

Laser Doppler Flowmetry

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February 6th, 2006

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Abstract- Laser Doppler Flowmetry is an inexpensive, non-invasive method of measuring the continuous circulation of blood flow on a microscopic level. This method of measuring the flux of red blood cells is growing in practical application.

A Laser Doppler Flowmeter (LDF) works by reading the frequency of the oscillation produced by the Doppler frequency shift of the red blood cells in a peripheral tissue and translates the frequency to an intensity oscillation.



The apparatus is composed of a low-powered laser and probe that takes readings and sends results to an analyzer. The apparatus can penetrate 1-4 mm of non-pigmented tissue. The light emitted and reflected is fed through optical fibers to the analyzer-recorder. The output of the LDF is the flux of red blood cells, defined as the number of red blood cells times their velocity, which determines circulation.

Currently the apparatus can be found in many shapes and sizes, dependent on the industry and location of where the device will be used. Below is an accurate diagram of the basic hardware setup of an LDF:

Currently the LDF is used in the areas of dermatology, facial surgery, vascular surgery, dental applications, ocular applications, transplant surgeries, cardiac surgery, pharmacology, and exercise physiology. The specific studies that have been performed all relate to detecting blood flow abnormalities in these specialties.

Some limitations of the LDF have been found

in its signal processing, processing bandwidth, motion artifact and instrument calibration, the effect of probe pressure on the skin, and the type of laser used. Usually the best results are found when using a low-powered scanning laser.

References:

Journal Articles and Reviews

1. "Microcirculation abnormalities in patients with fibromyalgia - measured by capillary microscopy and laser fluxmetry"
 - Susanne Morf, Beatrice Amann-Vesti, Adrian Forster, Ulrich K Franzek, Renate Koppensteiner, Daniel Uebelhart, and Haiko Sprott
 - Arthritis Research Therapy*, 2005, Volume 7(2), pages 209-216.
2. "Scanning laser Doppler is a useful technique to assess foot cutaneous perfusion during femoral artery cannulation"
 - Nicholas H Boyle, Peter C Roberts, Bernice Ng, Haim Berkenstadt, Angela McLuckie, Richard J Beale and Robert C Mason
 - Journal of Critical Care*, 1999, Volume 3, pages 95-100.
3. "Laser Doppler flowmetry: in the assessment of peripheral vascular disorders? A preliminary evaluation"
 - T Cochrane, S B Sheriff, A J M Boulton, J D Ward and R M Atkins
 - Clinical Physical Physiology*, 1986, Volume 7(1), pages 31-42.
4. "A critical review of laser Doppler flowmetry"
 - Obeid AN, Barnett NJ, Dougherty G, Ward G.
 - Journal of Medicine Engineering Technology*, September 1990, Volume 14(5), pages 178-81.

Online Resources:

- "Scanning Laser Doppler Flowmetry: Principles and Techniques"
- Gerhard Zinser
- Heidelberg Engineering GmbH, Heidelberg, Germany
- <http://www.heidelbergengineering.com/docs/hrf-tutorial.pdf>
- "Transonic Laser Doppler Monitor Operator's Manual"
- http://www.transonic.com/BLF_21_ManRev_B.pdf
- <http://www.transonic.com/icu.shtml>

Pictures:

- <http://www.bme.jhu.edu/courses/580.471/circuits/ldoppler.JPG>
- <http://www.transonic.com/duplicate1/BLF21.jpg>

