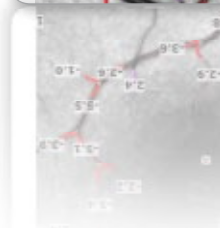
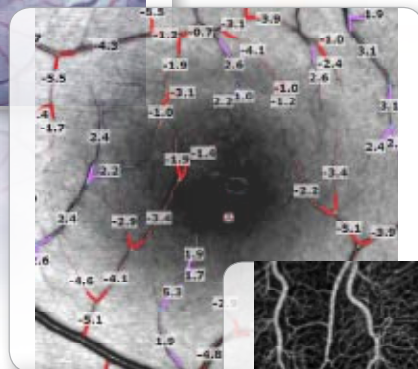
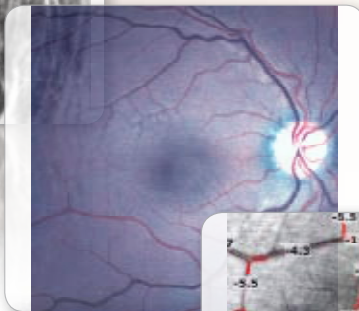
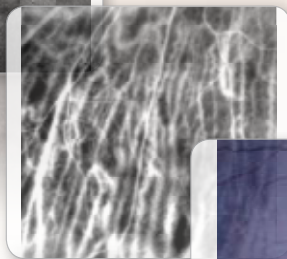
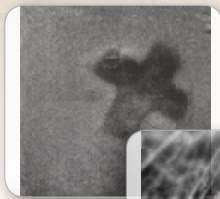


 *Optical Imaging*
Seeing the invisible



Retinal Function Imager

Unique Retinal
Imaging System

www.opt-imaging.com

The Retinal Function Imager

Optical Imaging Ltd. is dedicated to introducing to the medical community novel diagnostic equipment that provides new early diagnostics capabilities and new insights into ophthalmic diseases, enabling targeted treatment, clinical follow-up and enhanced drug development.

The Retinal Function Imager (RFI) is an integrated hardware and software turnkey system, providing a unique non-invasive, functional imaging system with novel capabilities for “seeing the invisible”. It maps the retina to the resolution of single red blood cells moving through capillaries and it offers both clinicians and researchers insight into the pathogenesis of retinal disease leading to better patient care.

The RFI contains software modules to capture, analyze, store and retrieve all patients’ images and history information, making it easy to use for both patients and physician. There are currently two RFI models. RFI 3000 is cleared for marketing in the US and RFI 3005 is at present only a research model. Each of the models offers specialized support for the following fundus imaging modalities:

RFI 3000

- Blood Flow Velocity Maps
- Capillary Perfusion Maps

RFI 3005 (All-in-One)

- Blood Flow Velocity Maps
- Capillary Perfusion Maps
- Multi-spectral Imaging for Qualitative retinal oximetry
Choroidal visualization (without dye injection)
- Metabolic Function Imaging
- Photic Stimulation (retinal challenge)



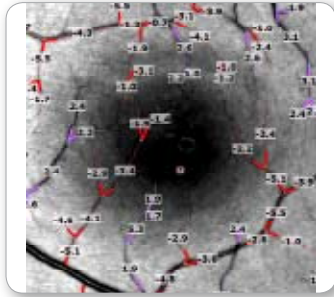
 *Optical Imaging*
Seeing the Invisible™

The Retinal Function Imager 3000

Functional retinal imaging in the clinic

The RFI model 3000 offers blood flow velocity analysis and vascular visualization capabilities presenting ophthalmologists with advanced opportunities for retinal evaluation.

Comprehensive Blood Flow Velocity Analysis

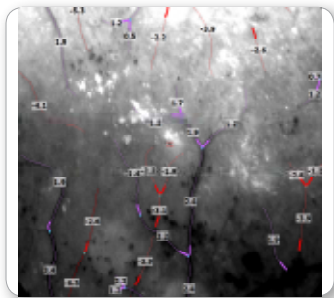


The RFI's direct visualization of retinal blood flow, without the injection of contrast agents, opens up many new diagnostic possibilities of abnormal retinal blood flow velocity, particularly in large capillaries arterioles and venules.

The RFI imaging system can clearly reveal the motion of individual clusters of red blood cells, providing a powerful tool for measurement of retinal blood flow dynamics.

Preliminary studies show that the RFI provides new insights into clinical diagnosis and treatment**

Diabetes Mellitus (DM): Clinical Studies with the RFI exploring special characteristics in diabetic patients



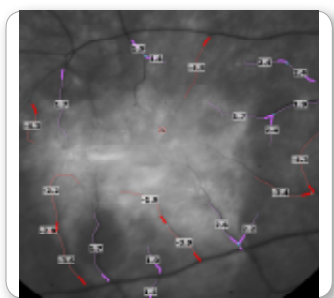
- In patients with non-proliferative diabetic retinopathy, the RFI revealed a significant velocity decrease compared to healthy controls.^a
- In patients with early DM with no diabetic retinopathy the RFI detecte increased blood flow velocity compared to controls.^b
- nCPM imaging showed an increase in Foveal Avascular Zone in detected diabetic patients compared to healthy controls.^c
- nCPM imaging showed areas of capillary non-perfusion in patients with diabetic retinopathy and BRVO in correspondence with FA findings.^d
- nCPM facilitates follow up of capillaries drop out, neovascularization and other microvascular changes in response to surgery or medication treatments.

a. Burgansky et al. *Retina* (2010); 30:4

b. Burgansky et al. *Retina* (2011) In press

c. Nelson et al. *ARVO Meeting Abstracts 2010* 51:1056

d. Nelson et al. *ARVO Meeting Abstracts 2011* 52:4473

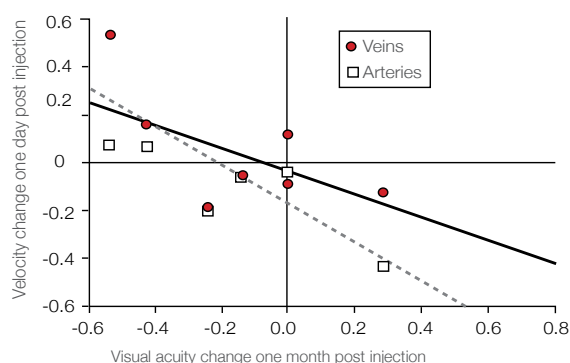


Age related macular degeneration (AMD)

- Average blood flow velocity in AMD patients was significantly lower compared to controls in arteries and veins.^e
- nCPM imaging reveals choroidal neovascularization membranes.^f

e. Burgansky et al. *ARVO Meeting Abstracts 2010* 51:291

f. Grinvald et al. *ARVO Meeting Abstracts 2011* 52: 4798



Assessing drug treatment efficacy using the RFI

The RFI detected responders and non responders to Intravitreal Bevacizumab (Avastin) injections.

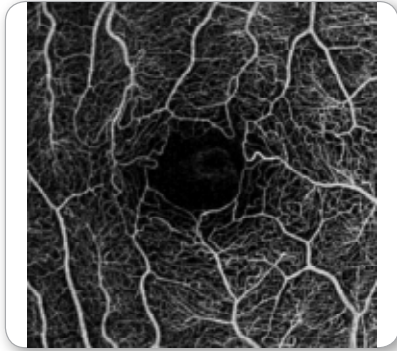
Blood flow velocity changes one day post- injection correlated with changes in visual acuity after one month.^g

g. Grinvald et al. *ARVO Meeting Abstracts 2009* 50:411

**Study results are not described as clinical indications for market.

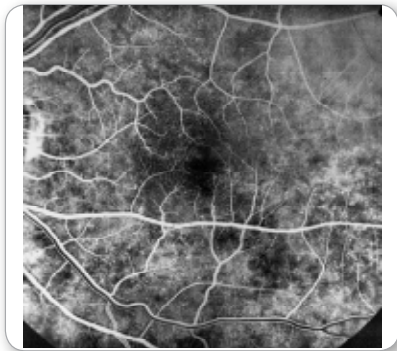
non-invasive Capillary Perfusion Map (nCPM)

Capillary Perfusion Map of a healthy volunteer



These Capillary Perfusion Maps are obtained without any contrast agent injection such as fluorescein. Instead, the red blood cells serve as an intrinsic contrast agent. Their flow shows the positions of the veins, arteries and capillaries. The RFI analyzes a series of images of the vasculature to reveal this motion signal, and hence to reveal microvasculature detail, including surface capillaries, in as much and often greater detail than most FA images¹. The foveal avascular zone is sharply delineated in the nCPM.

i. Rezek SS ARVO Meeting Abstracts 2011 52:2899



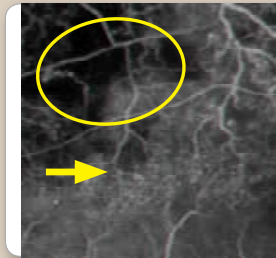
Fluorescein Angiography*

For those interested in standard Fluorescein Angiography (FA) the RFI enables performing high quality traditional FA (an option) in addition to novel (nCPM).

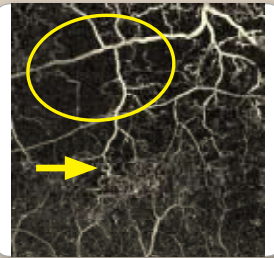
Fluorescein Angiography (FA) image taken 17 seconds after injection of fluorescein performed with the RFI on a patient with Diabetic Retinopathy.

* Currently for investigational use only.

Branch Vein Occlusion Patient

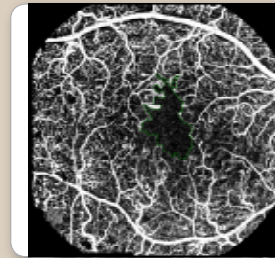


A Fluorescein Angiography image was taken from a BRVO patient. The yellow circle marks an area of non-perfusion.

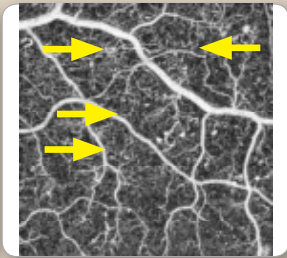


Non-contrast agent RFI Capillary Perfusion Map (nCPM) taken from the same BRVO patient. Vascular networks are shown in greater details with the nCPM map. nCPM shows the non-perfused retina (top left) and fine vascular pattern (left panel)

Diabetic Retinopathy Patient



Foveal avascular zone (FAZ) measurements in patients with diabetic retinopathy. The green line encircles the FAZ.



The nCPM shows vascular loops and shunts (yellow arrows)

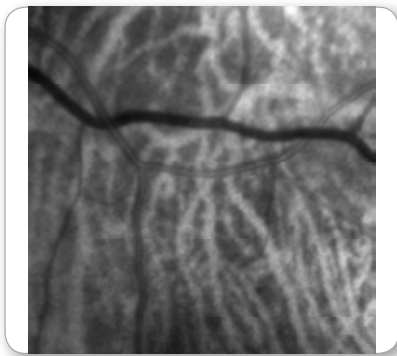
The RFI offers a non-invasive method to visualize and enhance details of the retinal vascular network, compatible with frequent screening and monitoring of patients that are suitable for retinal imaging and are prone to pathological retinal vasculature changes.

The Retinal Function Imager 3005*

Advanced Retinal Functional Imaging System Seeing the Invisible
The RFI model 3000 offers quantitative blood flow velocity and capillary network visualization capabilities that gives ophthalmologists and researchers insights into retinal function, promoting retinal disease diagnosis. The RFI model 3005 adds two important parameters: multi spectral imaging providing qualitative oximetry, choroidal visualization without ICG, and imaging of the “functional signal” that reveals the metabolic imprints of photic retinal activation. It also provides means for retinal challenge, e.g. controlled photic activation of the retina prior to measuring blood flow velocity, nCPM or oximetry.

*Currently for investigational use only

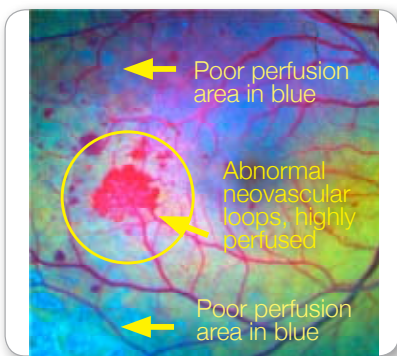
Multi-spectral Imaging for multiple applications



Noninvasive Visualization of
Choroidal Vessels

To provide insight into oxygen utilization and other retinal functions, a special RFI module allows multi-spectral imaging and analysis. The module, based on a fast-switching filter wheel, overcomes issues such as poor signal-to-noise ratio that have hampered such analysis until now. Using multi-spectral mode, we perform spectroscopic decomposition to assess the oximetric state of the retina. This measurement is completely non-invasive. In addition the filter wheel allows choroidal vessels visualization using near infra red light and pigment density maps.

Sickle Cell Retinopathy Patient (qualitative Oximetry)



A case of sickle cell retinopathy
with sea-fan vascular loops

Areas of poor perfusion are detected using qualitative oximetry with the RFI. Perfusion deficits and abnormalities appear as regions of color distinct from their surroundings. (Image courtesy of Richard Rosen, MD and Teerapat Jittpoonkuson, MD at New York Eye and Ear Infirmary).

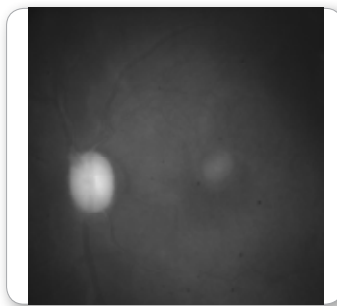
Benefits of using the multi-spectral imaging module:

- Rapid multi-spectral imaging of the retina
- Indicative of oximetric state of the retina
- Indicative of ischemic regions without using a contrast agent
- Direct, non-invasive enhanced visualization of choroidal vessels
- Indication of oximetric changes occurring after several types of challenges to the retina

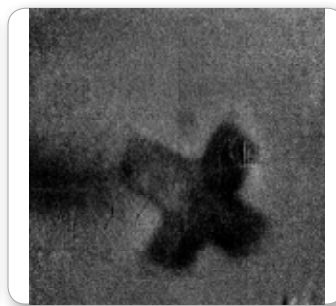
Metabolic Functional Imaging

Retinal reflectance changes in response to photic stimulation carry information about metabolic processes underlying light responses in the retina. The RFI is capable of imaging under near-infrared light, outside the absorption range of the photoreceptors, and can be used to optically monitor retinal activity in response to a well-defined visual stimulus. The difference between the post-stimulated images and the pre-stimulated images is used to determine the metabolic state of retinal components (Such experiments were successful only in experiments on anesthetized animals with immobilized eyes).

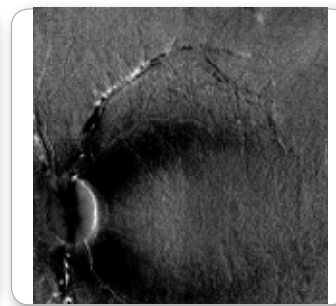
Exploring retinal imaging of anesthetized macaque monkey in vivo in response to a photic stimulus pattern, the RFI reveals a metabolic signature map directly corresponding to the stimulus pattern.



Near-infrared retinal image followed visual photic stimulus – metabolic map is invisible

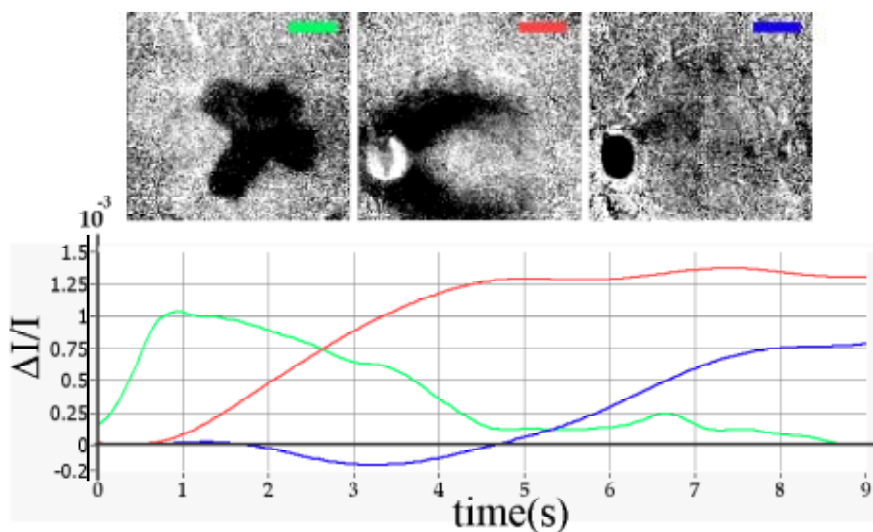


Metabolic map showing the signature of the stimulus pattern on the retina in response to a cross-patterned stimulus



Metabolic map showing the signature of the axonal arches

The RFI can reveal the exact time course of the three different metabolic signals. Fast and slow time course signals are distinguishable.



The RFI's stimulus module option allows additional imaging modes in functional imaging:

- Imaging blood flow changes under photic activation
- Imaging blood volume changes under photic activation
- Imaging oximetric changes under photic activation

Literature

1. Burgansky-Eliash Z, et al. Retinal Function Imager Measurements of Retinal Blood Flow Velocity in Patients with Early Diabetes Mellitus. *Retina* in press
2. Beutelspacher SC, et al. Central serous chorioretinopathy shows reduced retinal circulation in retinal function imaging (RFI) *Acta Ophthalmologica* 2011 Mar 23 [Epub ahead of print].
3. Landa G, et al. Cilioretinal arteries in diabetic eyes are associated with increased retinal blood flow velocity and occurrence of diabetic macular edema. *Retina* 2011 Feb; 31(2):304-11.
4. Burgansky-Eliash Z, et al. Reduced Retinal Blood Flow Velocity in Diabetic Retinopathy. *Retina* 2010; 30(5):765-773.
5. Landa G, et al. A New Vascular Pattern for Idiopathic Juxtafoveal Telangiectasia Revealed by the Retinal Function Imager. *Ophthalmic Surg Lasers Imaging*. Jan-Feb 2010;41(3).
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8. Landa G, et al. Correlation between Retina Blood Flow Velocity Assessed by Retinal Function Imager and Retina Thickness Estimated by Scanning Laser Ophthalmoscopy/Optical Coherence Tomography. *Ophthalmologica*. Jan 12 2009;223(3):155-161.
9. Nelson DA, et al. Special report: Noninvasive multi-parameter functional optical imaging of the eye. *Ophthalmic Surg Lasers Imaging*. Jan-Feb 2005;36(1):57-66.
10. Grinvald A, et al. High-resolution functional optical imaging: from the neocortex to the eye. *Ophthalmol Clin North Am*. Mar 2004;17(1):53-67.



For additional recent publications please visit
www.opt-imaging.com/references.asp

RFI Specification

Computer	
CPU	Intel core i7
RAM	4GB
Data storage capacity	1TB
Software	
RFI Software suite	Browse for blood flow analysis, nCPM and multispectral (RFI 3000 and RFI 3005) Metabrowse for functional analysis (RFI 3005)
Imaging Camera	
Sensor size	12.3 mm x 12.3 mm
Sensor resolution	1024 x 1024 pixels
Frame rate	up to 100 fps at 512 x 512 pixels
Photographic magnification	50 (1.1X), 35 (1.6X), 20 (2.7X)
Illumination	
Number of flashes	8 per series
Light source	Stroboscopic xenon for photography
Max flash frequency	55 Hz typical
Inter-series interval	10 sec
Filter wheel (RFI 3005)	Up to 8 filters
Filter switching frequency	30 ms
Imaging Optics	
Field angle (degrees)	Variable among 50, 35, 20
Observer magnification	50 (10X), 35 (13.3X.1), 20 (23.3X)
Working distance	38 mm
Diopter compensation range (patient's eye)	-10 to +41 diopter
Minimum pupil diameter	6 mm
External fixation light	Red light, flashing
General	
Dimensions	Fundus Camera: 34"x14"x20" (88cm x 36cm x 51cm) Stroboscopic Power Supply and computer cabinet: 36" x 18" x 20" (92cm x 46cm x 51cm)
Classification (regulatory)	Class I (type of protection against electric shock) Type B (degree of protection against electric shock)
Power requirements	AC input 100V, 117V, 220V, 240V 50, 60Hz (preset), 7-14A

Technical specifications are subject to change without notice

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