



FLIR APPLICATION STORY



Erasmus MC
Universitair Medisch Centrum Rotterdam



Infrared thermography helps to measure, chart and combat pain

To be able to chart pain, to describe it precisely and in accordance with clear criteria – this is what doctors dream of and patients yearn for.

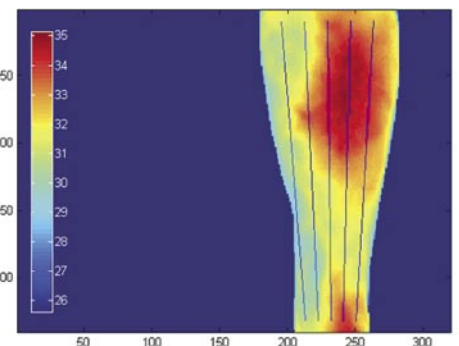
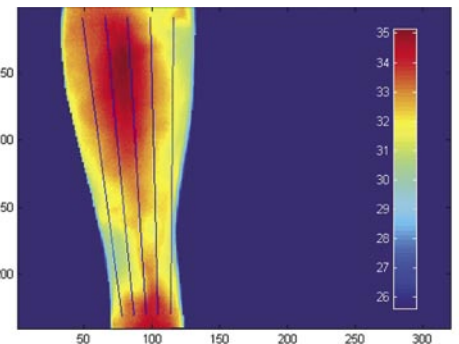
The Erasmus Medical Centre (ErasmusMC) in the Netherlands, the university hospital of Erasmus University, Rotterdam, is working on measuring pain and carrying out research on the combating of pain.

In the ErasmusMC's pain treatment centre, anaesthesiologists, neurologists, rehabilitation specialists, clinical psychologists and physiotherapists are working together. Under the leadership of anaesthesiologist Dr F.J.P.M. Huygen, they are engaged in diagnosing and treating chronic, acute and oncological pain.

In this multidisciplinary environment, research is also being performed into the causes, intensity and distribution of pain as a symptom – does it involve an attack on nerves, pain nerve cells that react to

disorders of blood supply? What is the relationship between pain, bodily temperature and the extent to which tissue is supplied with blood?

An FLIR Systems infrared camera is used as a measuring tool to help answer these questions. "Thanks to the skin's high level emissivity, the human body is an object that rewards investigation using an infrared camera.", says Sjoerd Niehof, clinical physicist and user of the FLIR Systems infrared camera. "It can produce an image of the blood supply to the limbs, up to and including the influence of capillaries." The camera in the pain treatment centre, a FLIR Systems SC 2000, detects variations in temperature of less than 0.08°C."



Pain zones in left and right lower leg. Added meridians help to localize the pain zones exactly.



Complex Regional Pain Syndrome

One project in which the FLIR Systems camera is being used as an objective measuring tool, is research into the Complex Regional Pain Syndrome (CRPS). A syndrome that resembles an inflammatory reaction and develops following a (minor) traumatic event, such as an injury, fracture, trauma or operation. This syndrome is accompanied by, among other things, demonstrable changes in the blood supply to the skin, resulting in an altered skin temperature and characteristics such as oedema, reduced mobility and ongoing pain.

A qualitative measurement of the pain can be effected by means of a combination of questionnaires, thermography and other methods of measurement. But can thermography also help to establish the quantitative intensity of the pain? In other words, is there a connection between quantitative changes in skin temperature and the intensity of the pain syndrome in these patients?

Can thermography measure pain?

The research team, led by project manager Dr Freek J. Zijlstra, set up an experiment. They compared the temperature of the hands of CRPS patients and healthy volunteers at different environmental temperatures.

A few basic data are first recorded, and then volunteers and pain patients are asked to place their left and right hands on a metal sheet. The FLIR Systems



Measuring the temperature of the hand of a CRPS patient with a ThermoCAM.

ThermaCAM SC2000, a highly sensitive infrared camera, is put in a fixed position and aimed at the hand, while a laser Doppler flow instrument uses a laser beam to measure the rate of the blood platelets from a distance. The sheet on which the hand rests, is cooled to approximately $+7^{\circ}\text{C}$.

Meanwhile, the infrared camera records successive images of the hands at 5-second intervals. On the basis of these images and of the radiometric data (temperature levels), with the aid of specialised software, mathematical asymmetric coefficients are calculated to measure the intensity, the reciprocity between heat and pain.

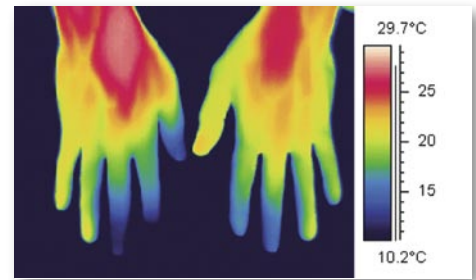
"You obtain an outstanding indication by the colour variations in the infrared image", says Sjoerd Niehof, "but to obtain a more detailed analysis of the images, you need investigative software, that can process and analyse the underlying temperature levels."

Anaesthesia, a new field of application for IR in the world of medicine?

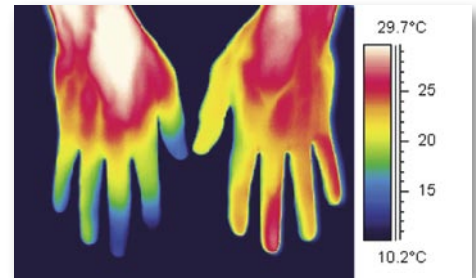
The multidisciplinary approach adopted by the pain treatment centre in Rotterdam opens up possibilities for experimenting with new fields of application for thermography. And this approach also ensures sensational results.

An infrared camera proves to be capable of visualising the effectiveness of local anaesthesia of a limb and of monitoring it over time². Of course, a great deal of research is still needed in order to develop the necessary parameters and systems. But it is conceivable that infrared cameras could develop into a vitally important anaesthetic instrument that could be used to make the effectiveness of local anaesthesia more predictable than is the case with the current pinprick and ice pack method. Localisation and monitoring of a local regional blockade would then help to ensure more precise dosing of the anaesthetic, which would lead to a significant reduction in the time involved and possibly to a reduction in the risk for the patient to be operated on.

"The camera is particularly sensitive, objective, reproducible and reliable", says Dr Zijlstra, research coordinator in the Anaesthesiology Department. Dr Zijlstra still remembers infrared images



Cold CRPS (no complaints, no stress).



warm CRPS in left hand: (complaints, warm induced stress).

from earlier research at the end of the 1980s, when an infrared camera still took up a large part of the research area.³ "And", he adds, "cameras of this kind, with advanced hand-held systems now coming on stream, entice us into exploring new areas of research."

1. Huygen, F.J., Niehof S., Klein J. and Zijlstra F.J., 2004. Computer-assisted skin videothermography is a highly sensitive quality tool in the diagnosis and monitoring of complex regional pain syndrome type I. *Eur J Appl Physiol*, 91: 516-24.
2. Galvin E., Niehof S., Medina H., Zijlstra F., van Bommel J., Klein J., Verbrugge S.J., 2005. Thermographic temperature measurement compared to pinprick and cold sensation in predicting the effectiveness of regional blockades. *Anesthesia & Analgesia*. In print.
3. Michiels, J.J. and F.J. Zijlstra, 1992. Prostaglandin cyclooxygenase products but not thromboxane A2 are involved in the pathogenesis of erythromelalgia in thrombocythaemia. *Mediators Inflamm.*, 2: 385-389.



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