograms, in particular onto variations in mine orientation relative to the soil normal. The experiments reported in this paper were performed in order to investigate the influence of angle between the local vertical axis and mine symmetry axis, the angle between the local vertical axis and soil surface normal, and the object depth. The influences are quantified and ranked through the statistically planned experiment. The strongest influence is the statistical interaction of depth and angles. According to the statistical test these two combinations are significant influences. The results indicate that the application of modern thermography in humanitarian demining is to be broadened by including the variations in mine orientation.

3D heat flux effects in the experimental evaluation of corrosion by IR thermography

by S. Marinetti, P.G. Bison and E. Grinzato

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Abstract

IR thermography has been successfully applied to corrosion detection in metals. The main advantage of such a technique is its capability to inspect large surfaces in a short time. A simple formula for corrosion evaluation was proposed in 1996. It is based on the assumption of one-dimensional heat diffusion and was successfully applied to estimate the material loss for large defects. In this paper the case of small sized defects is analysed. When the 3D heat diffusion effects are strong, the formula yields underestimated values. Results of numerical simulations are used to devise a method which makes the estimate of the material loss more accurate.

A thermographic method to evaluate laminar bubble phenomena on airfoil operating at low Reynolds number

by G. Cesini[1] R. Ricci[2], S. Montelpare[1], E. Silvi[1]

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(2) Università "G.D'Annunzio" di Chieti, D.S.S.A.R.R., Italy.

Abstract

The aim of this research is the study of the laminar boundary layer separation phenomena on aerodynamic bodies by infrared thermography. The presence and the size of laminar bubble are mainly observed. A thermographic method is adjusted to detect the presence and the longitudinal dimension of the laminar bubble. In this region the convective heat transfer coefficient is lower than in the surroundings, because of the recirculating flow. Heating the airfoil surface, the laminar bubble will appear warmer than the other zones and so it is possible to know its presence and position.

Application of infrared thermography for investigation of unsteady flow in a circular pipe

/ by A. Ekholm[1], T. Koppel[2], M. Lähdeniemi[3] and R. Puust[2]

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Abstract:

The heat transfer of pulsating flow in pipes has been theoretically and experimentally investigated. The interest in this problem is due to increase in heat exchange efficiency. An experimental set-up has been constructed for the investigation of unsteady flow in a circular pipe. For the evaluation of convective heat transfer in pulsating flow the temperature of the pipe wall has been measured by IR- thermography.

Comparison of plexiglas and vespel materials for heat flux measurements by infrared thermography at hypersonic conditions

by C. O. Asma, F. Barbe, S. Paris, D. G. Fletcher

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Abstract:

The aerodynamic heating rate on axisymmetric cone-flare models under hypersonic conditions (Mach 6) is investigated by using infrared thermography. The primary purpose of the work is to see the effects of different flow conditions. Tests with several unit Reynolds numbers are performed to obtain laminar, transitional and turbulent flows. Locations of separation and reattachment points are determined and detailed investigations on the magnitude of aerodynamic heating rate are carried out. Another purpose of this study is to evaluate the model material. Two different materials, Plexiglas and Vespel are used. It is observed that experiments with Vespel yield more reliable and more accurate results by infrared thermography, owing to its lower thermal diffusivity and its ability to withstand high temperatures with little changes in thermal properties.

Studies of wall temperature effects on shock wave/boundary layer interactions in hypersonic flow

by A.Ciani, S.Paris, D.G.Fletcher

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Abstract

Infrared thermography equipment is used to measure the temperature rise at a surface of a model simulating a deflected flap of a re-entry vehicle. The model is tested in the VKIH3 hypersonic wind tunnel with a flow at Mach 6 at different Reynolds numbers and temperatures. Examining the rise of temperature on the interested surface, it is possible to visualize the flow topology on the surface and to infer the heat flux on the model. By heating artificially the model before the tests it is possible to evaluate the effects of the wall temperature on heat flux and flow topology.

Analysis of external temperature profiles in tubes with inserted turbulators using thermography

by M. Malinovec, Z. I. Jereb, M. Andrassy and S. Švaić

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Abstract

Enhancement of heat transfer intensity in all types of thermo technical apparatus is of great significance for industry. Beside the savings of primary energy, it also leads to a reduction in size and weight. Up to the present, several heat transfer enhancement techniques have been developed. One of them is using turbulators. In this technique, because of a large number of parameters involved, and rather complex fluid flow structure, usually a complex measurement set is needed to characterize a tested model. This situation could be simplified using thermography, which is expected to bring about simpler and faster measurements, ending up with sufficient measurement data.

This paper deals with external temperature profiles on a smooth tube and on tubes inserted with turbulators, recorded thermographycally. In order to access the induced heat transfer enhancement, an experimental set-up was designed which includes a ventilator, a mass flow measuring orifice, an air-heater and the investigated tube cooled in still air. In the measurements, the effects of three types of turbulators on the external temperature profile of the tube were analyzed. Inside the investigated tube (Ø48.3x2.9 mm, length 1000 mm) air is used as the heat transfer medium. Using recorded thermograms, the differences in heat transfer were determined.

Infrared thermography study of heat transfer in an array of slot jets

by J.M. Buchlin[1], J.B. Gouriet[1], J.P.A.J. van Beeck[1], M. Renard[2]

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Abstract

The paper describes a study of convective heat transfer in a multiple-jet systems composed of straight and inclined slot nozzles. The application concerned is the fast cooling of moving strip. The experimental approach involves the application of infrared thermography associated with the steady-state heated foil technique. The study aims to determine the effect on the average heat transfer coefficient of the slot Reynolds number up to the value of 100000, the nozzle spacing normalised by the slot hydraulic diameter in the range $6 \leq W/S \leq 18$, the normalised nozzle protrusion length, E/S, from 5 to 17 and the normalised nozzle to strip standoff distance Z/S from 3 to 10. The geometrical arrangements tested include perpendicular (90°) and tilted (60°) nozzles. The experimental findings are compared with existing correlation; deviations, which are observed at high values of the Reynolds number may reach 25%. Jet merging phenomenon is experimentally observed a low W/S-values.

Infrared measurements of heat transfer in jet impingement on concave wall applied to anti-icing

by M. Marchand, V. Ménard, J.G. Galier, P. Reulet and P. Millan

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Abstract

This paper addresses the experimental study of hot jets impingement on a concave wall. Both low and high Mach number conditions have been investigated. Infrared thermography is used to measure the wall temperature evolution during the heating. This temperature mapping provides the boundary condition necessary to solve the transient heat equation in the wall. From this, heat transfer and Nusselt number are derived and their behaviour compared to literature on the subject when possible. Finally, a correlation of Nusselt versus Reynolds, Prandtl and the nozzle to wall distance is proposed.

Experimental determination of fuel evaporation rates using IR- Thermography

by M. Founti[1], D. Kolaitis[1], G. Zannis[1], O. Kastner[2], D. Trimis[2]

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Abstract

The scope of the present work is to experimentally investigate the heat and mass transfer phenomena occurring in the case of pure liquid as well as FAME-diesel fuel mixture droplets evaporating in a constant temperature and constant air velocity environment. Experiments have been performed to record the time evolution of droplet diameter and surface temperature. An ultrasonic droplet acoustic levitator has been operated in order to suspend the isolated droplets in air. A fast CCD camera and an infrared camera have been used to record droplet diameters and droplet surface temperatures, respectively. The produced experimental data can be used in the validation of computational and empirical models for single, pure liquid or multicomponent droplet evaporation.

Evaluation of evaporation flux in building materials by infrared thermography

by M. Milazzo, N.Ludwig, V.Redaelli

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Abstract

The presence of water inside the walls can be considered one of the most important causes of degradation in historical buildings. In particular, evaporation can give rise to salt deposits inside the superficial pores. Evaporation flux from wall surfaces can quantitatively be estimated by measuring the surface temperature since it depends in a sensitive way on the evaporation rate. The value of the surface temperature, in equilibrium conditions for all the different heat exchange contributions to the wall, depends on the evaporation rate, material's thermal conductivity as well as temperature and ventilation experimental conditions.

Several experiments have been performed on brick, plaster and stone specimens with different porosity values in the laboratory of the "Istituto di Fisica Generale Applicata" to empirically obtain correlations of temperature with evaporation rate. A climatic room with controlled environmental parameters (temperature, relative humidity, ventilation, thermal irradiation) was employed and cooling effects due to evaporation were investigated in steady conditions by a SW IR thermographic camera.

Tables for evaporation rate, water content and surface temperature values (Φ, Wc, Ts) were obtained for several materials. Applicability limits of the thermographic technique for moisture detection are discussed.

Validating a numerical phase change model by using infrared thermography

by R. Lehtiniemi[1], P. Lamberg[2], A.M. Henell[1]

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Abstract

In this study, both the feasibility and accuracy of numerical methods in FEMLAB environment to simulate phase change events in a heat storage were studied. Two different storages were built and modelled, and the predictions were compared to experimental data. The results of the measurements followed the predictions rather well. According to the results, the applied models measurements allow a quick and flexible way to design phase change heat storages.

3D numerical model for heat conduction analysis based on IR thermography

by I. Boras, S. Švaić

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Abstract

A 3 D model based on control volume numerical method was used to simulate the heat conduction in a flat metal plate containing artificial defects. The plate was made of steel with known thermal properties and the defects of different depth were flat bottom holes simulating areas damaged by corrosion.

The result of simulation was the temperature distribution on both the intact and the damaged rear side of the plate. The temperature distribution on the metal plate surfaces depends on material properties, start and boundary conditions, heat stimulation intensity, and duration. The goal of the research was to find if there is a possibility to combine pulse thermography (a technique which is being used since many years) and numerical modeling to determine the degree of hidden corrosion on the rear surface of a thin metal plate.

Thermal compact modeling for power electronic devices in D2Pak enclosures

by M. Lis, B. Wiecek, T. Wajman

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Abstract

In this paper, the compact modeling of power electronic devices is presented. Physical modeling using ANSYS is helpful to identify the compact model parameters. Thermographic measurements were applied to modeling validation. Compact models are very easy for computation, so they generate the results fast and with satisfactory accuracy.

Thermal diagnostic of power transistor at increased junction temperatures

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Abstract

Infrared (IR) thermography in power-cycling experiments was combined in reliability studies of an RF power amplifier, operating at elevated junction temperatures. A powercycling technique (adjusted to reach high junction temperatures) was used as a life acceleration method. Several sets of IR measurements were performed for various working conditions to correlate the device power and the maximum junction temperatures. Finite element (FE) simulations in combination with traditional failure analysis methods were employed to examine main failure causes. IR thermography was used for experimental validation of temperature distributions obtained by the simulations. Furthermore, the validated FE model has been extended to achieve stress distribution and reliability predictions via selection of the most risky areas. The entire procedure can provide reliable, evaluated information of the governing thermal resistances and enable optimizing the required cooling arrangement.

Measurement of temperature during simple dynamic shear

by W.K. Nowacki, S.P. Gadaj, E.A. Pieczyska

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Abstract

This paper presents an application of infrared thermography to investigate the dynamic simple shear of sheets at high strain rates. The methodology of the simple shear deformation are described. Two methods of temperature measurements on the basis of infrared radiation detection were used in order to satisfy the conditions of dynamic investigation. The temperature accompanying the dynamic simple shear has been evaluated.

Thermomechanical study of cycling, relaxation, and creep sequences in polymers

by E.A. Pieczyska, S.P. Gadaj, W.K. Nowacki

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Abstract

Specially designed experiments were performed to study the thermomechanical aspects of cycling, relaxation, and creep in polymers. Sheet samples of the material were subjected to a special program of the tensile deformation in a testing machine. An infrared camera was used in order to measure the temperature changes of the sample surface during the deformation. The mechanical and the thermal characteristics were obtained both in elastic and plastic ranges of straining, as well as after the process.

Modelling and thermography measurements of thermal properties of nonwoven

by M. Michalak[1] B. Więcek[2], I. Krucińska[1]

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(2) Computer Thermography Group, Institute of Electronics, Technical University of Łódź, Poland

Abstract

By means of a thermography method we studied the thermal parameters of nonwovens manufactured from hemp fibres, chemical fibres and with an addition of electrically conducting fibres. In textile, such investigations using the thermo wave method was applied for the first time.

Quantitative analysis of thermal bridges of structures through infrared thermograms

by I. Benko

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Abstract

Thermal bridges are those parts or components of a physical structure that have better thermal conductance than their environment i.e. than that of the structure whose parts they are. Thermal bridges cause excess heat loss. This paper presents examples for the analysis of thermal bridges in energy conversion/transportation equipment and building structures. The examples feature the identification of thermal bridge locations and excessive heat loss.

Comparison of thermal diffusivity measurement techniques

by F. Cernuschi[1], P.G. Bison[2], S. Marinetti[2],
A. Figari[1], L. Lorenzoni[1], E. Grinzato[2]

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Abstract

Thanks to the collaboration between two laboratories, we present different techniques to measure thermal diffusivity. A brief description of any technique both in the experimental layout and in the processing algorithms is given. Results obtained on samples cut from the same block of stainless steel AISI 304, are reported. Uncertainty evaluation of any measurement is reported as well.

Sub-pixel edge location in thermal images using a mean square measure

by R. Bąbka, W. Minkina

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Abstract

In the paper a statistical method of edge location on the basis of the object radiation signal taken directly from thermogram has been presented. The proposed edge location method is based on maximum searching of mean square measure in an area. Considering the edge as an area between two isothermal surfaces, the maximum of variance in the edge neighbourhood can determine location of the edge. There was introduced a thermal edge model including such parameters as: spatial resolution, bias and a range of the edge temperatures.

Surface roughness influence on photothermal radiometry

by H. G. Walther

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Abstract

Surface roughness has to be taken into account for accurate interpretation of photothermal measurements. An expression for photothermal signals from rough samples was derived by combining the effect of roughness induced thermal wave dispersion with the equivalent layer model. The performance of the proposed model was successfully demonstrated by comparing calculations with radiometric measurements from rough steel samples.

On the FPA infrared camera transfer function calculation

by S. Datcu[1], L. Ibos[1],Y. Candau[1], S. Matteï[2]

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Abstract

In order to obtain a good quantification of the heat flux emitted by a surface using infrared images, it is necessary to calculate accurate values of the surface temperature. Infrared images often distorted due to aberration and diffraction phenomena and electronic noise. A convolution product can model aberration and diffraction distortions and the detector noise is assumed to be stationary and additive. Image restoration can be treated as an ill-posed problem. Its solution is commonly obtained using regularisation methods.

Computer faceted thermal model of helicopter

by R. Dulski and M. Dąbrowski

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Abstract

The paper presents a computer Faceted Thermal Target Model of helicopter (FTTM) describing radiative properties of target in the infrared. The model is predestined for target simulation in analyses of influence of thermal-scene conditions on the possibilities of target detection by a thermodetection system. This is a faceted model describing the target as a set of facets. The set of data for the model of helicopter requires information on the shape and dimensions of the target as well as on temperature distribution and emissivity coefficient of its surface. The model enables to determine emission of radiation from the target surface for various directions and distances of detection. It makes possible to obtain the data necessary to design devices for infrared recognition with a limited application of costly experimental investigations.

Thermographic measurements in environmental and bio sciences

by C.S. Garbe[1], U. Schimpf[1], U. Schurr[2], B. Jähne[1]

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Abstract

In this paper we give an overview of thermographic techniques employed in environmental physics and bio sciences by our research group. Generally, thermography plays an essential role in measuring boundary layer exchange processes. We investigate such processes at the sea surface and on plant leaves. A mid-wave low-noise infrared camera images the temperature distribution directly at the sea surface. By employing digital image sequence analyses important parameters of air-water heat and gas exchange are estimated. The same concept is applied in bio sciences. Here transpiration rates, water content, water flow and heat flux in plant leaves are deducted from thermographic techniques.

Evaluation of new diagnostic procedures of medical thermography - in-vivo experiments

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Abstract

The advantages and disadvantages of active thermography in medical diagnostics using different thermal excitations: halogen lamps as a heating source and ice and a fan as cooling sources are discussed. A new procedure of tissues thermal properties identification and a new image processing method used to increase contrast between healthy and injured tissues are described. In-vivo experiments prove validity of proposed methods.

Evaluation of thermal diffusivity variations in multi-layered structures

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Abstract

The paper deals with the problem how to reconstruct internal structure of tested multilayered biological objects using external heat flux. The procedures of nonlinnear least squares approximation are used for this purpose. Two methods of investigation are presented: 1. active dynamic thermography using a step heat excitation 2. an isothermal contact probe for heat flux measurement. Some results of examination of phantoms and a burned skin are described.

Thermal imaging as a non invasive application in the field of diagnostics and treatment of varicosis and succeeding symptoms

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Abstract

Infrared thermography is successfully introduced to medical practice. Within the diagnostics of varicosis this is not yet very common, although varicosis with all its side effects represents a wide-spread human disease especially occurring at progressive age. The methods used at present are sonography and invasive angiography. In connection with these two methods the infrared thermography can contribute much as a non-invasive, picture-giving procedure to the diagnosis of this illness. Within the scope of this study first examples are presented.

The use of thermovision technique for diagnosis of periodontal diseases and evaluation of treatment effects

by M. Dąbrowski[1], R. Dulski[1], S. Żmuda[2], P. Zaborowski[2]

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Abstract

The aim of this study was to create the diagnosis method of early marginal gingiva pathological states and to evaluate treatment effects. ln periodontal, chronic bacterial infection is observed, which caused inflammation. Initially there are a large amount of G (+) cocci, then they are replaced by Actinomyces viscosus, Actinomyces israelii, Fusobacterium, Veillonella, Bacteroides and Treponeme sp. The temperature changes are often one of the earliest symptoms of pathological process. Almost all. pathological conditions, for example, inflammations or cancers (tumors) caused changes of hot stream, produced in sick tissue. This process can affect temperature of surrounding tissues and often it is demonstrated on the skin and oral mucosa surfaces. Thermographic methods allow determining the value and surfaces distribution of these temperature changes.

Detection of defects of foil sensors applied in the automotive industry by means of active ir thermography

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Abstract:

Examples of industrial application of the active Infrared Thermography are presented here. lEE Luxembourg produces foil sensors which are applied in car seats in order to detect the presence of a passenger or alternatively of a child seat. This information is supplied to the airbag electronics which thus knows whether it should deploy or not in the case of accident. The sensors are made of two plastic foils with printed electrical circuits. The input of electrical current produces heat sources due to the electrical resistivity of the lines, especially at the position of local inhomogeneities, which can be detected by this technique.

Inspection of rivets and cracks in metal using thermography methods

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Abstract

Though modern non-metals attract a lot of interest there are still many applications where metallic structures are being used and where safety depends on the integrity of structures, especially if they suffer from aging. Two topics of relevance for aging aircraft are fatigue cracks and rivets. The reliability of inspection relates also to the safe operation of vehicles and trains. We will discuss the application of thermography with optical or ultrasonic excitation to detect such defects.