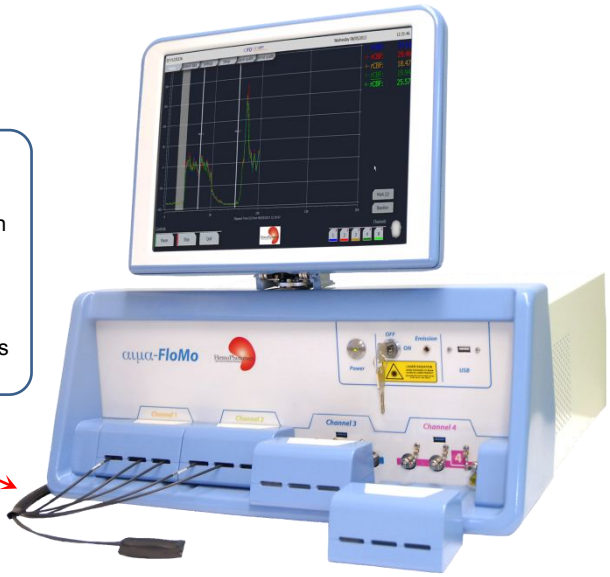
Technology Overview

The Neuro-Monitor αιμα-FloMo is based on diffuse correlation spectroscopy (DCS). It utilizes near-infrared light (785 nm, continuous-wave), a set of detectors and a physical model to directly and non-invasively measure local cerebral blood flow in the microvasculature. Since DCS is based on similar physical principles as near-infrared/diffuse optical spectroscopy (NIRS/DOS), it shares its characteristics such as deep tissue penetration (~ 1cm) and good time resolution.
The schematic figure below (top panels) shows an example application in a surgical unit where the laser light is supplied via fiber optics to the forehead and at a typical distance of 2-3cm the photons are collected by detection fibers integrated in the custom designed sensor. The detection system detects single photons and the time correlation of the photon intensity fluctuations is evaluated. Based on a theoretical model changes in cerebral blood flow are then derived. The screenshot of the αιμα-FloMo software shows the blood flow for each channel individually as well as the average measured in real-time (example of a cuff occlusion/release procedure on the forearm, marked by vertical bars).

αιμα -FloMo

Detection of single photon pulses @ 785nm & evaluation of intensity fluctuations

=> Blood Flow Parameters



Sensors (custom parts)
Integrated fibers for laser source & detection

Graphical User Interface (15" touch screen)

The αιμα-FloMo is meant to be used with an NIRS/DOS system and can readily be integrated with most commercial and custom systems. Together with NIRS/DOS, the blood oxygenation and blood volume (Hb, Hb,THb and StO_2) can be measured as well as the blood flow which allows the derivation of other relative parameters such as the oxygen extraction fraction (OEF) and cerebral metabolic rate of oxygen extraction ($CMRO_2$).

Technology & Operation	• Method: Diffuse Correlation Spectroscopy • Hardware evaluation: Multi-channel auto-correlation • No. of detection channels: 8, No. of laser channels: 4 (configurable according to application specific sensor design) • Sampling time per channel: 200ms to minutes
Measured Parameter	Changes of blood flow in the microvasculature [μBF]
Light Source	• Fiber-coupled diode laser (detachable FC connection) • Wavelength: 785nm • Laser power (internally): 100mW • Output channels (switchable): 4 (front) + 1 (photodiode) + 1 (back, control) • Switching times: < 10ms
Light Detectors	• SPAD (single photon counting, 8channels) • Quantum efficiency @ 785nm: 55% • Timing resolution: 600ps • Dead time: 50ns • Dark counts per channel: $500s^{-1}$
User Interface	• Graphical: 15" touch screen, swivel mount for viewing at different angles • Electrical: software configurable digital/analog I/O channels, USB, RS232
Software	• User-friendly guidance menu • Real-time evaluation & display of μBF • Highly configurable for hardware communication with external systems as well as for display and analysis modules • Plot configuration for derived parameters (arithmetic operations) • Study specific, user defined configuration files (timing, sensor, plotting, evaluation parameters etc.) • Optional: Sensor readout for bending or force sensing as well as laser enable only on correct plug connection • Optional: Evaluation and/or plotting of external NIRS data for oxygenated hemoglobin [HbO_2], deoxygenated hemoglobin [Hb], total hemoglobin [THC], derived parameters, e.g. oxygen extraction fraction, metabolic rate of oxygen consumption
Dimensions & Weight	540mm x 560mm x 300mm (screen folded down), ca. 21,5kg
Power requirements	Power input: 110-240V, 100W

Disclaimer:
The αιμα-FloMo device presently has no CE marking but complies electrically with CE. The device is provided for **research purposes only**. Fiber sensors are not included. Safe system operation including the required laser safety precautions falls into the user's responsibility.

Hemophotonics S.L.
Mediterranean Technology Park, Av. Carl-Friedrich Gauss 3,
08860 Castelldefels (Barcelona), Spain
URL: www.hemophotonics.com, Phone: +34 93 554 2255, Email: info@hemophotonics.com

Selected bibliography:
*Durduran T and Yodh A G. Diffuse correlation spectroscopy for non-invasive micro-vascular cerebral blood flow measurement. NeuroImage, **85**, 51-63, (2014).*
*Durduran T, Choe R, Baker W, and Yodh A G. Diffuse optics for tissue monitoring and tomography. Rep Prog Phys, **73**(7):076701–076744, 2010.*
*Choe R and Durduran T. Diffuse optical monitoring of the neoadjuvant breast cancer therapy. IEEE Journal of Selected Topics in Quantum Electronics, **18**(4):1367–1386, 2012.*
*Mesquita R C, Durduran Turgut, Yu G, Buckley E M, Kim M N, Zhou C, Choe R, Sunar U, and Yodh A G. Direct measurement of tissue blood flow and metabolism with diffuse optics. Philosophical Transactions of the Royal Society A: Mathematical, Physical and Engineering Sciences, **369**(1955):4390–4406, 2011.*