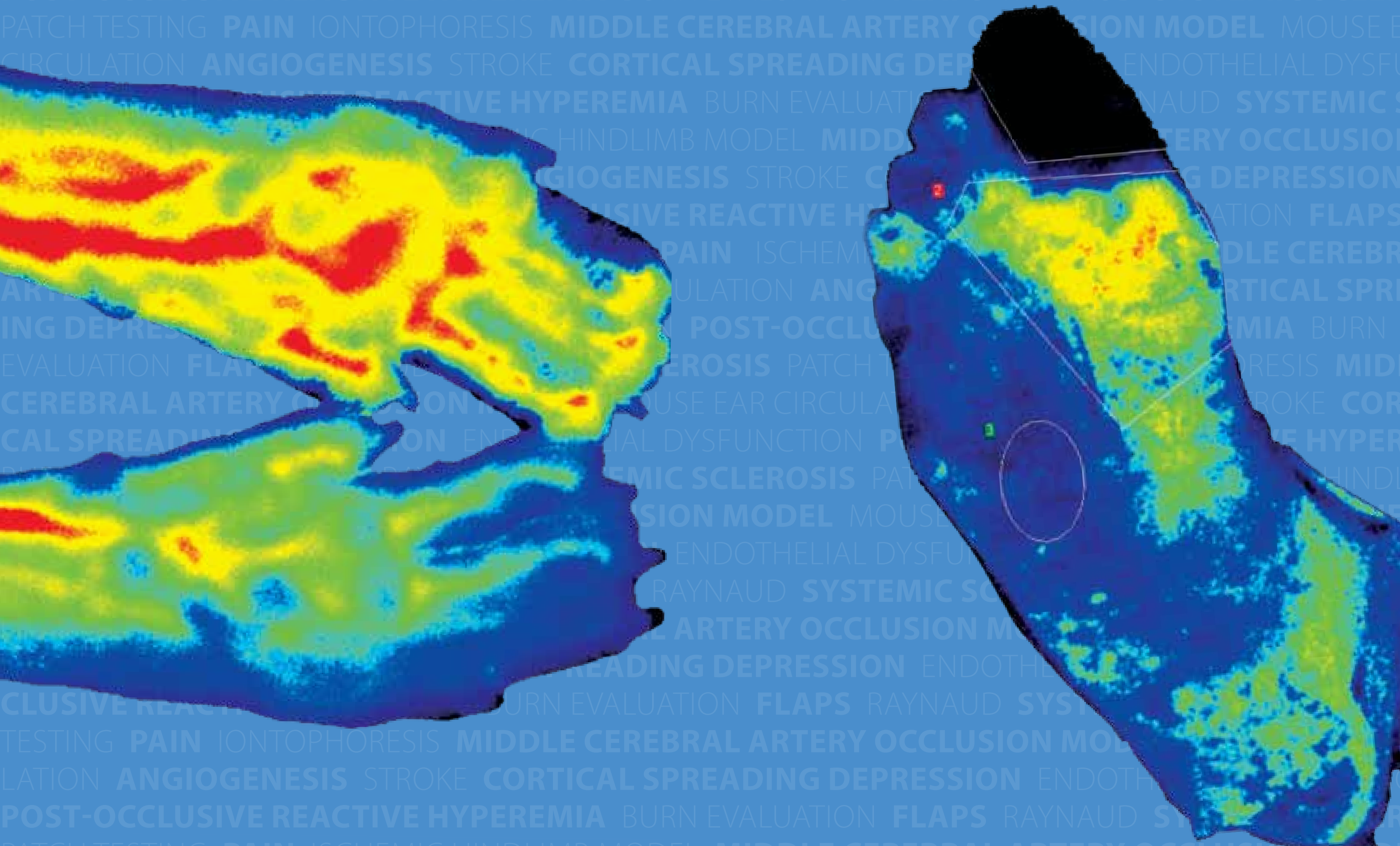
REAL-TIME MICROCIRCULATION IMAGING

PeriCam PSI System



YOUR PARTNER
IN MICROCIRCULATION

PERIMED

INTRODUCTION

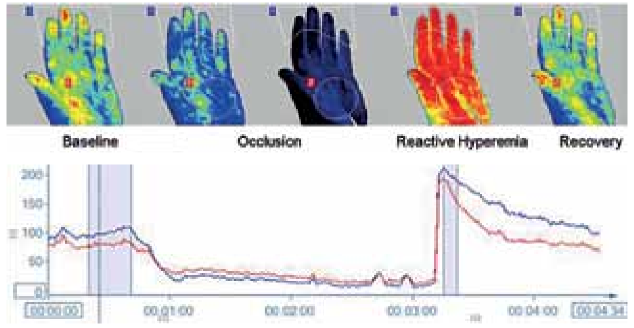
The PeriCam PSI System is a blood perfusion imager based on Laser Speckle Contrast Analysis (LASCA) technology. LASCA provides new means to study the microcirculation in ways that were not possible in the past. It allows visualization of tissue blood perfusion in real-time and combines dynamic response with spatial resolution. There is no influence on the perfusion, as no direct contact to the tissue is needed, nor dyes or tracer elements.

The PeriCam PSI System

EXAMPLES HUMAN

Endothelial dysfunction

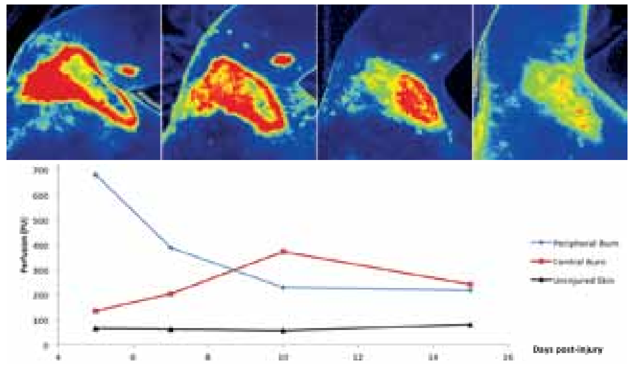
Endothelial dysfunction is one of the key events in the development of atherosclerosis and has been confirmed in patients with cardiovascular related diseases. Owing to its accessibility, the skin microcirculation is frequently used as a model to assess the general condition of the endothelium. Blood perfusion imaging with the PeriCam PSI System, in combination with iontophoresis, post-occlusive reactive hyperemia or thermal challenge, has proven to be an excellent tool for endothelial function studies.[1]



Post-occlusive reactive hyperemia in hand. PeriCam PSI NR.

Burns

Burn wounds are not always straight forward to judge clinically. Early assessment of burn depth is crucial to avoid unnecessary surgery or potential hypertrophic scarring. The PeriCam PSI System measures the status of the skin microcirculation, reflecting the burn depth. Changes in the skin blood flow over time will reveal the wound healing potential. Increased activity indicates that the microcirculation is functioning and that there is a higher degree of wound healing potential.[2]

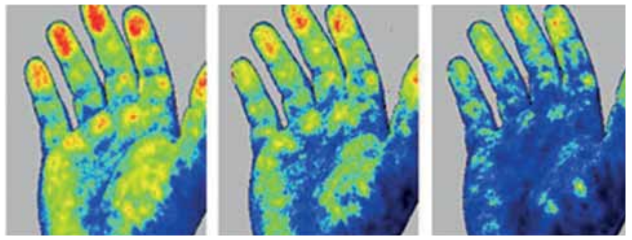


Perfusion patterns in different burn areas. Mixed second degree scald burn. Healed within 15 days with conservative treatment. PeriCam PSI NR.

Courtesy of Linköping University Hospital, Sweden

Raynaud´s phenomenon

Raynaud's phenomenon is characterized by a vasospasm in the extremities as a response to cold temperatures, for example. The PeriCam PSI System can be used to follow these vascular changes in order to understand the underlying mechanisms. It has also proven useful to distinguish between secondary and primary Raynaud, as well as differentiating between established and early disease.[3,4]

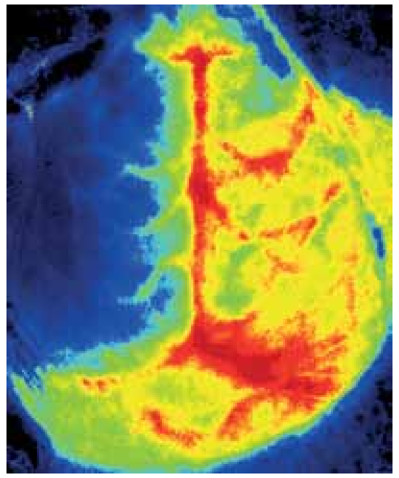


Changes in skin blood flow as a response to cold provocation. PeriCam PSI NR.

EXAMPLES ANIMALS

Middle Cerebral Artery Occlusion Model – Stroke

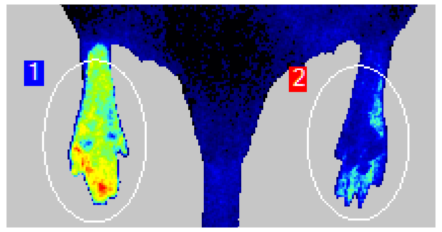
Middle Cerebral Artery Occlusion (MCAO) is a commonly used stroke model in mice and rats. A major drawback with this model is the risk of incomplete occlusion upon filament insertion. As a quality control, the cortical blood flow can be monitored to ensure that a stroke, in fact, has been induced.[5] The PeriCam PSI System provides data displaying both the dynamics and the spatial distribution of the perfusion throughout the procedure in real time. This opens up the possibility to not only confirm complete occlusion, but also to study the extent of the stroke by quantifying the affected area (mm^2).



Mouse brain during induced MCAO. PeriCam PSI HR.

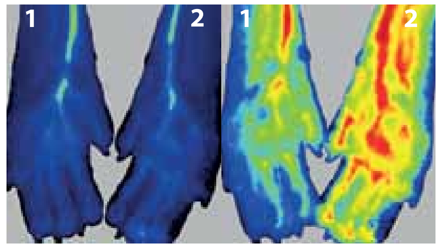
Ischemic hind limb model

The ischemic hind limb model is an animal model in which ischemia is induced by femoral artery ligation. It is often used to investigate the formation of new blood vessels during angiogenesis and arteriogenesis. In order to evaluate the model, blood perfusion imaging is commonly used. The PeriCam PSI System will not only provide high resolution images of the blood perfusion distribution in the legs, but also opens up the possibility to follow the vascular dynamics after heat exposure, for example.



Blood perfusion in mouse legs: (1) control and (2) induced femoral artery ligation. PeriCam PSI NR.

Courtesy of University of California, San Diego

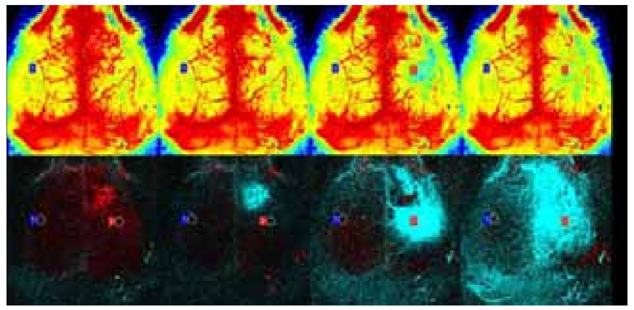


Heat-induced hyperemia in mouse foot pads one week post unilateral femoral artery ligation (ischemic leg (1), healthy leg (2)).
Baseline (left) and during hyperemia (right).
PeriCam PSI HR.

Courtesy of Uppsala University, Sweden

Cortical spreading depolarization

It is well known that cerebral blood flow is coupled to the neuronal response in the brain. Events, such as cortical spreading depolarization/depression (CSD), may therefore be characterized by studying changes in the cerebral blood flow. The PeriCam PSI System has proven useful for this purpose, as it is possible to investigate changes in high resolution and at high speed. Data evaluation is facilitated by software features, such as viewing the data as video recordings and applying different types of color scales.



Needle induced cortical spreading depression in mouse. Two different color scales: regular perfusion scale (top) and difference image mode (bottom). PeriCam PSI NR.

Courtesy of Charité, Berlin, Germany

WHAT IS LASER SPECKLE CONTRAST ANALYSIS (LASCA)?

When an object is illuminated by laser light, the backscattered light will form a random interference pattern consisting of light and dark areas. This pattern is called a speckle pattern. If the illuminated object is static, the speckle pattern is stationary. When there is movement in the object, such as red blood cells in a tissue, the speckle pattern will change over time. Depending on the degree of movement, the level of blurring will differ. The more movement, the more blurred the speckle pattern will appear. The level of blurring is quantified by the speckle contrast. By analyzing these contrast fluctuations, information about the blood perfusion in the tissue is obtained.[6,7] In the PeriCam PSI System, an advanced CCD camera will record these changes in the speckle pattern at a speed of up to 100 images per second and up to 1388 x 1038 pixels per image. The result, an instant image of the microcirculation. Blood perfusion is expressed in the arbitrary units, Perfusion Units (PU).

PeriCam PSI System:

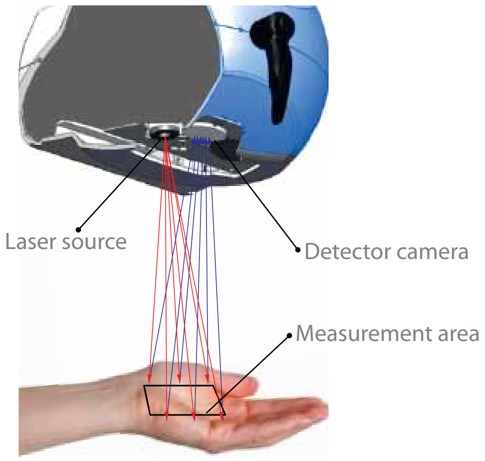
Fast	Up to 100 images per second
Detailed	10 000 pixels/cm^2 (100 µm/pixel) NR 250 000 pixels/cm^2 (20 µm/pixel) HR
Instant	Real-time processing of data
Controlled	Automatic background compensation once per second Optical and polorizing filters
Two models	PeriCam PSI NR - Larger measurement area (23.7 x 23.7 cm), robust arm, normal resolution PeriCam PSI HR - Advanced microscopic type stand for exact positioning, high resolution

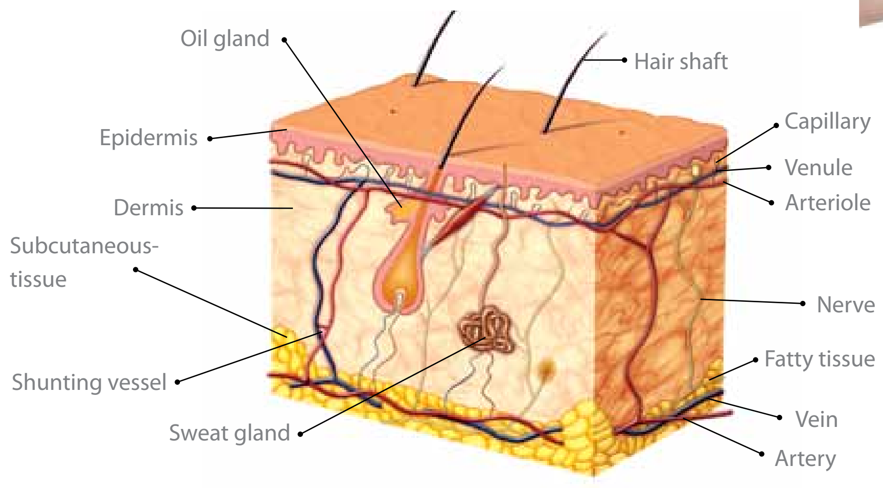
LASCA – Laser Speckle Contrast Analysis

1 A 785 nm laser illuminates the sample creating a speckle pattern.

2 The speckle pattern is recorded by a CCD camera.

3 Variations in the speckle pattern are analyzed and presented as blood perfusion images in real-time.





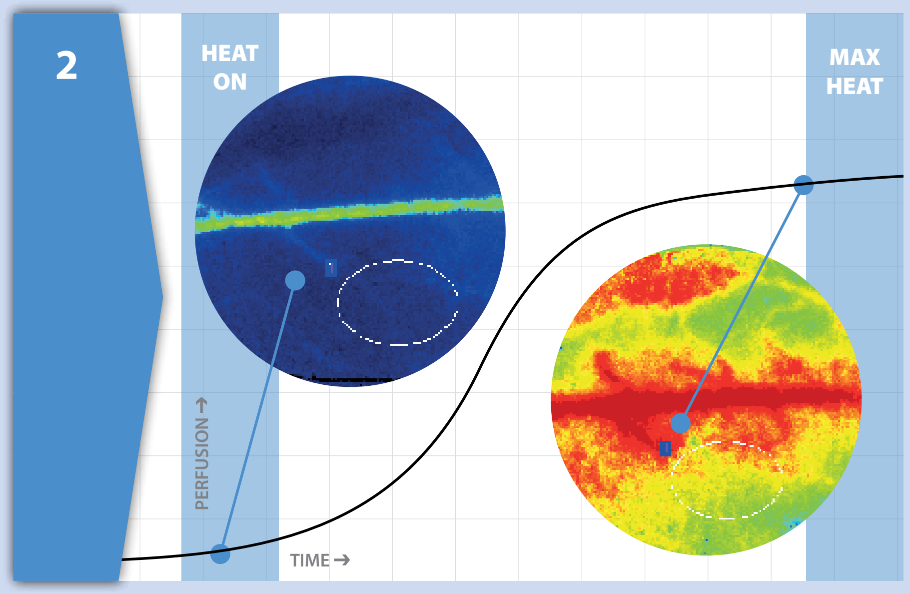
Microcirculation

The microcirculation refers to the blood flow through the smallest vessels in the circulatory system, i.e. arterioles, venules, shunts and capillaries.

SIMPLE TO GET STARTED

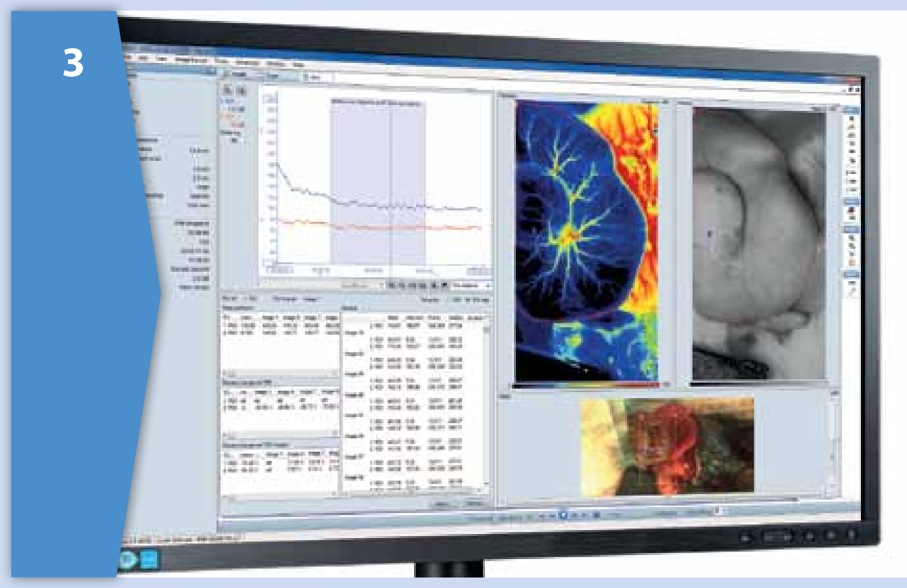
- ✓ Flexible to adjust at any angel
- ✓ Color camera for documentation
- ✓ Automatic working distance calculation
- ✓ Pre-define Regions Of Interest ROIs

ANALYZE DATA WHILE RECORDING



- ✓ Instant update of data, graphs and images
- ✓ Add/Edit ROIs during measurement
- ✓ Automatic background compensation once per second
- ✓ Stable and accurate results at varying lightning conditions

ADVANCED DATA REVIEWING



- ✓ Edit ROIs for single image, complete run or sections of a run
- ✓ Time periods Of Interest – TOIs
- ✓ Perfusion overlay feature
- ✓ View recording in playback mode at different speeds

Images, courtesy of Uppsala University, Sweden

PeriCam PSI System Specifications

Measurement Principle:	LASCA (LAser Speckle Contrast Analysis)
Image Size:	Normal Resolution model: ~5.9 x 5.9 cm – 23.7 x 23.7 cm High Resolution model: ~20 x 27 mm
Image Acquisition Rate:	50 Hz: 94, 44, 21, 16, 10, 5, 2, 1, 0.5, 0.2 images per second 60 Hz: 112.8, 52.8, 25.2, 19.2, 12, 6, 2.4, 1.2, 0.6, 0.2 images per second Automatic frequency detction
Precision:	+/- 4% (Motility Standard), +/- 3 PU (Zero Perfusion)
Accuracy:	+/- 4% (Motility Standard), +/- 3 PU (Zero Perfusion)
Image Resolution:	Maximum 1386 x 1036 measurement points Normal Resolution model: 100 µm/pixel (at 10 cm) High Resolution model: 20 µm/pixel
Scale:	0-3000 PU
Camera Resolution:	Measurement camera: 1388 x 1038 pixels Documentation camera: Color, 752 x 580 pixels, up to 1 image per second
Working Distance:	Automatic working distance calculation
Background Compensation:	Automatic background compensation once per second
Lighting Conditions:	Normal, ambient room lighting
Laser Specifications:	Measurement laser: 785 nm, NR: 100 mW, HR: 80 mW Class 1 per IEC 60825-1:2007 - Safe to use without eye protection Area indicator laser: 650 nm, NR: 7 mW HR: 3 mW, Class 1 per IEC 60825-1:2007 - Safe to use without eye protection
Software:	PIMSoft, Windows based, Export options: pdf, avi, xml, binary Available in several languages
Dimensions and Weight:	Scanner head: 22 x 15 x 20 cm, ~2.4 kg

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4. Alteration of microcirculation is a hallmark of very early SSc patients: a laser speckle contrast analysis Della Rossa A, Cazzato M, d'Ascanio A, Tavoni A, Bencivelli W, Pepe P, Mosca M, BaldiniC, Bombardieri S., Clin Exp Rheumatol, 2012

5. Ansari, S., Azari, H., McConnell, D.J., Afzal, A., Mocco, J. Intraluminal middle cerebral artery occlusion (MCAO) model for ischemic stroke with laser Doppler flowmetry guidance in mice, Journal of visualized experiments, 2011

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7. Dynamic imaging of cerebral blood flow using laser speckle. Boas, D. A. et al. Journal of cerebral blood flow and metabolism 21(3), p. 195-201, 2001

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