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Lockin and burst-phase induction thermography for NDE

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Abstract
Eddy current activated thermography uses resistive losses inside the sample for heating. This heating is done in a modulated way (Induction-Lockin-Thermography: ILT) or as a burst with a subsequent Fourier transformation of the temperature image sequence (Induction-Burst-Phase thermography: IBP). The phase evaluation of ILT and IBP has significant advantages as compared to inductive heating with visual inspection of the thermographic sequence: Phase angle images are independent of most artefacts like reflections, variation in emission coefficient, or inhomogeneous heating. Also the signal-to-noise ratio in the amplitude and phase images is significantly better than in single temperature images.

Keywords
lock-in thermography, burst-phase thermography, induction thermography, NDE

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Reflections and surface temperature measurements in experimental fusion reactors Tore-Supra, JET and ITER

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Abstract
In nuclear fusion experiments with water cooled plasma facing high heat flux components as in Tore Supra and ITER, infrared thermography is and will be used to survey their temperature during operation to avoid damage. The use of metallic components makes things more difficult for surface temperature measurements because of reflections. This paper deals firstly with the estimation of errors made on surface temperature measurements on these high heat flux plasma limiters (first material objects limiting the radial extension of the plasma) due to multiple reflections of the light from the limiter back to the limiter itself, and secondly with specular/diffuse reflections on the main limiter, from other hot elements of the machine. Both effect are small in machines with high absorption (carbonaceous) limiters but quite important in machines with reflecting (metallic) limiters.

Keywords
Nuclear Fusion, Tokamak, Tore-Supra, JET, ITER, Infrared Thermography, Calibration

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Ageing evaluation of thermal barrier coating: comparison between pulsed thermography and thermal wave interferometry

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Abstract
Ceramic thermal barrier coatings (TBC) are widely applied for protecting from combustion gases hot path components of gas turbines for both aero- and land-based applications. In order to prevent the detachment of TBC, it would be essential to monitor their degradation in terms of sintering kinetic. As sintering strongly affects also the thermal diffusivity of TBC, the idea is to measure the latter parameter to account for the former.
The technique to measure thermal diffusivity variation with ageing was recently presented. Tests and results concerning the through-thickness thermal diffusivity on TBC specimens artificially aged were reported. Pulsed Thermography together with the model that leads to the identification of diffusivity for both through-thickness and lateral diffusion was used for that purpose. Thermal Wave Interferometry (TWI) is a photothermal technique used to evaluate thermal parameters when steady periodic conditions are applied to the material.
In the present work a recall of the main results obtained with Pulsed Thermography for this application is given. After that, TWI technique is used to measure again the through-thickness thermal diffusivity of the same samples artificially aged and yet tested with Pulsed Thermography. Laser-Flash technique is also applied to one layer of TBC in the as-sprayed condition.

Keywords
Thermography, Thermal Wave Interferometry, Thermal Barrier Coating, Thermal Diffusivity

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Measurement of forest fire parameters with multi-spectral imaging in the medium infrared

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Abstract
Infrared (IR) imaging is a standard technique for the detection of forest fires but its use to measure the physical parameters of fires faces difficulties due to their spatial and spectral complexity. Multi-spectral images in the Medium IR make possible to classify the scene in different fire regions, thus enabling a region-specific processing and providing values for the instantaneous radiated power and the total radiated energy. Comparison with energy release determined from fuel consumption results in an estimation of a radiative energy fraction of 14 ± 3 %. It is the first time that this parameter is measured by IR imaging in the field.

Keywords
multi-spectral imaging, infrared thermograhy, fire detection, forest fires, remote sensing, classification

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Effective compression algorithms for pulsed thermography data

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Abstract
Two compression algorithms for the image sequences generated by pulsed-transient thermography for non-destructive testing were developed. The first algorithm allows to balance the quality of the original measurement data reproduction against a compression ratio. This algorithm comprises a dedicated space/time mapping (STM) method and an image compression algorithm (JPEG2000). The second algorithm provides lossless reproduction of the original measurement data. This algorithm is based on a particular transformation of dynamically changing data and a lossless compression algorithm (ZIP). Both algorithms were tested on typical experimental thermography data. In both cases, the achieved compression ratios were significantly higher than those of existing algorithms.

Keywords
Thermography, data compression, space/time mapping

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Phase contrast using a differentiated absolute contrast method

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Abstract
A depth retrieval technique based on phase contrast calculations by pulsed phase thermography (PPT) has been previously reported. The phase contrast requires an appropriate selection of the sound area. This is rarely an easy task primarily because a non-defective zone is not always a priori known and even when it is, some variability is typically observed in the results due to changes in the sound phase. This article proposes implementing the differentiated absolute contrast (DAC) method to eliminate the need of defining a sound area. The proposed PPT-DAC approach, allows computation of the phase contrast by subtracting the ideal phase value of a pixel from its measured phase.

Keywords
Pulsed phase thermography, differentiated absolute contrast

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Determination of critical moisture content in porous materials by IR thermography

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Abstract
This work is devoted to the first analysis of temperature fields related to chemical microfluidic reactors. The heat transport around and inside a microchannel is both convective and diffusive with spatial distribution of source terms and strong conductive effects in the channel surrounding. With simplified assumptions, it is shown that Infrared thermography and processing methods of the temperature frames allow to estimate important fields for the chemical engineers, such as the heating source distribution of the chemical reaction along the channel. A validation experiment of a temperature field processing method is proposed with Joule effect as calibrated source term and non reactive fluids. From such previous experiment, a Peclet field is estimated and used in a further step in order to study an acid-base flow configuration.

Keywords
Chemical microreactors, Microfluidic, Inverse Methods, Temperature field processing, MEMS, Microsystems