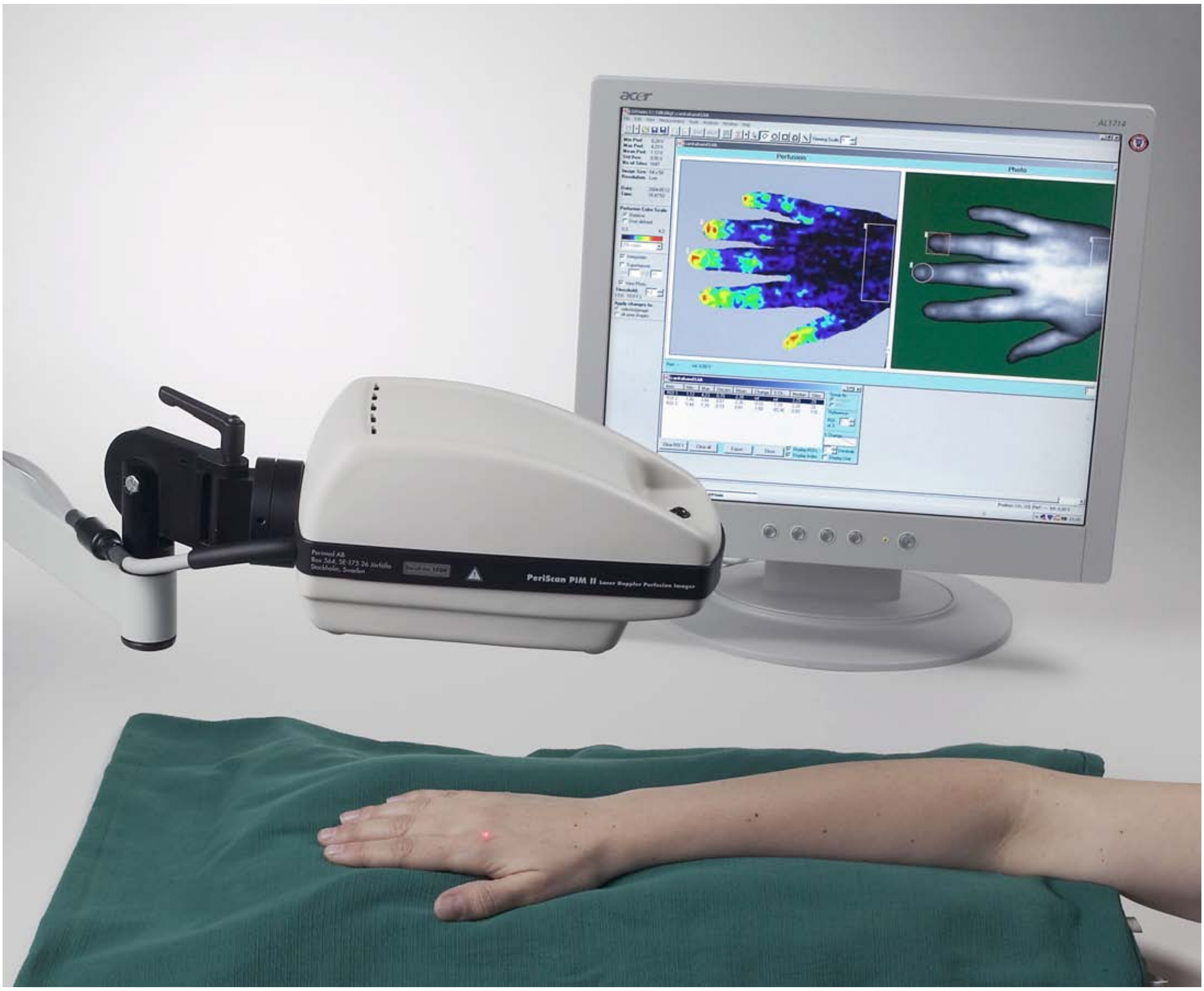
Blood Perfusion Imager

PeriScan visualizes tissue blood perfusion in a wide variety of applications.



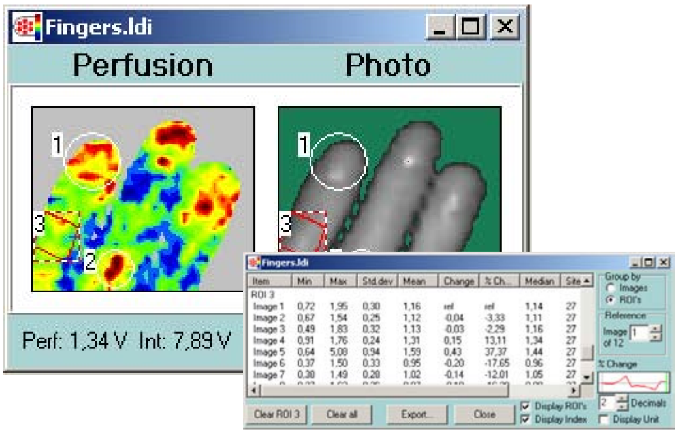
The PeriScan System

The PeriScan System is a Laser Doppler Perfusion Imaging system for non-invasive imaging of superficial tissue blood perfusion. The technique can be used to monitor microcirculatory activity in healthy and diseased tissue, and show responses resulting from an applied physiological stimulus, a “provocation”.

Based on the well-known Doppler principle, two-dimensional maps (*imaging mode*) or time traces (*monitoring mode*) of the tissue blood perfusion can easily be created. Easy-to-use image analysis software (*LDPIwin*) assists in the evaluation of the results and in report generation.

Since no physical contact with the tissue is necessary, and no dyes or tracer elements are used, the influence on the perfusion can be kept to a minimum. These features also imply that repeated clinical investigations of e.g. healing wounds and leg ulcers can be performed without the additional risk of contamination, infection or discomfort to the patient.

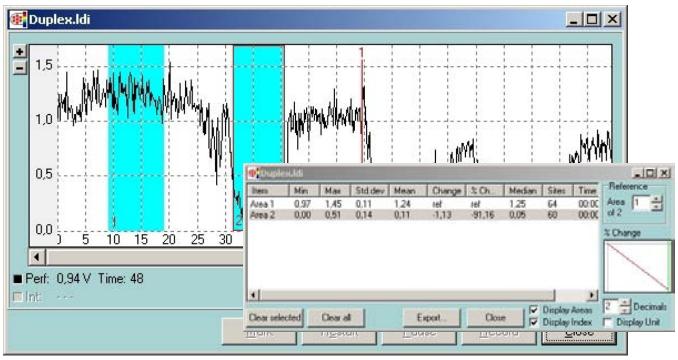
Imaging mode



Two-dimensional map of tissue blood perfusion in the hand, with data table from regions of interest.

A color-coded image of the spatial distribution of the tissue perfusion is created in the imaging mode. Repeated images of the same area can show variations and reactions over time. User specified regions of interest – special areas in the image – can be defined and evaluated with the LDPIwin software.

Monitoring mode



Spot tissue blood perfusion monitored over time.

In monitoring mode (also called duplex mode), temporal variations of the tissue blood perfusion in a single spot or up to 4x4 spots can be recorded. The LDPIwin software assists in evaluation and calculations.

LDPIwin software

The LDPIwin software runs on a PC and is used for evaluation and to control the PeriScan System. With the software it is easy to set up shape and size of the preferred measuring area. There are four different measuring modes:

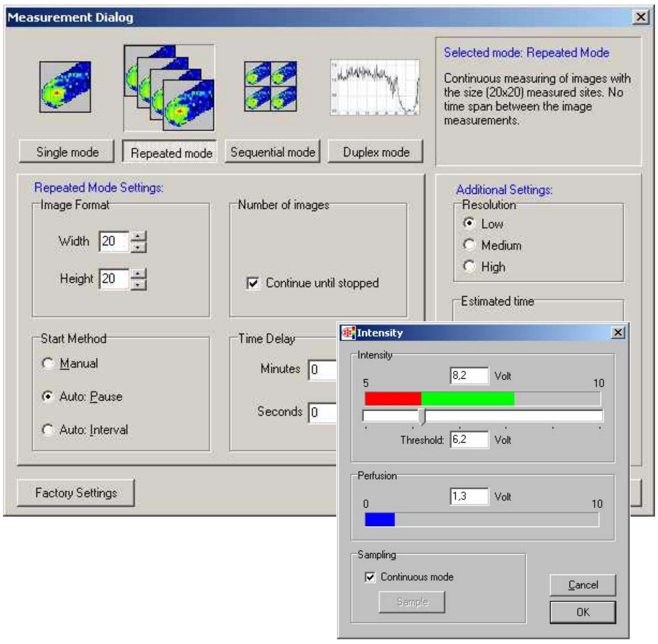
Single mode – Records one single color-coded image.

Repeated mode – Records a series of color-coded images to study the perfusion over time.

Sequential mode – Records one single color-coded image comprising up to 64 sub-images.

Duplex mode – Continuous recording of perfusion in 1-16 (4x4) measuring spots.

It is also possible to adjust the resolution. The recorded data can be evaluated easily and if desired, exported to other programs for further evaluation.



Measurement setup in LDPIwin.

Perimed AB, Box 564, SE-175 26 Järfälla, Stockholm, Sweden, Tel: +46-8-580 119 90 Fax: +46-8-580 100 28
E-mail: mail@perimed.se Websites: http://www.perimed.se and http://www.tcpo2.com Part no. 44-00049-02

Applications

The PeriScan System can be used for several different types of applications, both in clinical and in research environment.

Angiogenesis and Growth Factor

The PeriScan System has proven very useful in different research areas, such as studying the angiogenesis process in combination with growth factors. The effect of administered growth factor can be measured with the PeriScan System. A typical example of this kind of research is with ischemic hind limb on mice.

Ischemic hindlimb model on mouse

Dermatology

An important clinical and research application is with dermatology. With Skin Allergy Patch testing, the PeriScan System allows for user-independent recording of the blood flow caused by the allergic reactions.

Malignant skin tumors have higher perfusion than benign navus and basal cell carcinomas. Thus increasing malignancy is reflected by increased tumor circulation. When measuring the perfusion, there is a possibility to differentiate between various types of skin tumors. The PeriScan System is a useful tool in the research dealing with tumor growth and tumor neo-vascularization.

Diabetes

Another important clinical application is the assessment of the skin blood flow response to a provocation in diabetic patients. Already in its early stages, the diabetic disease impairs the sympathetic nervous system, which controls skin blood flow. Stimulating the microcirculation, either by a drug or cold exposure, and then measuring the vascular response with the PeriScan System allows for a quantification of the sympathetic control function.

Wound Healing

Measuring perfusion in wound healing is useful for several disciplines, such as diabetes care, surgery and geriatrics medicine. Infections and inflammation of the wound increases the perfusion. This can easily be detected with the PeriScan System. Leg ulcers and wounds can be monitored easily and without physical contact, which is a benefit regarding contamination and discomfort issues.

Burns, Plastic Surgery and Transplantations

When the skin is burned, the blood perfusion increases relatively to the severity of the burn as long as the microvascular network is intact (first- and superficial second-degree burns). When the microvascular network is destroyed, the blood perfusion is dramatically reduced and the tissue becomes necrotic (third degree burn). Superficial burns with increased perfusion and deep burns with apparent tissue necrosis are both easily classified by visual inspection. However, deep partial thickness burns can be difficult to identify visually. Measuring the blood perfusion helps to diagnose the actual severity and depth of the burn and can show if the burn will heal spontaneously (high perfusion) or if it is necrotic (low perfusion).

In plastic and reconstructive surgery – flap surgery – it is of fundamental importance that the perfusion in the flap is adequate. Using the PeriScan System, a perfusion image of the flap can be recorded at the end of the procedure to give valuable information about the microvascular condition of the flap. At this point, a simple correction of a poorly perfused flap may save it from being rejected in the post-operative phase. Measuring the perfusion in a post-operative phase can also provide information regarding possible malfunction in the blood supply to the flap.

In transplantation it is possible to monitor the performance and viability of applied artificial skin grafts with the PeriScan System.

Iontophoresis

Iontophoresis can be used to transport drugs in ionic form through intact skin. The technology is based on the principle that an electric potential will cause ions in solution to migrate according to their electrical charges. The quantity and distribution of a drug delivered by Iontophoresis are dependent on the charge of the ion, the size of the ion (molecular weight), the strength of the electrical current being applied, the duration of the current flow and numerous other factors. The drugs being administered by Iontophoresis can cause changes in the blood flow. The vascular response is then assessed by the PeriScan System.

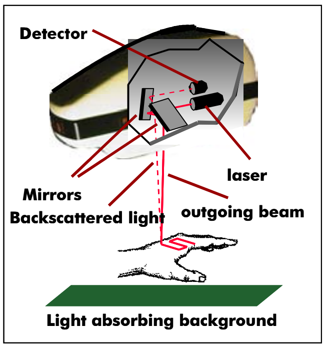
PeriIont for PeriScan

PeriIont has a disposable Drug Delivery Electrode. This minimizes the risk of spillage, drug contamination between tests and cross-infection between subjects. This design is unique and differs from the present technique of Iontophoresis which utilizes reusable electrodes. The Drug Delivery Electrode and a Dispersive Electrode are connected to the constant Current Power Supply. The PeriScan System reads the vascular response through the transparent lid of the Drug Delivery Electrode.

Perimed AB, Box 564, SE-175 26 Järfälla, Stockholm, Sweden, Tel: +46-8-580 119 90 Fax: +46-8-580 100 28
E-mail: mail@perimed.se Websites: http://www.perimed.se and http://www.tcpo2.com Part no. 44-00049-02

Technology

A low power laser beam successively scans the tissue recording up to 4096 measurement spots (64x64). In the tissue, the laser light is scattered and changes wavelength when it hits moving blood cells (Doppler shift).



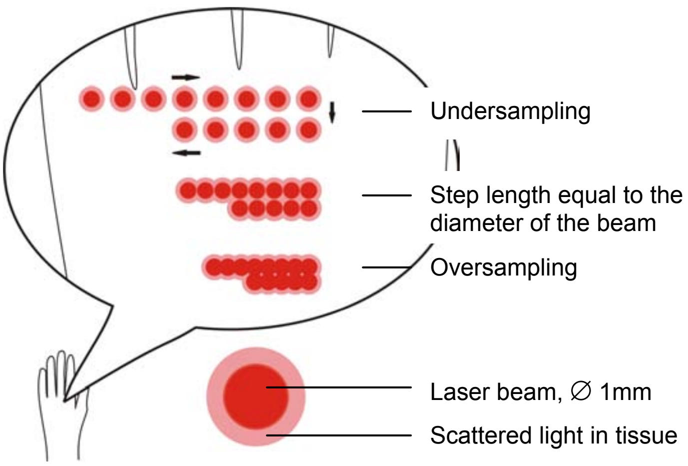
Principle of PeriScan System.

A fraction of the backscattered light is detected by a photo detector and the data is recorded and processed by software. The *Perfusion* is defined as *Concentration of Moving Blood Cells × Mean Velocity of these blood cells.* The concentration is related to the magnitude of the Doppler signal and the velocity is related to the frequency shift.

Scanning, Physiological information

The figure below shows how the laser beam moves during a typical scan. The distance between two measuring points depends on the distance between the scanner head and the measurement object, but can also be adjusted in the software. The laser beam light scatters in the tissue. This results in that a slightly larger area than that of the laser beam contributes to the measured signal.

When making a scan it is important to select the number of measuring points carefully. It is important to minimize the time that it takes to make a scan, but it is also important to have enough measuring points so that all physiological information is collected. This is best achieved if the step length is equal to the diameter of the laser beam. For step lengths smaller than the beam diameter the same physiological information is partly collected by neighboring measurements (oversampling). This takes extra time and does not add any additional information.



Laser beam movement.

Mobile carrier option

The PeriScan System can be mounted on a mobile carrier to allow measurement in preferred room if patient movement is not an option. Chassis runners allow the scanner head and adjustable arm to be positioned at an operating height from 35 – 115 cm.

PeriScan System on a Mobile Carrier.

Technical Specifications

Type (protection against electric shock):	Class I Equipment, Type B
Laser:	EN 60825-1 Class 2 Wavelength: 670 nm Max output power: 1 mW Beam diameter: 1mm
Mains:	100 – 240 VAC, 50 – 60 Hz
Current:	90 mA (240 VAC) and 220 mA (100 VAC)
Power consumption:	35 VA
Dimensions (cm) **Scanner head:** **Opto-Isolation Unit:**	 23 x 12 x 12 24 x 20 x 18
Weights (kg) **Scanner head:** **Opto-Isolation Unit:** **Arm and stand:**	 2.5 2.0 7.4
EC Declaration of conformity:	MDD 93/42/EEC
Transport and storage conditions:	+10 to +50 °C at 10–90% RH
Operating conditions:	+10 to +30 °C at 30–75% RH Atmospheric pressure between 700 mbar and 1600 mbar
Computer requirements:	CPU 300 MHz or faster 128 MB RAM 50 MB free hard disk space Windows 98 or higher
Max scan area:	Approximately 30 x 30 cm, depending on distance to object
Scan depth:	Approximately 0.5-1 mm, depending on tissue properties
Scan time: (Approximate)	(10x10 spots) 9 seconds (16x16 spots) 18 seconds (32x32 spots) 1 minute (64x64 spots) 4 minutes

Perimed AB, Box 564, SE-175 26 Järfälla, Stockholm, Sweden, Tel: +46-8-580 119 90 Fax: +46-8-580 100 28
E-mail: mail@perimed.se Websites: http://www.perimed.se and http://www.tcpo2.com Part no. 44-00049-02