CORSO SOI n°107
SEMEIOTICA STRUMENTALE

LIVELLO AVANZATO

Direttore
A. Lucente
Istruttori
F. Berardo, A. Carnevali, L. Di Antonio, S. Donati, A. Lucente, P. Patteri, N. Rosa, V. Scorcia
Panel
R. Bonfili, F. Cruciani, S.L. Formoso, S. Simonetta, P. Troiano

Angio-OCT: Caratteristiche e Performance

Disclosure

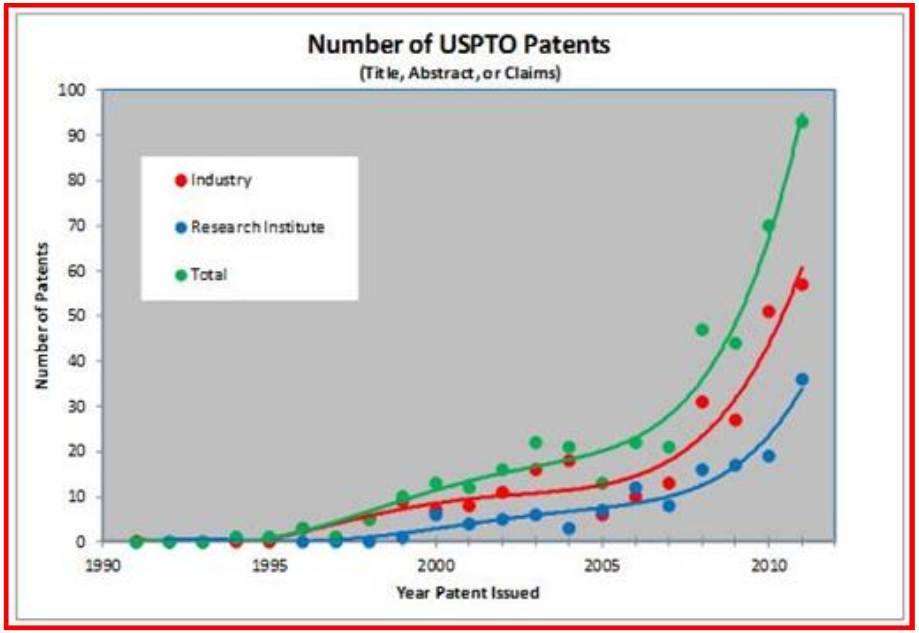
Consulting Free

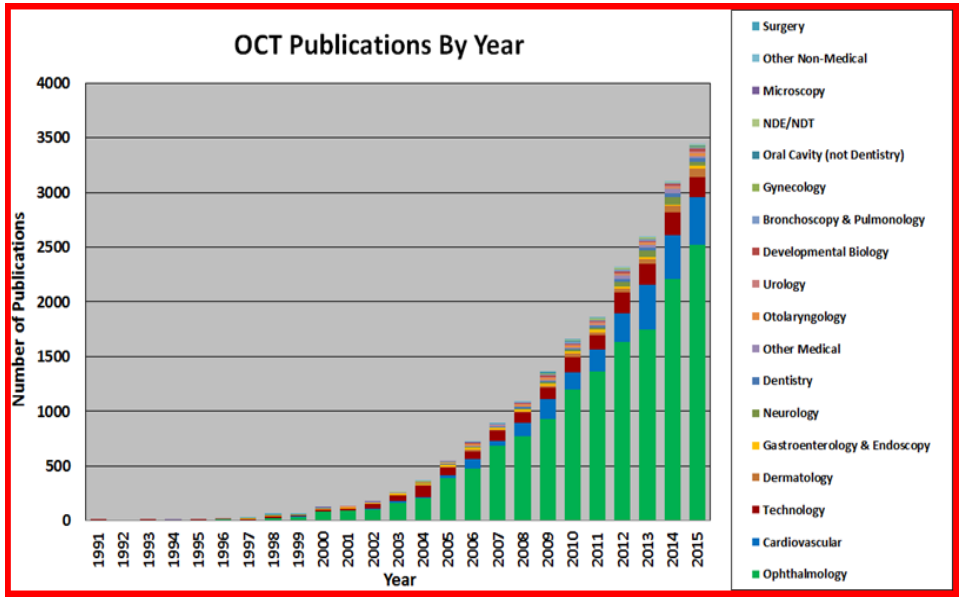
- Carl Zeiss Meditec
- Alfa Intes
- Mesofarma srl

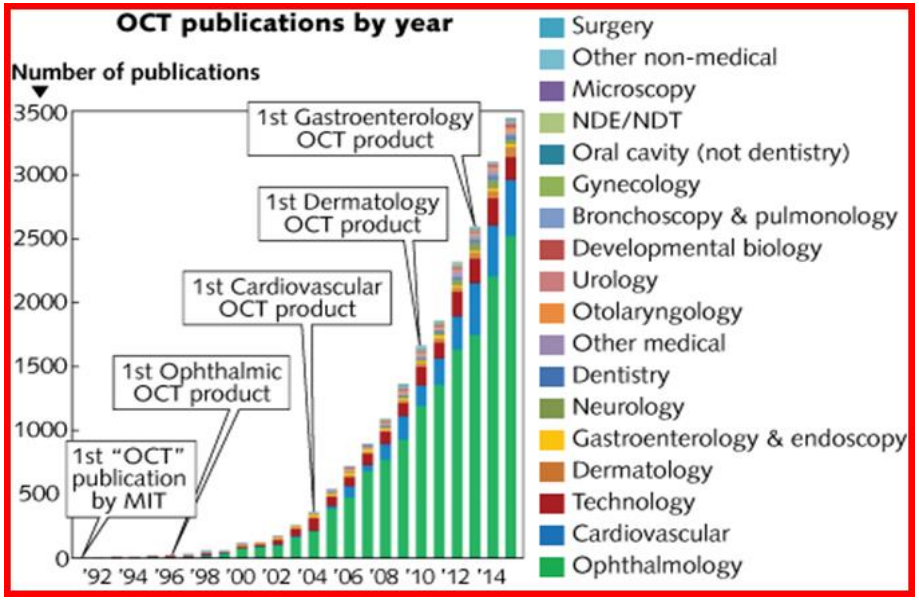
Foreword: 25 Years of Optical Coherence Tomography

by:James Fujimoto and David Huang

The market is just over $1B in 2012, and it is expected to grow by 18–30% per year for the foreseeable future

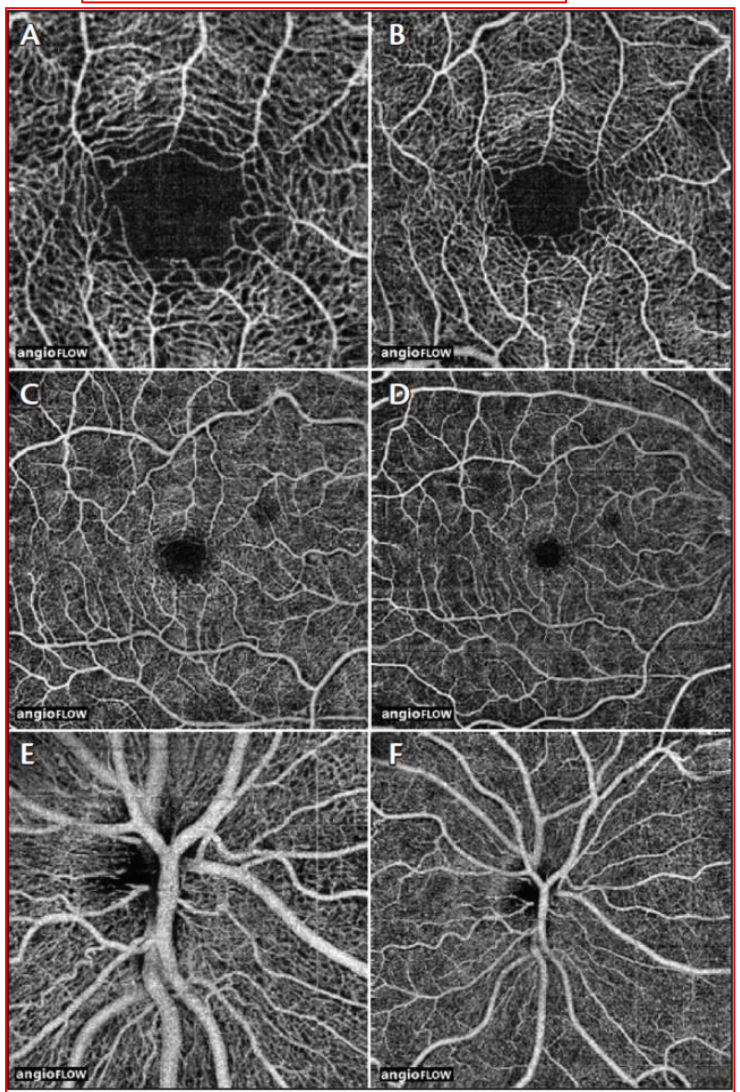


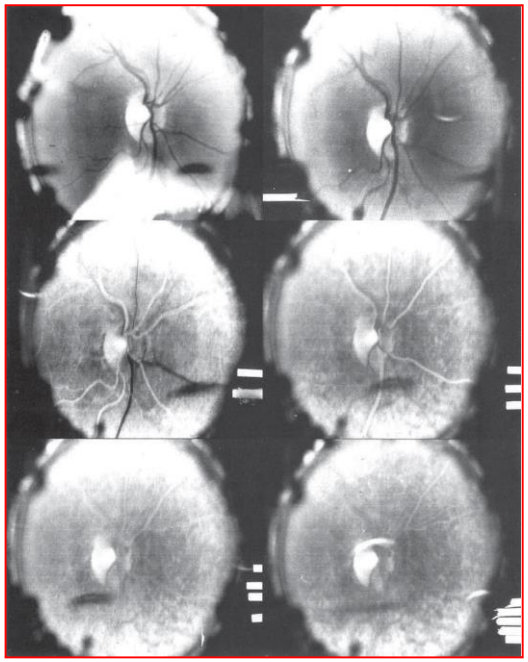




Capillary Network

Image shows at the Fovea:
2.0 x 2.0 mm (A)
3.0 x 3.0 mm (B)
6.0 x 6.0 mm (C)
8.0 x 8.0 mm (D)
12 x 12 mm 12 x 16 mm
Images at the Optic Nerve:
3.0 x 3.0 mm (E)
6.0 x 6.0 mm (F)
8.0 x 8.0 mm





A Method of Photographing Fluorescence in Circulating Blood in the Human Retina

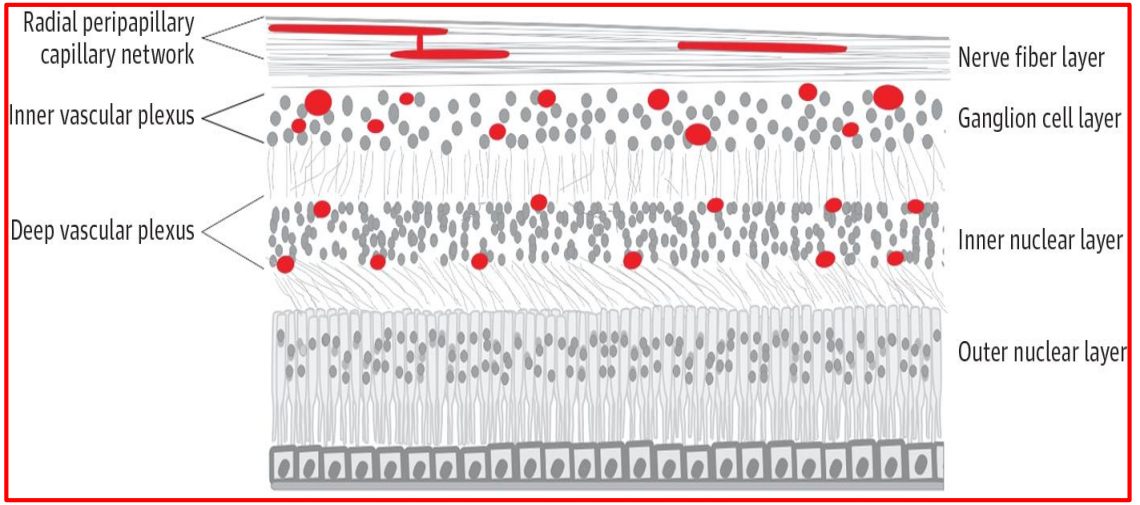
By Harold R. Novotny, B.S., and David L. Alvis, M.D.

THE PHYSIOPATHOLOGY of the retinal vasculature would be better understood if more were known about blood flow in these vessels. Because of the unique quality of transparency in the eye, methods depending on direct observation of the retinal vessels seem especially inviting. Already reported by various authors are technics for

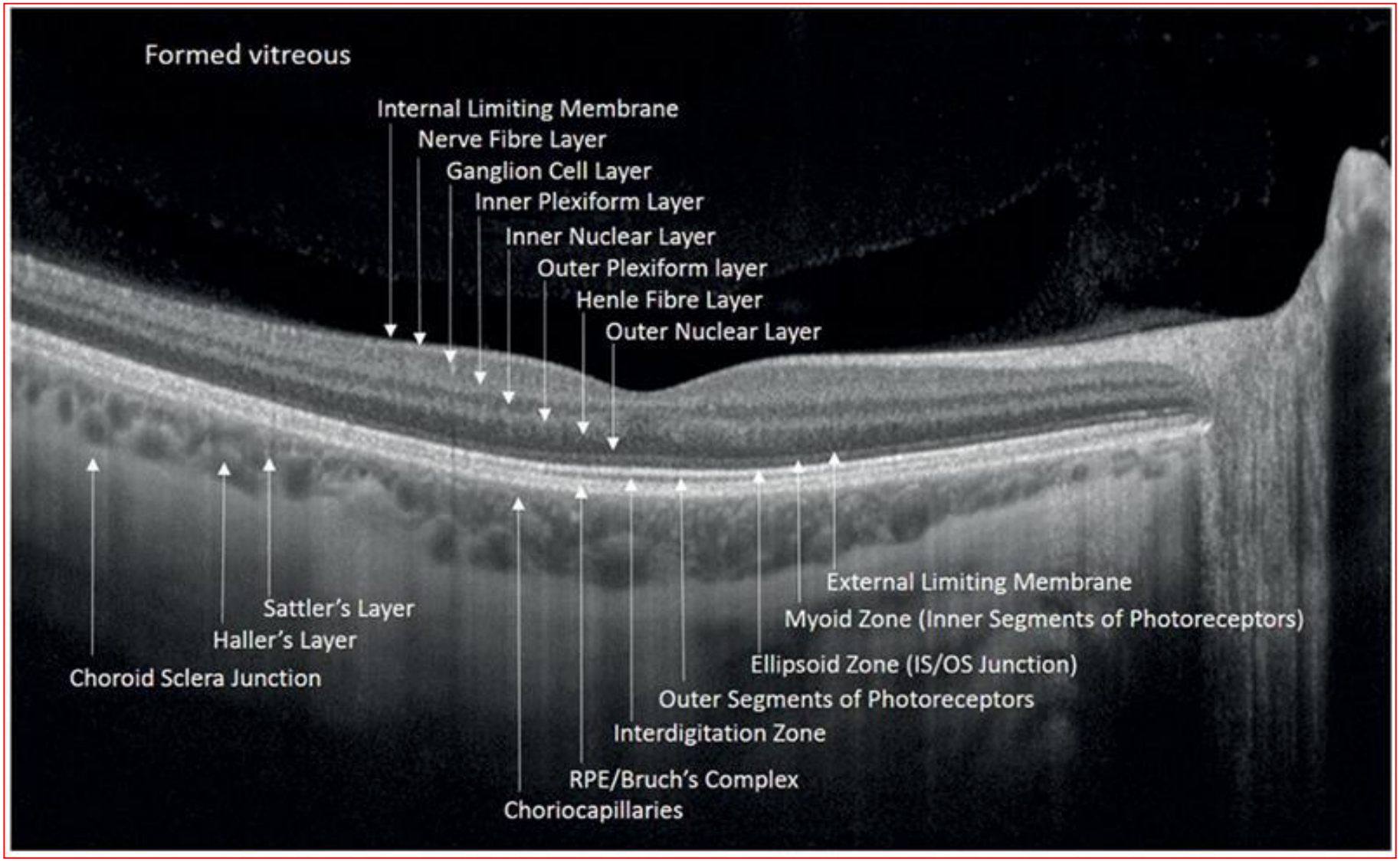
emitting wave length was 520 mμ, in the green. Kodak wratten filters no. 47 and no. 58, combined with a 3-mm. layer of 0.25 M copper sulfate, were accordingly inserted into the optical system (figs. 1 and 2) at appropriate points.

In order to modify the activating light, the blue no. 47 filter was placed in the path of the beam from the electronic flash and from the incandescent viewing source. This made it possible to see, as well as to photograph, the fluorescence

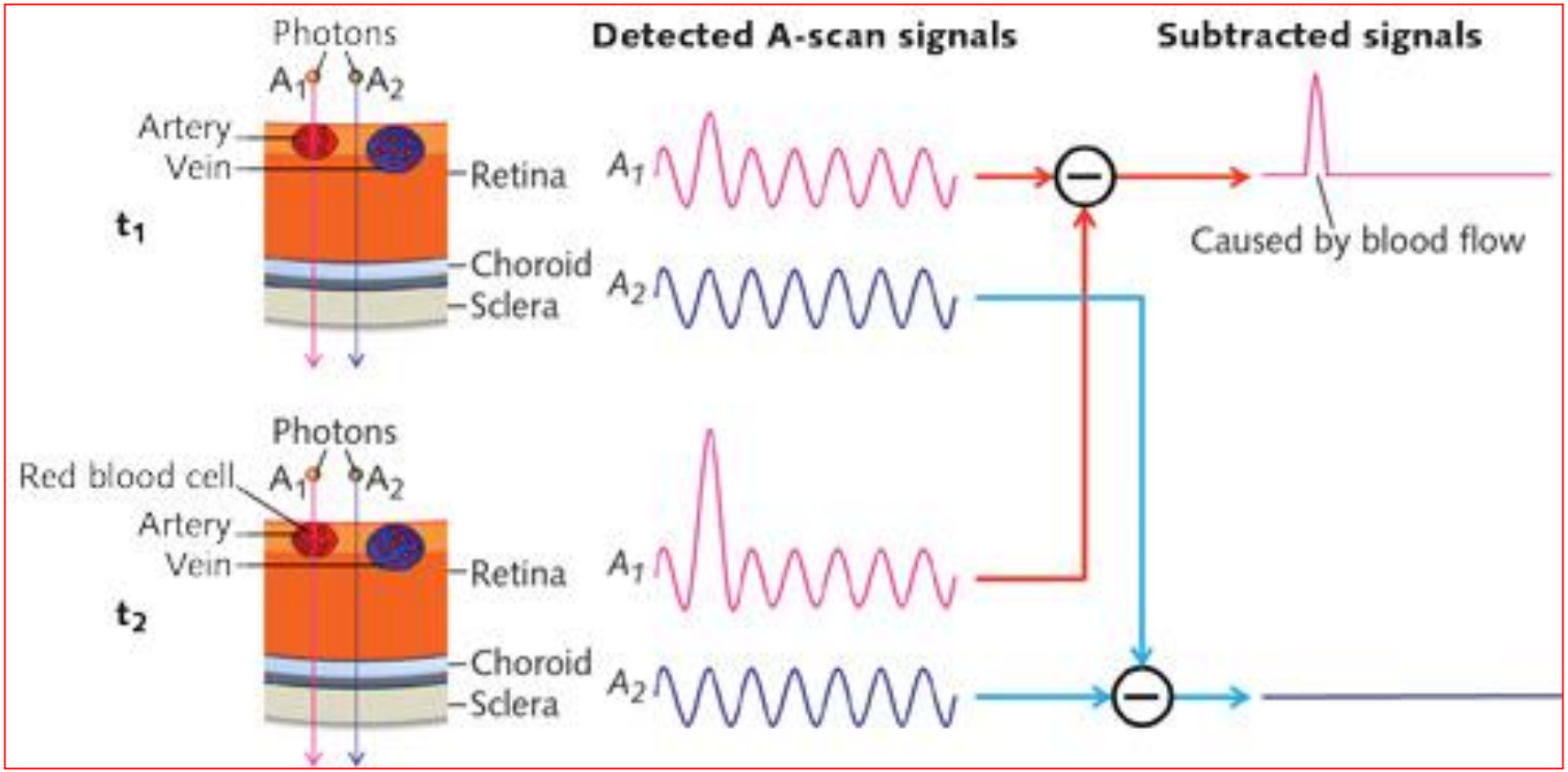
- **The first fluorescein angiogram taken in November 1959, of the right eye of David Alvis with Harold R.Novotny**



International Nomenclature OCT (INOCT)

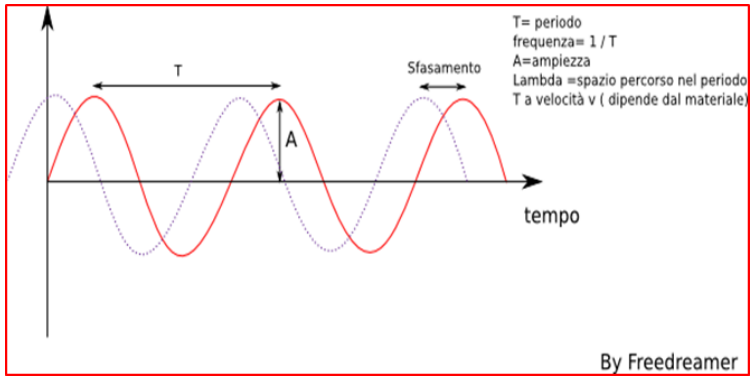


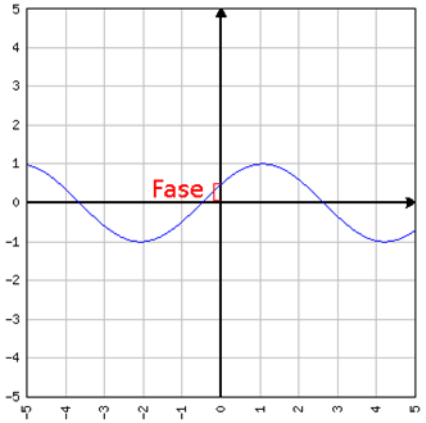
How OCTA Works

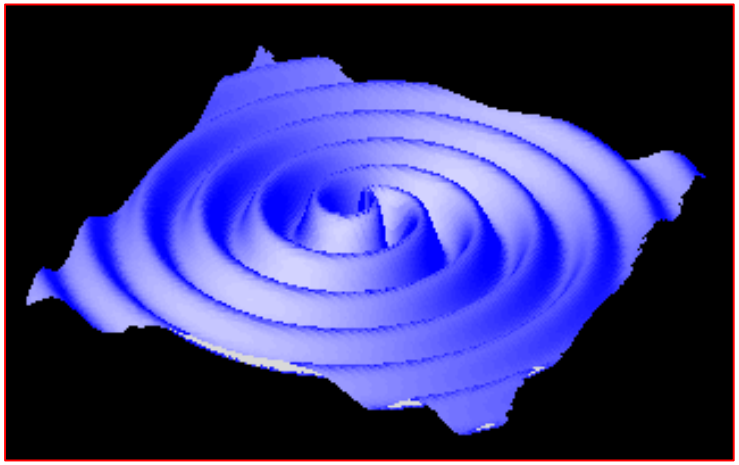


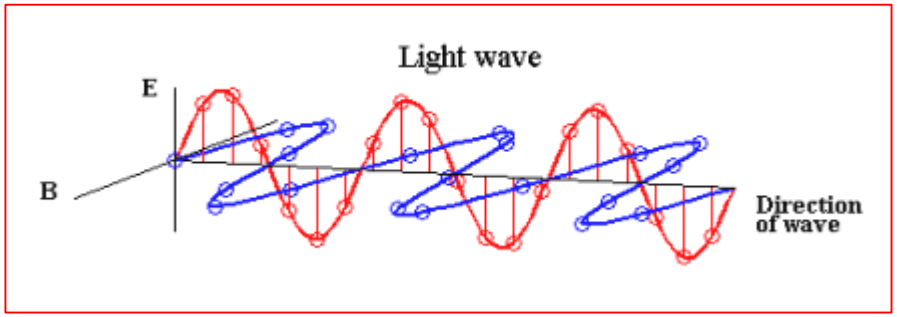
As **moving blood cells** pass through vessels, they **generate changes in OCT signals.** Based on this concept, a **blood flow signal can be extracted** by subtracting the OCT signals from the same location but **at different time points (red path).** The OCT signals will be different at these locations, while OCT signals from **surrounding retinal tissues** will remain **steady (blue path).-**

What is a wave? «energy propagated through matter» A. Einstein









a)Angiografia dyeless basata sull'ampiezza del segnale OCT

b) Angiografia dyeless basata sulla fase del segnale OCT

c) Angiografia dyeless basata sull'ampiezza e sulla fase del segnale OCT (complex signal)

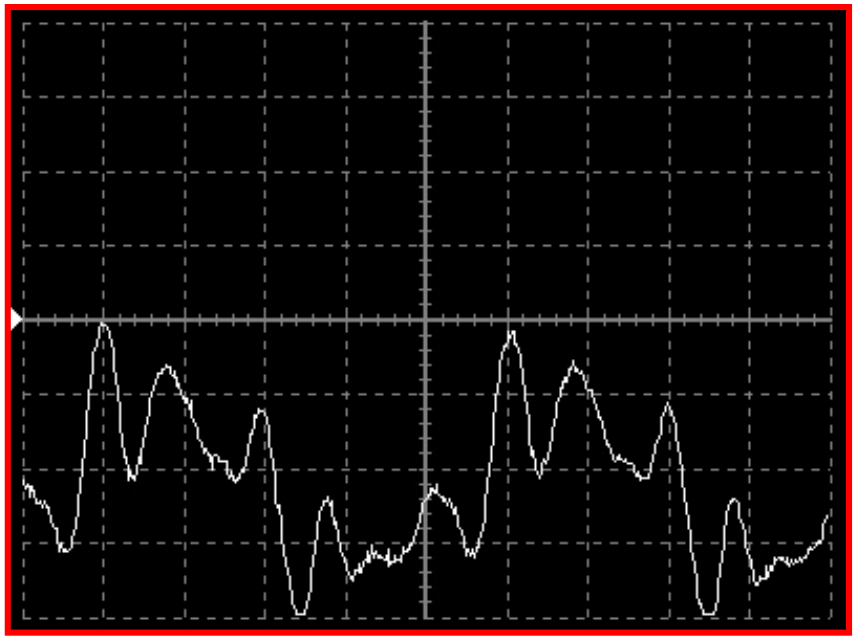
Dawn of a New Era in Imaging

x(t) vs X(f)

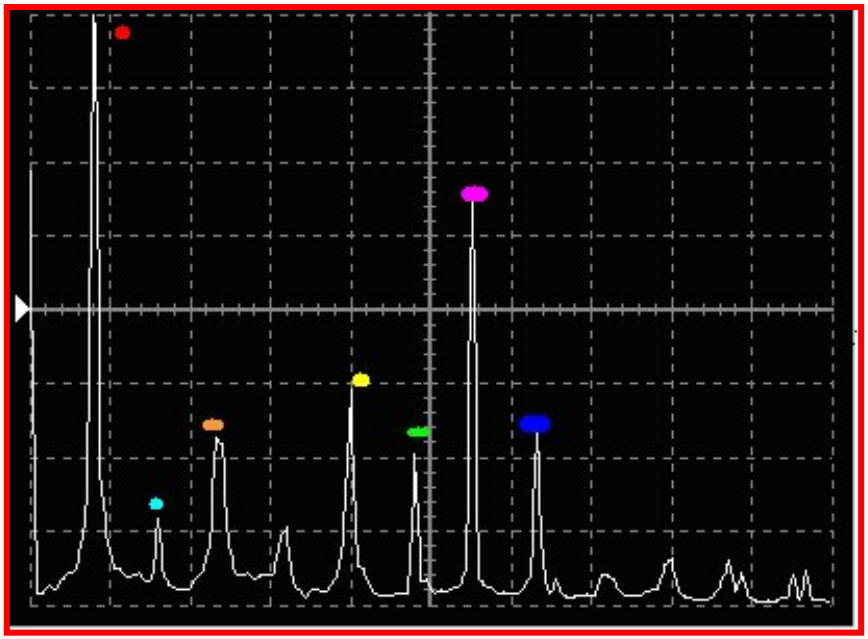
$$X(f) = \int_{-\infty}^{+\infty} x(t) \cdot e^{-j\,2\pi\,f\,t}\,dt$$

$$x(t) = \int_{-\infty}^{+\infty} X(f) \cdot e^{+j\,2\pi\,f\,t}\,df$$

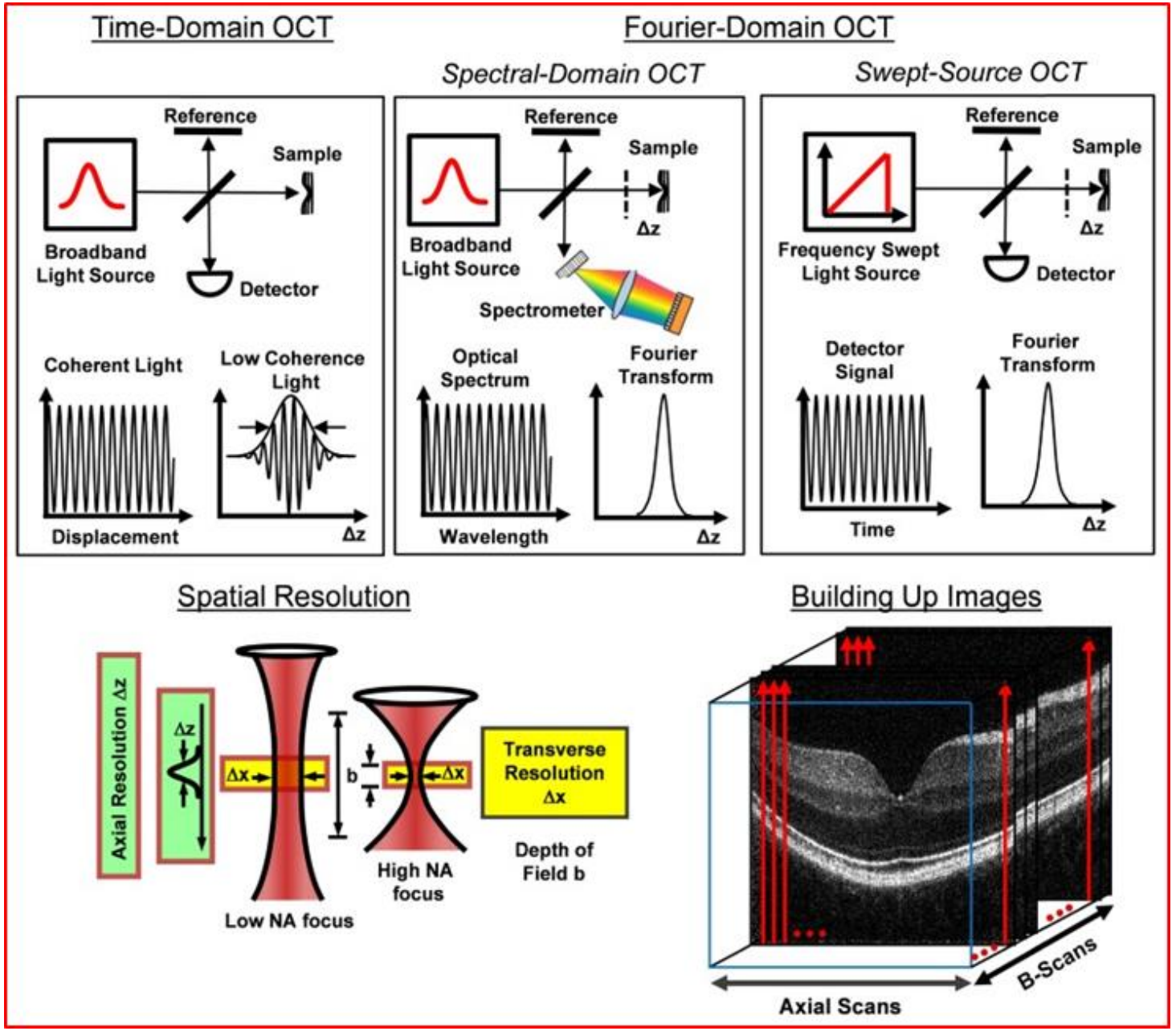
Trasformata e Antitrasformata di Fourier



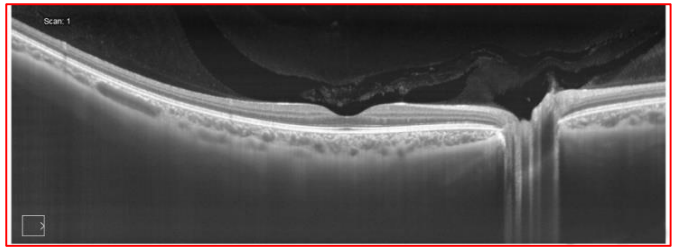
Nota musicale «La» di un clarinetto nel dominio del tempo
x(t) dominio del tempo



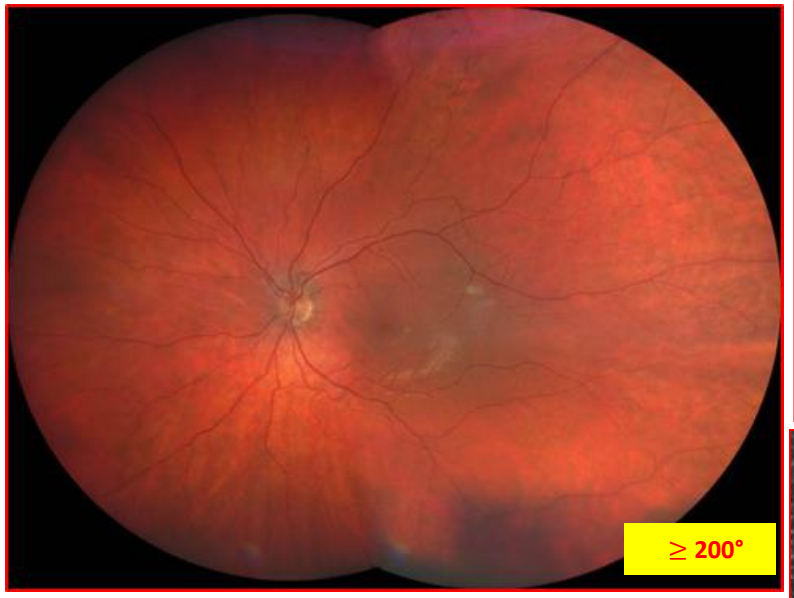
Nota musicale «La» di un clarinetto nel dominio delle frequenze
X(f) dominio delle frequenze

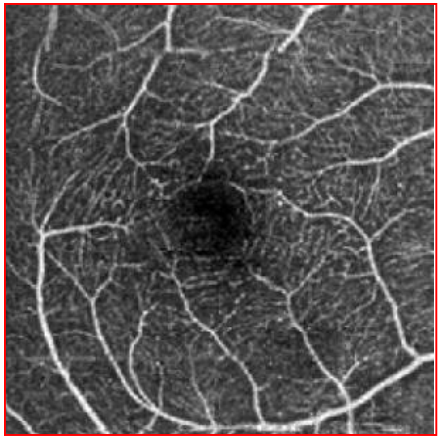

Time-Domain OCT
Fourier-Domain OCT
Spectral-Domain OCT
Swept-Source OCT
Reference
Sample
Broadband Light Source
Detector
Coherent Light
Low Coherence Light
Displacement
Δz
Spectrometer
Optical Spectrum
Fourier Transform
Wavelength
Frequency Swept Light Source
Detector Signal
Time
Spatial Resolution
Axial Resolution Δz
Δz
Δx
b
Transverse Resolution Δx
Depth of Field b
High NA focus
Low NA focus
Building Up Images
B-Scans
Axial Scans

The high resolution of OCTA provides information about areas v/s WideField



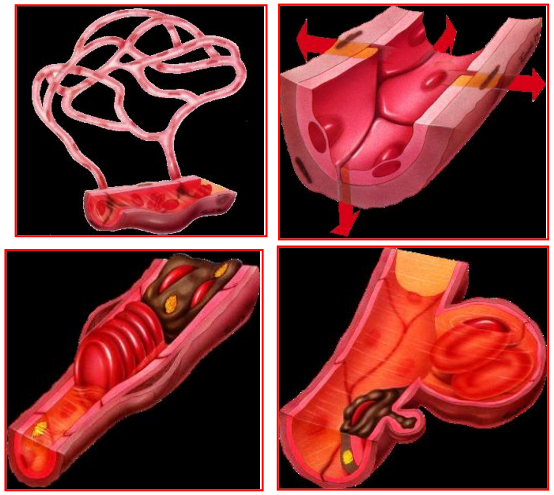
HD Spotlight 16mm B-scan of normal eye

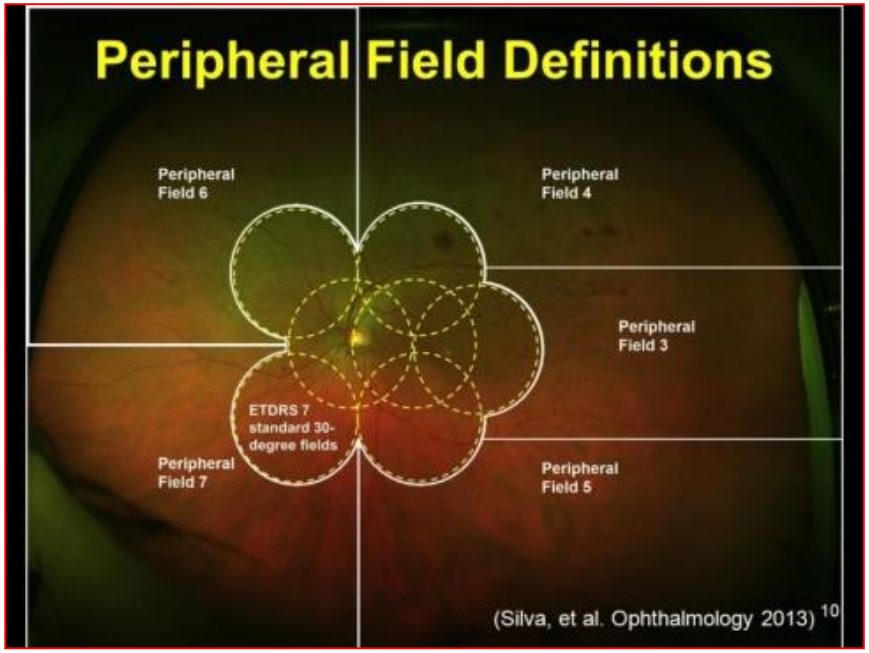


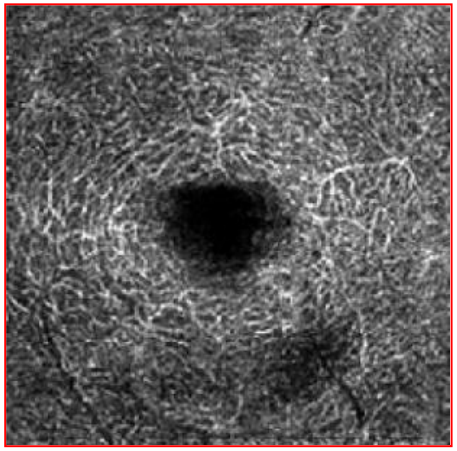


Superficial capillary

- capillary nonperfusion
- vessel dilation and attenuation
- telangiectasias
- microaneurysms
- vascular proliferation





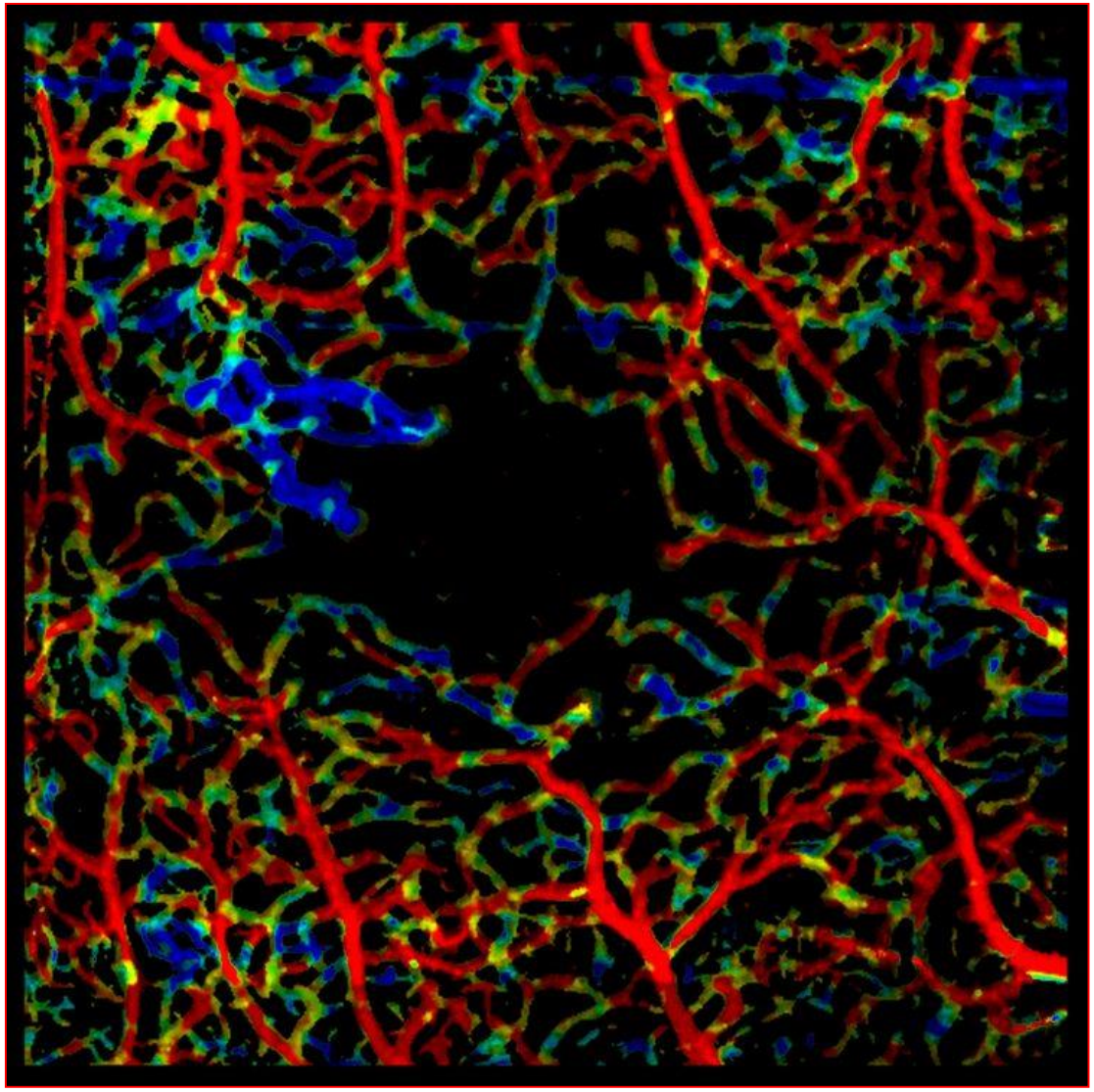


Deep capillary

Ultra WideField: Future Direction

ZEISS receives the **first US FDA Clearance for Swept-Source OCT** posterior ocular imaging with **PLEX Elite 9000**. It is a SS-OCT instrument with **a tunable laser centered at 1050 nm**, a scan speed of **100,000 A-scans/sec** at a tissue **depth of 3.0 mm,** and an **axial resolution of 6.3 µm**, with a **56° field of view.**

Advanced Retina Imaging (A R I) a global consortium **(network)** of the highest caliber of clinicians and scientists.



Variable Interscan Time Analysis (VISTA) is a step towards quantitative optical coherence tomography angiography (OCTA) that allows determination of relative blood flow speeds. As a next innovation, the VISTA developers have created 'VISTA visualisation', a method for mapping the VISTA data into a colour-coded format to make image interpretation intuitive and easy for clinicians

The development of VISTA and VISTA visualisation represents a collaboration between teams of clinicians, optical engineers and computer scientists at **MIT and the NEEC New England Eye Centre Boston,** USA**; Bascom Palmer Eye Institute Miami,** USA; and **the Friedrich-Alexander-University Erlangen-Nürnberg**, **Germany**

VISTA visualisation in a 30-year-old proliferative diabetic retinopathy patient taken over a 3mm × 3mm field of view **(red indicates faster blood flow speeds; blue indicates slower speeds).** Courtesy **OCT Research Group, MIT-NEEC**

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Thank you for your kind attention!