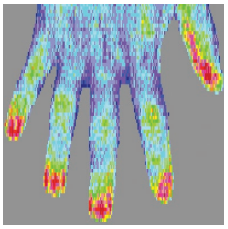
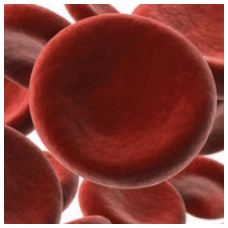
Rapid laser Doppler blood flow imaging

with moorLDLS2





moor instruments

innovation in microvascular assessment

moorLDLS2 – Laser Doppler Line Scanning

The first laser Doppler imager available using a unique line scanning optical design.

- **Non Contact** images are obtained by scanning a low power laser line across the tissue.
- **Unique Patented Line Scanning Optics** enables rapid imaging and 64 channel real time monitoring.
- **Colour Digital Camera** eases scan set-up and provides photographs of the scan region.
- **Daylight Operation;** unique optical design enables operation even in high ambient room lighting.
- **Repeat Image Mode;** evolving responses can be imaged and quantified with automatic analysis functions.
- **Compact lightweight** design increases mobility and convenience.
- **Advanced** measurement software including:
  - Single Image
  - Repeat Image
  - Line Sampling Image
  - 64 Channel Single Point Monitoring
- **Highly developed** post scan analytical software.

The system is ideally suited to any application where the dynamic changes are too rapid to be captured by conventional single beam laser Doppler imaging. This enables time/cost savings to be made and excels when it is necessary in a clinical/surgical environment to minimise scan time. Imaging times are very quick e.g. 64 x 64 pixels in just 4 seconds.

moorLDLS2 with desktop stand/arm and PC

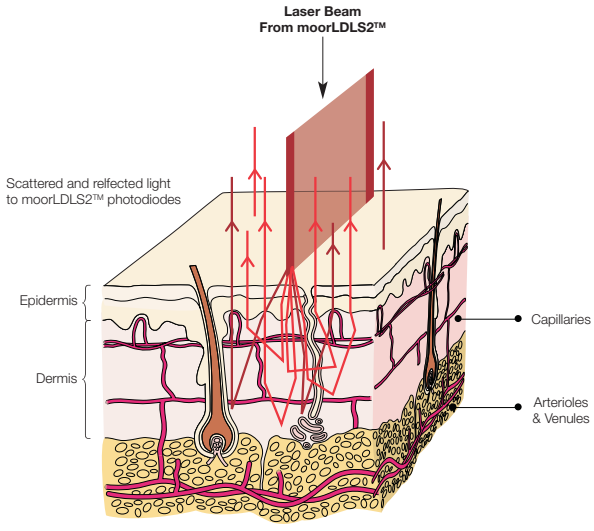
The Laser Doppler Technique

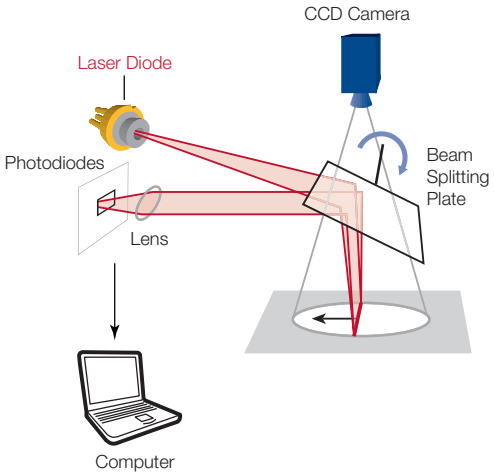
The moorLDLS2 laser Doppler imager scans a laser line over skin or other tissue surfaces enabling rapid imaging in comparison with single collimated beam imagers (Ref.1).

Moving blood in the microvasculature causes a Doppler shift of the scattered laser light, which is photodetected by a 64 element linear array and then processed to build a colour coded map of blood flow.

A digital camera records a colour photograph at the same time, corresponding closely with the blood flow image in size and aspect.

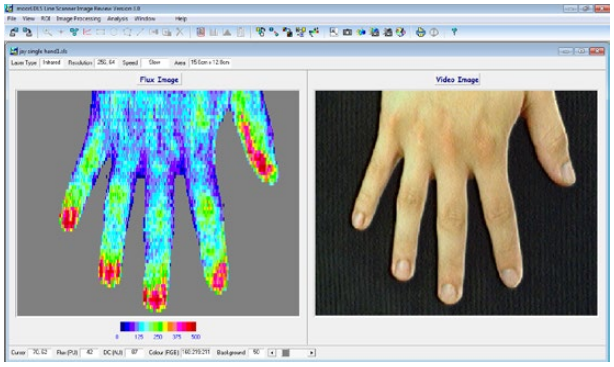
The measurement is non-contact and can quantify differences in flow within a single image or image repetitively to assess evolving flow patterns over time..





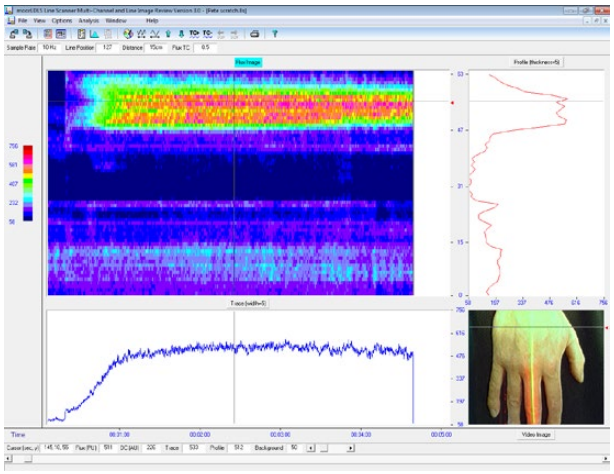
moorLDLS2 Software Features

Single Image Mode



The software offers flexible set-up for image size and resolution (and consequently scan time). Scan set-up parameters are 'remembered', if required, speeding up the whole scan process. A built in colour CCD camera aids set-up and the colour photo image is also captured and displayed alongside the blood flow image. Images can be saved in a range of formats, including high compression moorLDLS2 format, ASCII/text and JPEG and BMP. Comprehensive analysis functions include mean flow analysis (comparing flow values from up to 5 different regions), histogram and profile tools.

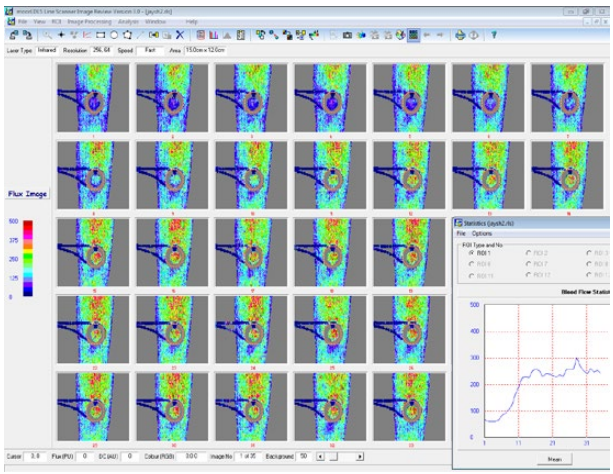
Line Scan and Single Point Mode



These modes are extremely useful to pick up very dynamic changes which may be 'missed' by imaging. In line scanning mode (example above) the laser line is stationary and blood flow changes along that line are continuously assessed. Subsequent samples build up to form a dynamic pattern of changes. Profiles and single point analysis is also displayed. Single Point Mode (not illustrated) acts effectively as a 64 channel laser Doppler monitor, with each pixel across the line plotted graphically. Flexible analysis functions enable dynamic responses to be quantified.

Repeat Scan Mode

Whilst Single Image mode is useful to compare flow differences within one image, Repeat Image Mode is useful to capture dynamic change – such as the flow responses to drugs, heating, pressure, posture etc.



In the example above an area of skin is heated using the moorVMS-HEAT heater system and unique, clear heater probe (VHP3). This probe provides an unobstructed view of the skin, enabling flow at the heated site and surrounding areas to be assessed directly. Regions of interest can be defined easily and the mean flow tabulated or graphed (see inset above – illustrating the increase in flow due to heating).

Iontophoresis Protocol

Weak electrical currents are used to induce drugs to pass through the epidermal barrier into the skin. The moorLDLS2 iontophoresis protocols are used to assess the effect of vasoactive drugs on skin blood flow. Using moorLDLS2 Repeat Scan mode iontophoresis is applied for a number of Repeat Scan Intervals and blood flow responses within transparent ion chambers are imaged. For faster dynamics (10Hz) multi-channel or line-scan protocols can be used. The moorLDLS2 PC software is used to easily set-up, run and automatically analyse protocol scans.

About Moor Instruments

Optional MS3 Mobile Stand with touchscreen panel PC

Moor Instruments, established in 1987, is a world leader in the design and manufacture of laser Doppler systems, used for the monitoring and imaging of blood flow in the microvasculature.

First hand experience of laser Doppler research and development within Moor dates back to 1978 and with this we have the breadth of knowledge to help with your application and the enthusiasm to help with answers to any of your questions.

By giving priority to performance, quality and service we strive to be our customers' number one choice.

Our dedicated design team are involved with a number of development projects for other partners and manufacturers. Whatever your needs, as a researcher, clinician or manufacturer, Moor will work harder for you.

Specifications:

Quality Control
Moor Instruments is certified to ISO 13485:2016.
The moorLDLS2 is CE marked as a medical device.

Laser Source
Near Infra-red laser diode: 785nm.
Maximum Output power: 2.5mW.
Laser Line Divergence: 20º.
Class 3R per IEC 60825-1:2014.

Colour CCD Camera
1024 x 768 pixel resolution, 15 fps.

Bandwidth
Lower cut-off frequency (3dB): 30Hz.
Upper cut-off frequency (3dB): 15KHz.

Range and Scan Area
11cm (W) x 10cm (H) at 10cm distance.
15cm (W) x 12cm (H) at 15cm distance.
20cm (W) x 15cm (H) at 20cm distance.

Scan Speed
Three scan speed options.
Typical scanning time for a 15cm x 12cm image at 15cm distance.

Scan Speed	Image (64 x 64)	Image (256 x 64)
Fast	4 Seconds	13 Seconds
Medium	5 Seconds	16 Seconds
Slow	6 Seconds	20 Seconds

Spatial Resolution
Up to 256 x 64 pixels (actual measurements not by interpolation).

Lighting Conditions
Normal, ambient room lighting.

Software
Windows™ based control, processing and analysis.

Hardware Options
There are two supports available for the moorLDLS2 which include the MS3b (pictured above) and desktop stand. PC packages normally supplied by Moor Instruments or by authorised distributors.
Options include:

1. Touchscreen panel PC kit, with mobile stand mounting, miniature keyboard and colour printer (pictured above).
2. Desktop PC with colour printer.

Minimum Computer Requirements
Pentium™ 500MHz or higher compatible CPU.
128MB RAM.
CD-ROM drive.
Super VGA monitor (800 x 600 resolution or higher).
40GB of available hard disk space.
Windows™ XP, Windows™ 2000 or higher.
1 USB port and 1 Firewire (IEEE1394) port.

General
Universal voltage switch mode power supply
Range 100 to 230V AC 50 to 60Hz, 50VA
Scan Head Dimensions: W H D mm 300 x 200 x 190 (max), Weight 3.2Kgs
Operating Temperature: 15-30ºC
Storage Temperature: 0-45ºC

Patents:

Europe Patent No: EP0904011
UK Patent No: GB2330719
USA Patent No: US6263227
Germany Patent No: DE69727220T

Moor Instruments reserves the right to change specifications without notice.

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