

Infra Red Digital Imaging in Medicine

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Infra Red Digital Imaging in Medicine

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Abstract

Background: The incidence of Breast Cancer is increasing. Breast thermography is a 15 minute non invasive test of physiology. It is a valuable procedure for alerting your doctor to changes that can indicate early stage breast disease. Abnormally reproducing cells demand greater nutrition through increased blood supply, thus generating higher concentrations of heat in specific areas.

Objectives: Thermography's role in breast cancer and other breast disorders is to help in early detection and monitoring of abnormal physiology and the establishment of risk factors for the development or existence of cancer. When used with other procedures the best possible evaluation of breast health is made.

Methods: The study analyses evidence for the existence of patients in 9 healthy volunteers (mean age \pm SD 38.7 ± 3.7 years; range 35 – 45 years). Two infrared cameras at different wavelength ranges were used for thermographic control. In addition to thermography, temperature and microcirculatory parameters were registered at a selected point using laser-Doppler flowmetry. Patients are very carefully chosen. Also the angles of standing of camera according to patient's body and the way of its programming are always submitted to deeper analysis before taking down of images. [1]

Results: Thermography can detect the subtle physiologic changes that accompany breast pathology, whether it is cancer, fibrocystic disease, an infection or a vascular disease. Your doctor can then plan accordingly and lay out a careful program to further diagnose and /or MONITOR you during and after any treatment.

Conclusion: Thermography is a non invasive test. In fact, there is no contact with the body of any kind, no radiation and the procedure is painless. Infra red imaging can only produce reliable and valid results if the technique follows established standards.

In medical applications these standards are based on the physics of heat radiation and the physiology of thermoregulation of the human body. This paper describes the requirements for the location, setting up the equipment and the preparation of the human subject to be investigated. A list of references is given to support each part of the recommended procedure. Despite the fact that thermal imaging has been available for many years, there are still some applications of this technique which require more research. Infrared thermography helps to detect and contain the spreading of bird flu and other viral diseases.

Keywords: Infra red imaging, Standards, Thermoregulation, Heat radiation, Screening

Introduction

Since when the thermometer had been found it was known that every illness changes the temperature of the body or the sick organ. According to that, is made this special camera which can register changes even to the hundredth part degree in some organ in the body. It registers infrared radiation of the body which changes with changing of temperature as a result of pathological processes of organism or illnesses. After the computer elaboration, there is the warmth „portrait” of a man on the screen with belts of higher or lower temperature which is important for diagnosis. On that way there is a possible diagnostic for early discovering of illness for which there are existing standard methods of escorting, but also diagnostic of illnesses which are existing nowadays and where the thermovision is playing the main role.

Many far-east countries such as Malesia, Hong Kong, Korea, Singaphure, Taiwan as well as Australia had introduced a bound thermovision control of the pasengers at the airports as prevention of many infective and virus illnesses. [2]

The adventages of thermovision over the classic instruments for diagnostic are:

- **Harmless method:** *there is no radiation or other harmful influence because it registers only infrared radiation of the body;*
- **Diagnosting of illness in the early begining,** *when there is still no organ changes, as there is no functional change of organs. The classic instruments can not do that;*
- **Testing all functiones and body systems** *and giving the complet image of healthy state of the organism;*
- **Can discover a huge number of different illnesses** *in the early begining;*
- **Do not require special preparations for taking down of image;**

- **On the screen the patient can see by himself his illness, and he gets all images, so called thermograms, at the end of taking down of the mentioned.** [3]

Thermovision is the scientific discipline which measures the temperature of objects without direct contact with the mentioned object (without mediating of other bodies) by using the equipment for thermovision. In this process by using the special camera you can get infrared image on which you can see the thermal energy emitted by the object that was taken down. The most important part of equipment is thermovision camera by which you can take down the temperature map of the object, or better say the temperature dividing of the object surface. The images you get with this process are called thermograms.

As a difference of transferring with conduction and convection which are behaving linear according to temperature differences, the transferring of heat with radiation depends of the third degree of temperature differences. The energy which is radiated from some surface is proportionally to the fourth degree of absolute temperature of the same surface. If you want to measure the temperature from the distance, you will need some information about that temperature. This information is consisted in physical law according which all the bodies emit the energy:

$$W = f(\epsilon, T)$$

where is:

ϵ = emissivity

T = absolute temperature K

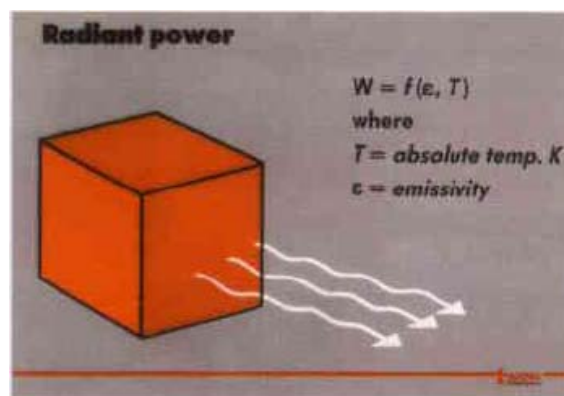


Image 1: The body radiance

The thermal radiance is, as the light, the photon phenomenon which is present in electromagnetic area. The visible light captures the part of spectrum from $0,4\mu\text{m}$ to $0,75\mu\text{m}$, infrared spectrum captures the part from $0,75\mu\text{m}$ to $1000\mu\text{m}$. The part of $20\mu\text{m}$ is the most interesting for measuring.

On the way from the body that is in radiation, to the body which receives the heat (to

the camera), in reality conditions, there is air. The part of heat will be absorbed. For shorter distances absorption can be ignored, but for longer distances, over 10m, absorption can be the source of mistake. But, in dependence from wave-length, absorption changes and according to that two "windows" exist and in that windows the absorption is ignored. The first "window" is into the interval from 3 to 5 μ m, and the other one is from 8 to 14 μ m. Most of infrared detectors are used from the "second window". (Image 2)

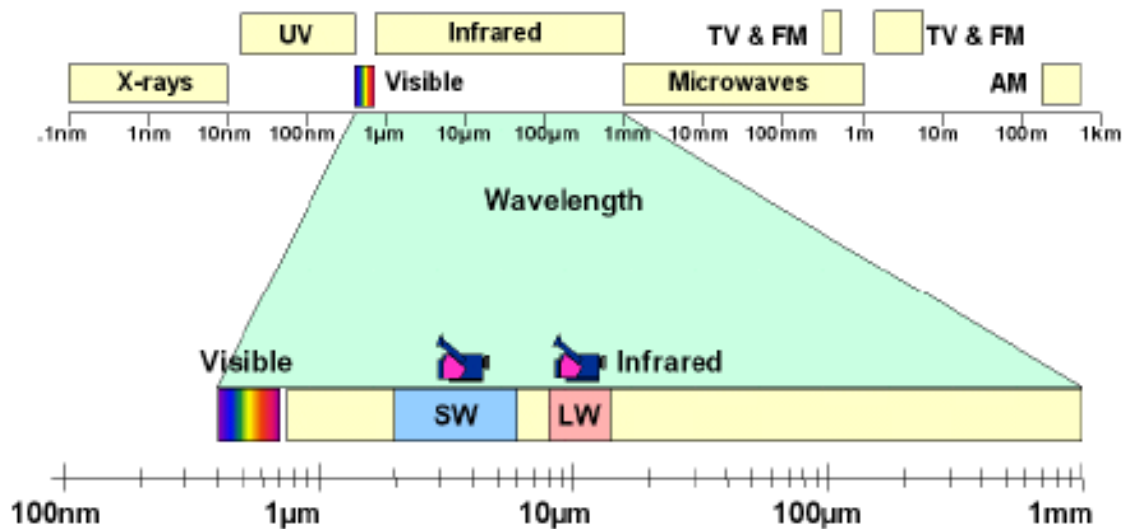


Image 2: The image of electromagnet radiance

The existing of other obstructiones as the glass or quartz can invite the need to bare in mind spectra characteristics of obstructione material in programing the camera. [4]

Equipment and Software For Thermovision

PC computers become the main part of modern healthy system. The production of digital images enable the communication by computer network on the simple way.

The thermovision camera has became the reliable and effective tool for discovering of different infectiones and temperature changings on the human organisam.

Also, the big advantage of this kind of temperature measuring is that on one thermogram the temperature dividing of the whole imaged surface is shown, and it can be very big.

Software for thermovision

After taking images with thermovision camera, they are thrown on PC computer. There is a need to install the appropriate software on computer to make this procedure possible. Generally, the software arrangement for thermovision camera will enable following functions:

- throwing of thermogram from thermovision camera to PC computer
- elaboration of thermogram
- organisation of thermogram at files
- complete analysis of thermogram
- making reports for chosen thermogram

Here is used software arrangement SnapViewPro Version 2.1. On image 3 the developing environment of this software arrangement with its basic help description is shown. [4]

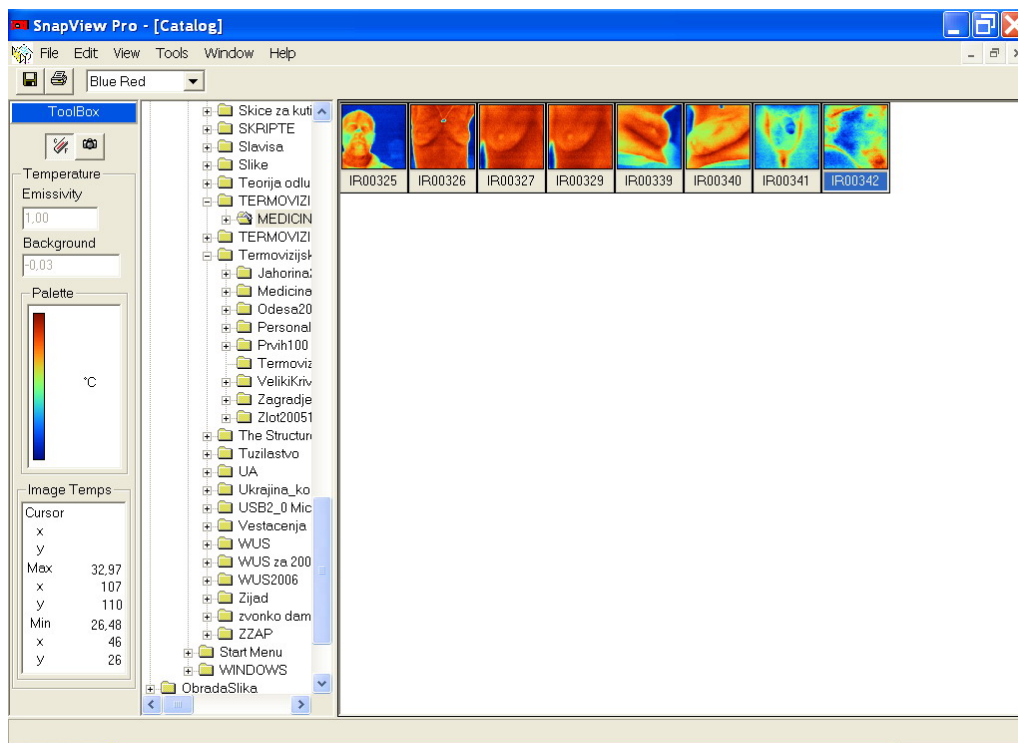


Image 3: The main menu

Every shown image of thermogram in catalogue can be magnified. In dependence of mouse position on thermogram in Image Temps you can set the temperature in that point. Also, minimal and maximal temperature of whole thermogram is shown. The connection between colours on thermogram and temperature is shown in the window Palette of software arrangement SnapViewPro, as it is shown on the image 4.

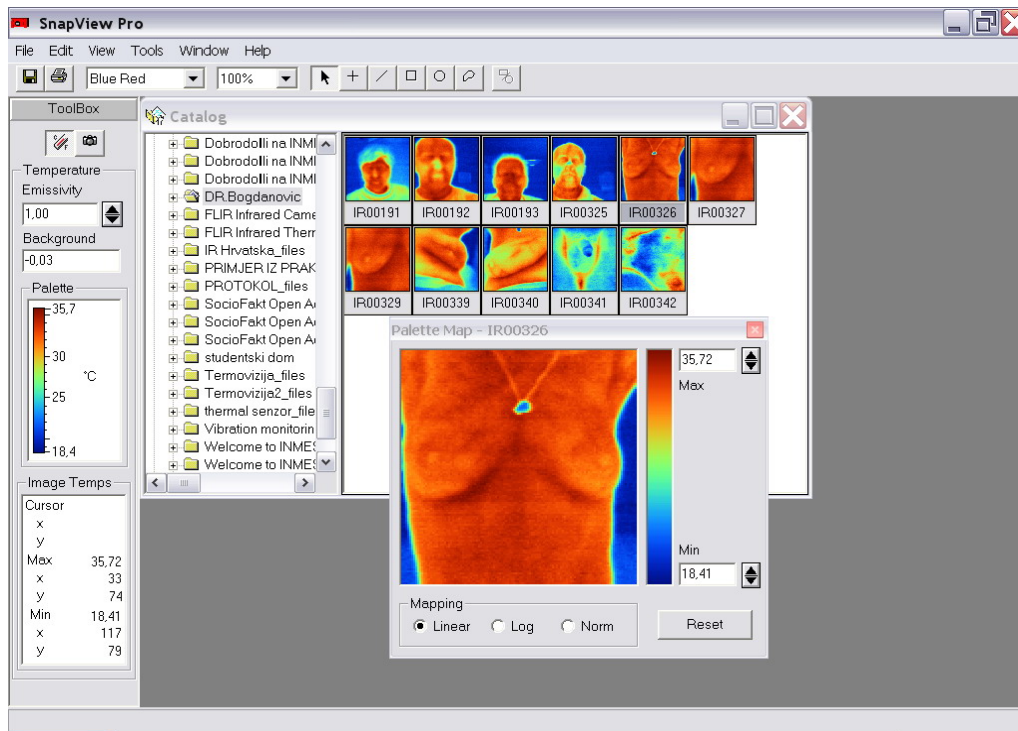


Image 4: Palette -SnapViewPro

By using of option Tool→Isotherm the window IsoTherm-Substation is shown on the screen and by moving the cursor on this screen we can get the temperature isotherm.

By choosing of option Tool→Palette map the window Palette Map – substation is shown on the screen and there it is possible to place minimal and maximal temperature of thermogram. With this analysis you can get the thermogram of set temperature interval.

By choosing of option Tool → AlarmZonerConfiguration we can get the window where we can place the temperature for some specific points, lines or areas on thermogram. When the camera detected the reaching or crossing of limitation it generates one outgoing signal or alarm message which is shown on the screen.

Using

By process of thermovision with digital ultra red thermovision camera thermograms in patient diagnostic are made and that is all using in Sanitary center Bor.

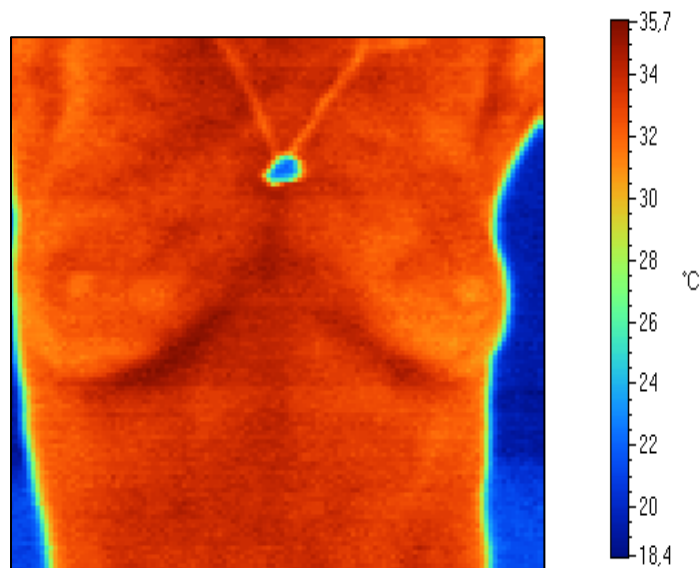
Methods

The study analyses evidence for the existence of patients in 9 healthy volunteers (mean age \pm SD 38.7 ± 3.7 years; range 35 – 45 years). Two infrared cameras at different wavelength ranges were used for thermographic control. In addition to thermography, temperature and microcirculatory parameters were registered at a selected point using laser-Doppler flowmetry. Patients are very carefully chosen. Also the angles of standing of camera according to patient's body and the way of its programming are always submitted to deeper analysis before taking down of images.

The laboratory work has followed taking the thermogram. On PC computer with installed software arangman SnapViewPro Version 2.1. you first conect digital IR thermovision camera. With this software arangman you can make transfer of thermogram from thermovision camera to PC computer. Further analisys of thermogram can be done with software arangman. In further text there are shown reports from SnapViewPro Version 2.1.[4]

Report Image 4 - IR 00326

Breasts



Info:

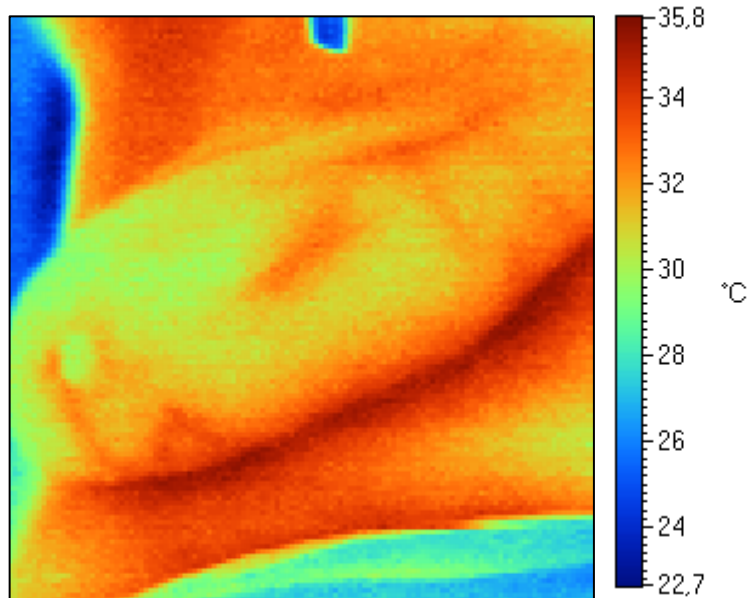
Image Path	F:\THERMOVISION\DR.BOGDANOVIC\IR00326.ISI
Image Date/Time	12 TH February 2006 15:43:30
Report Date/Time	20 TH February 2006 21:31:27
<i>Temp Unit</i>	Celsius
User	Dr. Bogdanović Gora
Location	Sanitary service Bor
Target	Breasts

Data:

Comments: Benignant changes

Report Image 5 - IR 00340

Right Breast CA



Info:

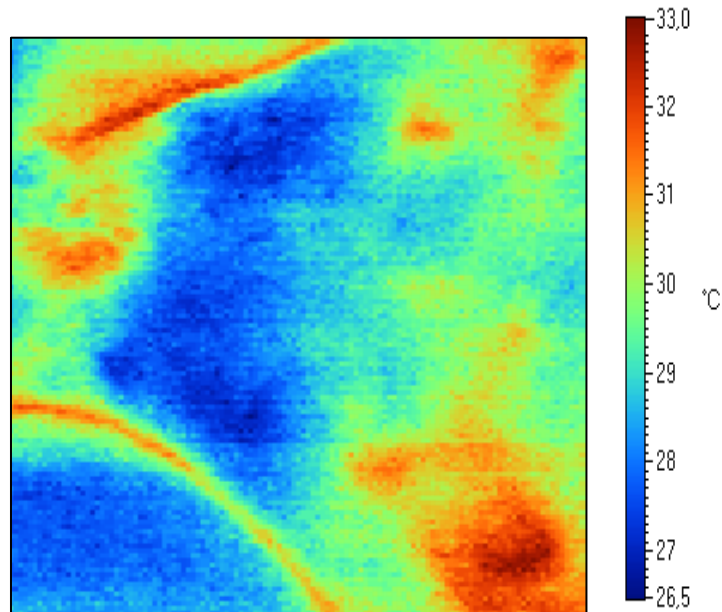
Image Path	F:\THERMOVISION\DR.BOGDANOVIC\IR00340.ISI
Image Date/Time	20 th February 2006 14:20:27
Report Date/Time	20 th February 2006 21:27:52
<i>Temp Unit</i>	Celsius
User	Dr. Bogdanović Goran
Location	Sanitary center Bor
Target	Breast

Data:

Comments:

Malignant changes

Report Image 6 - IR 00340



Info:

Image Path	F:\THERMOVISION\DR.BOGDANOVIC\IR00326.ISI
Image Date/Time	12 th februar 2006 15:43:30
Report Date/Time	20 th februar 2006 21:31:27
Temp Unit	Celsius
User	Dr. Radosavljević Vidoje
Location	Sanitary center Bor
Target	Prostate gland and kidney

Conclusion

The high thermovision technology has brought a new abilities and new challenges. With digital infrared thermovision camera Woehler IK 21 and software arrangement SnapViewPro Version 2.1, it is done taking down of temperature map (thermogram) and their analysis in Sanitary center Bor in Bor.

Here is presented only one of possible applications of thermovision process and thermovision camera, as well as software arangman in diagnostic of finding malignant changes on breast, prostate gland and kidney in their early begining.

By forming of model base – thermomap of healthy patients, patients with different degrees of illness and with their comparison with patients who are asking for help time by time there is a possibility of making software for simulation of development and attendanting of illness in different ages.

With patients who were diagnostic with traditional methods thermograph has solved for confirmation of diagnose. This researchin has shown that with mentioned method you can initiate the starting diagnose as prerequisite for other scientific researchs.

Starting from fact that infrared camera gives us IR images in real time, it's application is usefull for finding sick persones on the places with many people as bus and railway stationes, airports, hipermarkets, business centres, stadions and sport objects.

With early separation of infected persons it is possible to stop expansion of grippe infection and similar infectiones, such as SARS and grippe of birds.

The possibilities for using of this method with help of mentioned equipment and software or unlimited and they are going throught different areas of application.

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