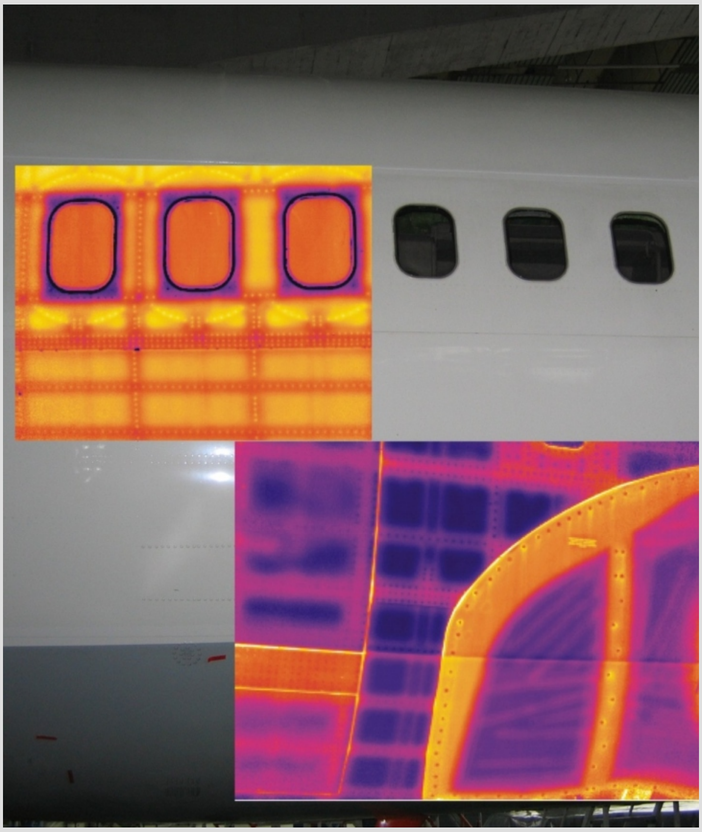
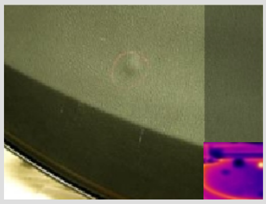
Automation Technology
Vision Systems for Automation





IrNDT -

Systems for Non-Destructive Testing with Active Thermography

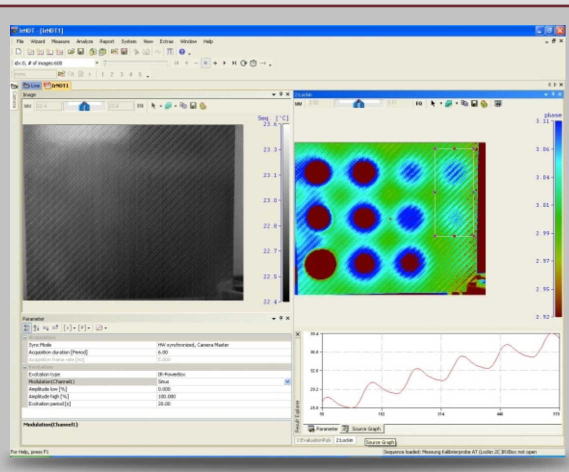
- Contactless quality control
- Fast, large-area scans
- Modular architecture enables performing lock-in, pulse, transient and vibro thermography measurements, as well as TSA
- Supports a wide variety of excitation sources, e.g. halogen lamps, flash lamps, laser, ultrasound, eddy current, among others.
- Presets of inspection parameters for the analysis of the most common materials

Non-destructive testing with IrNDT

IrNDT is a modular solution for non-destructive testing that supports all known NDT techniques based on active thermography:

- Lock-in thermography
- Pulse thermography
- Transient thermography
- Vibro thermography
- Thermal stress analysis

Depending on the inspection task, the IrNDT base package is complemented with one or more evaluation modules. This way the system can be customized to meet the customer needs; containing only the tools required to solve the application.
(→ cost effective compact solution)

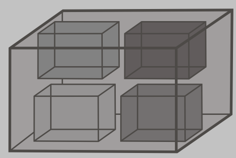


User interface of IrNDT

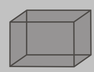
The measuring principle

A heat source gives the inspected material a thermal excitation. The flow of thermal energy through the material has a direct influence on the temperature development on the object's surface. If the temperature development on the surface is recorded over a certain period of time with an infrared camera and a mathematical analysis is applied to the acquired data. Then, if the processed data is displayed as an image, this image will provide us with information about the internal structure of the material or about possible defects in it.

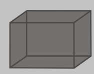
By applying different measuring procedures, the inspection can be optimally adapted to the material or defect searched. The different inspection methods differ from each other particularly from the type of excitation source used, the way the thermal excitation is applied and the type of mathematical analysis used.



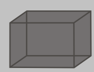
IrNDT Base
For administration of the IR camera and excitation sources, recording of IR data, export of data for further tools (e.g. Matlab)



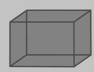
Module: „Lockin / Lock-in online“
Analysis module for lock-in measurings



Module: „Pulse analysis“
Analysis module for measuring with pulse or transient excitation



Modul: “TSA / Lockin Ref / Lockin Ref. online”
Analysis module for lock-in measuring with reference signal / for thermoelastic stress analysis

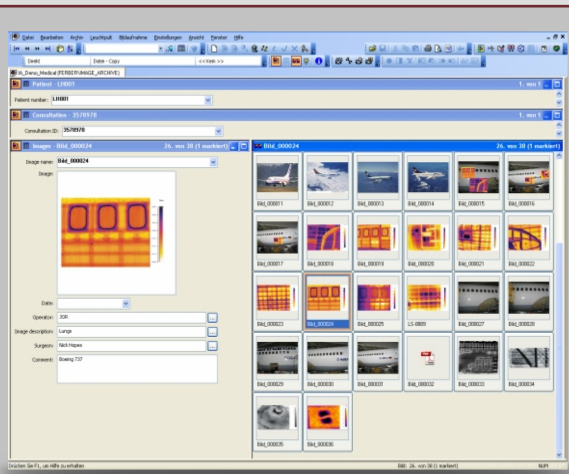


Evaluation Module: “SolarCheck”
Analysis module for inspections of photovoltaic cells

Software structure of IrNDT

Data base Connection

- Data base with client-server-architecture for administration of result images, measuring parameters, reporting, etc. (incl. sorting and search functions)
- The data base includes powerful image-processing functions, such as image subtraction, image comparison, image stitching, transparent mode, automated resizing of images, report generator for Word and PowerPoint, among others features.



User interface of image data base

Main Features of IrNDT at a glance

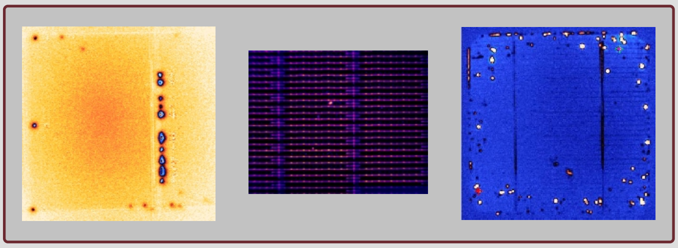
- Non-destructive inspection of materials
- Modular architecture that enables easy upgrading of system solutions without problems
- Very flexible measuring and evaluation algorithms for application-specific inspections
- Graphical user interface for easy set-up of inspection parameters
- Integrated script-engine for the creation of Macros for solving complex inspection processes
- COM/ DCOM Integrated COM/DCOM automation interface for control and data exchange
- Presets of Parameters for the inspection of the most common materials

Inspection examples

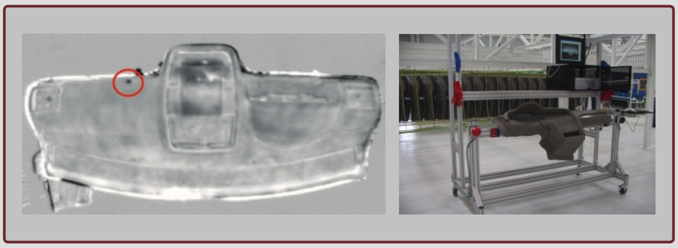
	Lock-in Online	Lock-in	Pulse/Transient		TSA	Inspection task
			Short	Long		
Halogen lamps/ IR emitter	✓	✓	–	✓	–	- Composite materials (dispondings, delaminations, etc.) - Foamed materials (cavities, etc.) - Leather (defects, etc.)
Flash lamps	–	–	✓	–	–	- Metal (welded seams corrosion, etc.) - Composite materials (dispondings, delaminations, etc.)
Ultrasound	✓	✓	–	✓	–	- Detection of cracks and delaminations
Laser	✓	✓	✓	✓	–	- Inspections where high-precision energy excitation is required (e.g. For small components)
Eddy current	✓	✓	–	✓	–	- Metal (cracks, etc.)
Mechanical excitation	–	–	–	–	✓	- Thermal stress analysis (TSA)

✓ = applicable – = unapplicable

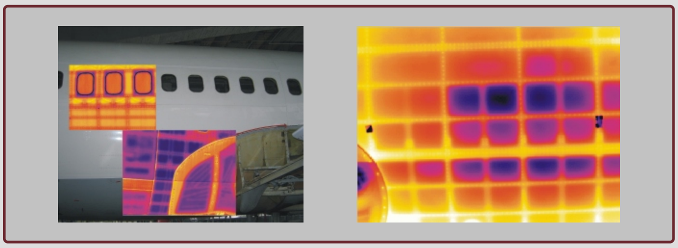
Solutions for Specific NDT Applications



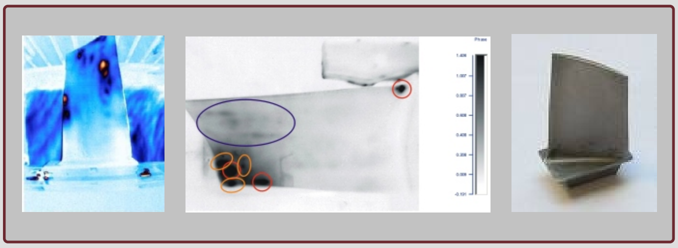
SolarCheck
SolarCheck was designed for the quality assurance of solar cells. The system serves for the detection of shunts and/or micro cracks, as well as for determination of the life expectancy of charge-carriers. SolarCheck supports the inspection techniques ILIT, DLIT, photo- and electro-luminescence.



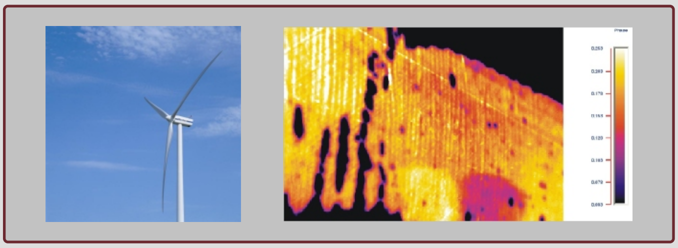
DashboardCheck
DashboardCheck is a system solution for the quality assurance of dashboards and other foamed parts. The system is ideal for contact-free detection of air cavities and other manufacturing defects within the foam material. The DashboardCheck system is available in the Online and Offline versions.



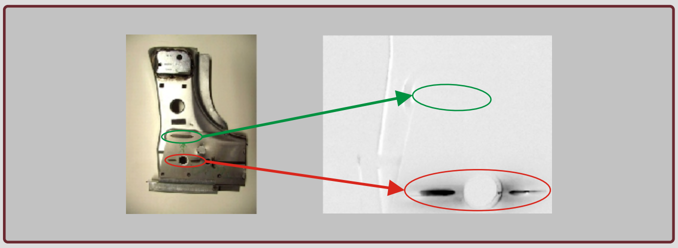
JetCheck
The JetCheck system was designed for the quality assurance of aircrafts. Its main advantage is that it can cover large areas per measurement, making it ideal for the inspection of an airplanes' hull, wings, rudders, etc. The system can be used for the detection of delaminations, disbondings, water inclusions, previous repair works, among others.



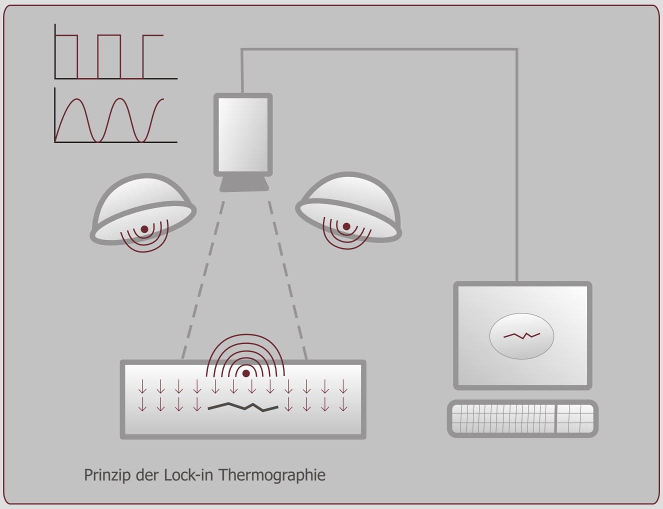
CrackCheck
CrackCheck is a solution for crack detection using ultrasound energy as excitation. It applies the methods of lock-in and pulse thermography for its analysis and can help detect even small defects within the material independently of their geometrical orientation. It is an ideal system for quality assurance after repair works.



CompositeCheck
The NDT solution for the quality assurance of composite materials such as Carbon Reinforced Plastic (CRP) and Glass Reinforced Plastic (GRP), among others. The system can be acquired in its compact presentation to serve as a mobile inspection system, ideal for the detection of disbondings, delaminations, etc.

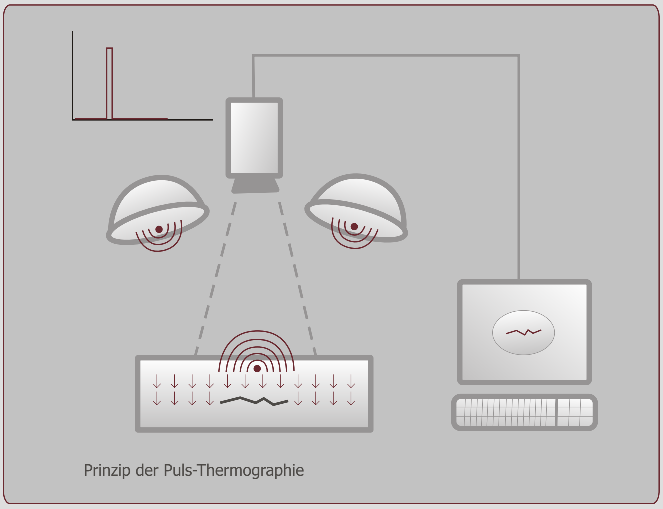


WeldCheck
WeldCheck is a system solution for the non-destructive inspection of welded joints. It's very short inspection times (<1 Sec.), and the fact that the measurements are performed free of contact makes this system ideal for its integration into production lines for online quality inspection.



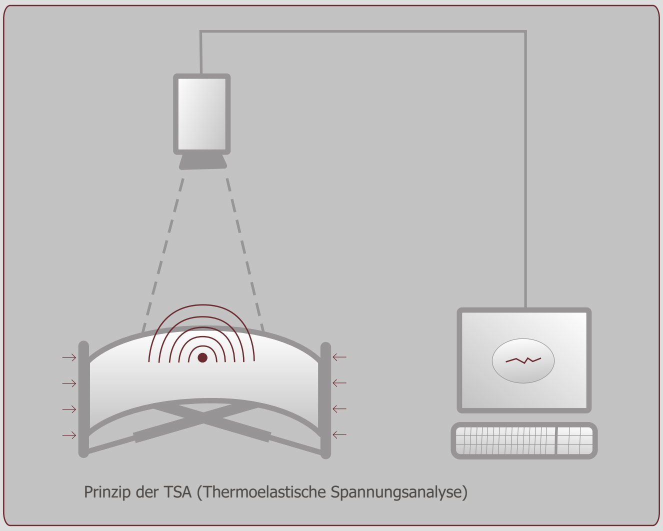
Lock-in thermography

The principle of the lock-in thermography is based on creating a thermal wave on the surface of a object and analyze its' penetration into the material. As the thermal wave penetrates into the object, if it reaches a defect (e.g. at delaminations or inclusions), it gets partly reflected. The reflected part interferes with the wave entering at the surface, whereby an interference pattern in the local surface temperature and thus in the surface radiation is caused. The mathematical analysis of this pattern will provide us information about the internal structure of test object.



Pulse thermography

The principle of pulse thermography is the stimulation of the surface by a signal of heat which uniformly penetrates into the material. If the thermal front should reach an area with a defect, it gets blocked, causing an increase of temperature in the object's surface. If this thermal behavior is recorded by an infrared camera, and a mathematical analysis is applied to the acquired date, then we can obtain depth-resolved information about the structure of the material. This technique works very good for large-areas scans, and requires in general shorter inspection times (when compared to the lock-in technique).



TSA

The thermo-elastic effect generates changes in the temperature of an object when stressed mechanically. The Thermal Stress Analysis (TSA) uses this effect, recording and evaluating these slight changes in the temperature. The resulting images show the different levels of tension in different colors, making it very easy to determine the areas that suffer more mechanical stress. This is therefore a great method for studying material fatigue and for optimizing the design of the new components and parts.

IrNDT -
Technical Specifications

Infrared cameras	
Supported cameras	- FLIR Systems SC-Series (SC7000, SC6000, SC5000, SC4000, SC3000, SC2000, SC325, SC305, SC660, SC620, SC325, SC305), - FLIR Systems A-Series (A615, A315,A310, A300) - IRSmartEye640, IRSmartEye320 - Omega, Phoenix, Merlin, Agema900, CEDIP, etc.
Camera interfaces	Gigabit Ethernet, Firewire (IEEE1394), IRFlashLink
PC	
PC types	Industry PCs, Laptops (for mobile systems)
Supported operating systems	Windows 7, Vista, XP, W2000, NT4
Excitation sources	
Light (Halogen lamps, Infrared emitter)	1kW - 33kW
Flash lamps	6kJ - 24kJ
Ultrasound	Adjustment of frequency from 15 kHz to 25 kHz, Adjustment of amplitude from 0 to 100%
Laser	High-precision laser with 400µm fiber optic interface, Power 32W, wave length 808nm
Eddy current	DC (max. power 3,0kW), output frequency control: 8 - 30kHz
Mechanical excitation	
Software	
→ Evaluation modules for lock-in, lock-in online, pulse/transient, TSA, photovoltaic cell inspection	
→ Graphical user interface to enable the easy creation of customer specific solutions without programming skills	
→ Integrated report generator for easy set-up of inspection reports, export of inspection data to MatLab, storing of inspection parameters in workspaces and storing of result images including its measuring parameters	
→ Integrated script-engine for the creation of Macros for solving complex inspection processes	
→ Integrated COM/DCOM automation interface for control and data exchange	
Measuring and Analysis properties	
Parameters for the excitation source	→ Analysis functions: pulse, sinus, trapezium, rectangle, user defined function → Rectangle width at rectangle modulation: 0,1% - 99,9% → Excitation frequency: 1µHz -50 kHz
Parameters for the IR camera (depending on camera type)	Recording frequency, integration time, temperature range, average temperature, detector window, etc.
Parameters for the analysis	→ Analysis methods: Several Methods for analysis of lock-in, pulse and transient thermography → Special functions for the inspection of photovoltaic cells (analysis module SolarCheck) → Special functions for thermal stress analysis (analysis module TSA) → Automatic noise reduction functions and compensation of exterior interferences in all analysis modules
Administration of properties	→ Saving of all properties in workspaces

Automation Technology
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Automation Technology GmbH
Hermann-Bössow-Straße 6-8
D-23843 Bad Oldesloe

Telefon: +49-(0) 45 31 / 88011-0
Telefax: +49-(0) 45 31 / 88011-20
E-Mail: info@automationtechnology.de
Internet: www.automationtechnology.de

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