
***Update per l'oculista ambulatoriale***

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# Angio-OCT in Progress

## *Amedeo Lucente*

# Disclosure

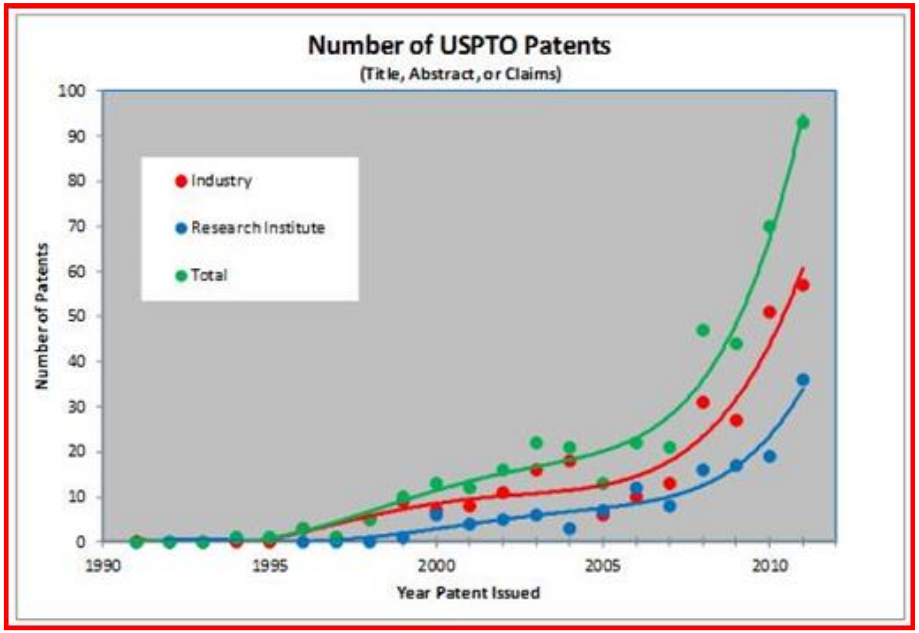
Consulting Free

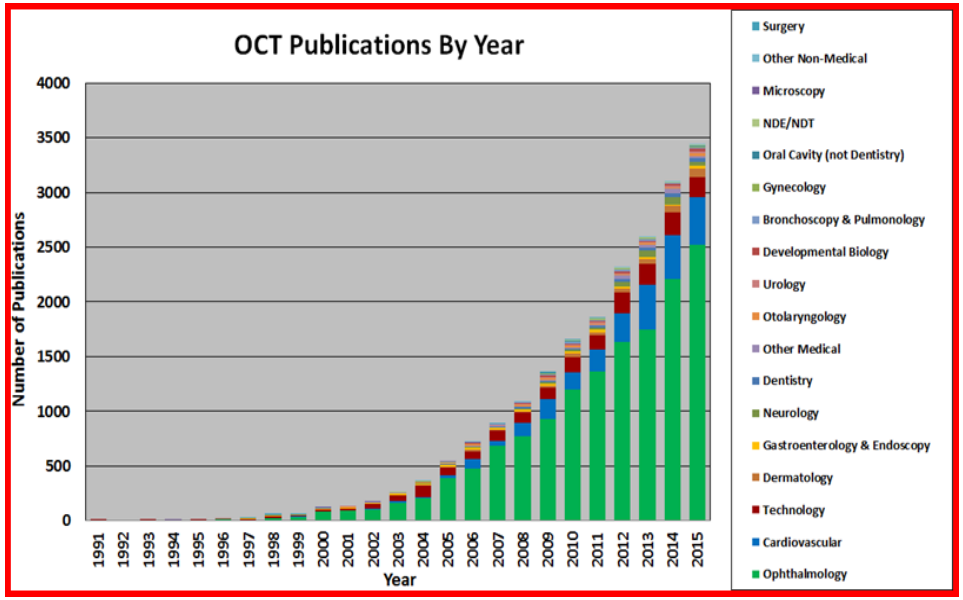
- Carl Zeiss Meditec
- Alfa Intes
- Mesofarma srl

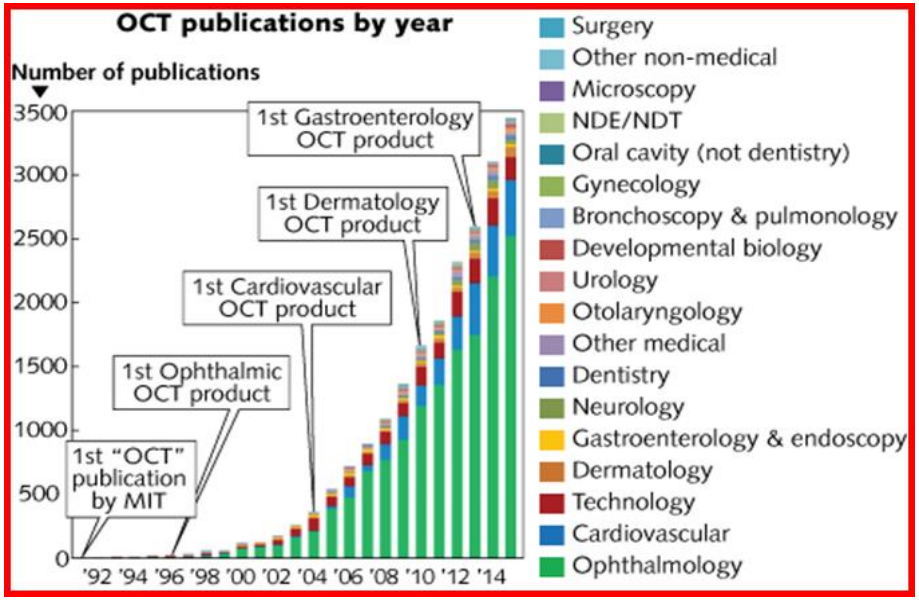

# Foreword: 25 Years of Optical Coherence Tomography

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

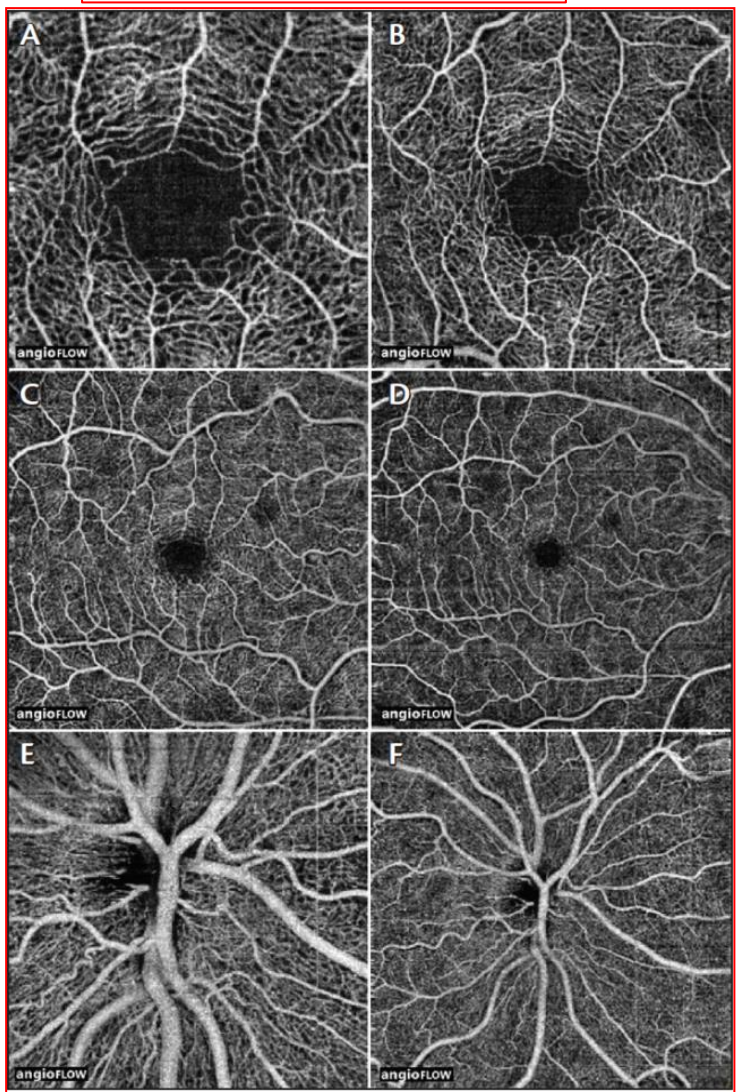


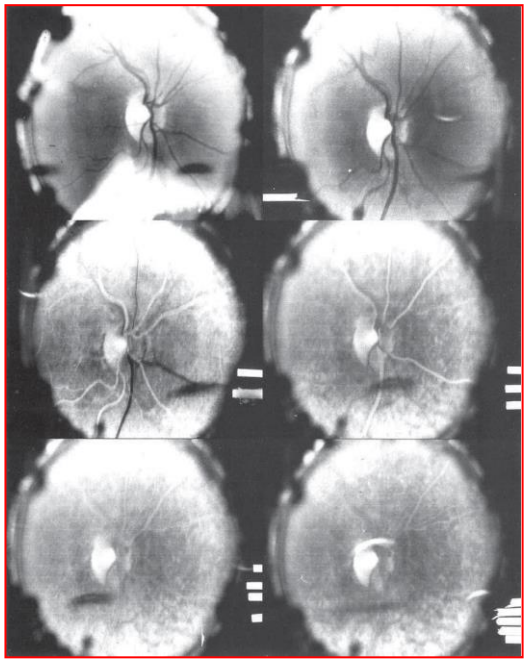



# Capillary Network

*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

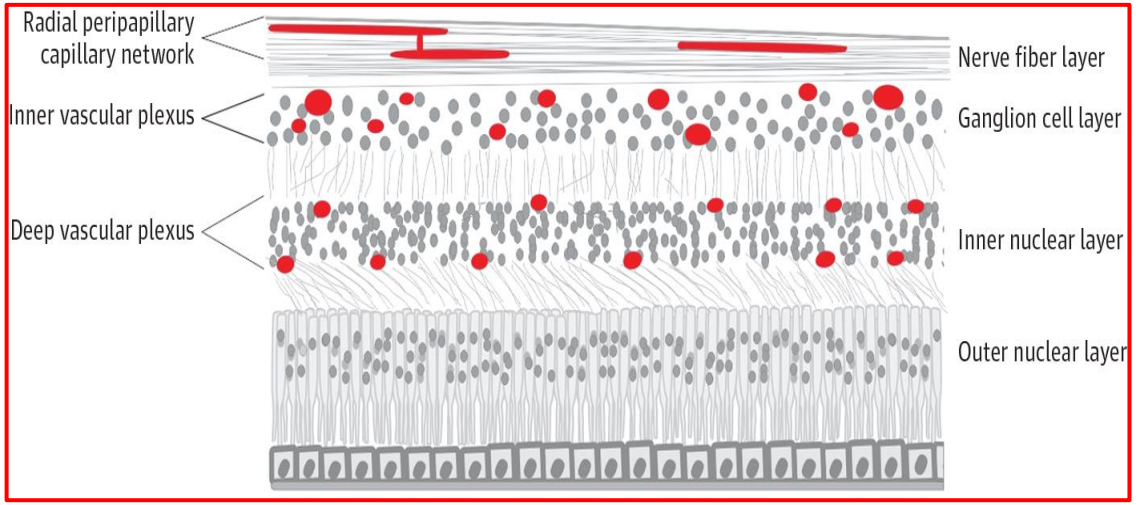
By Harold R. Novotny, B.S., and David L. Alvis, M.D.

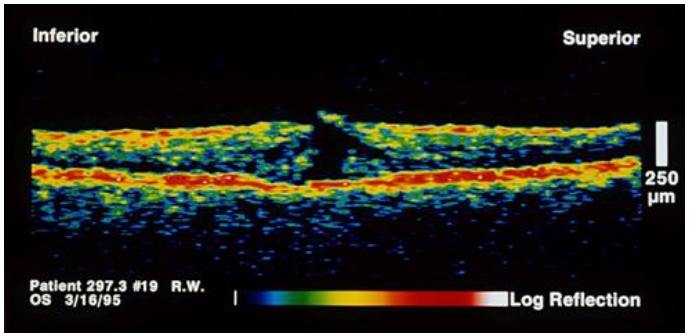
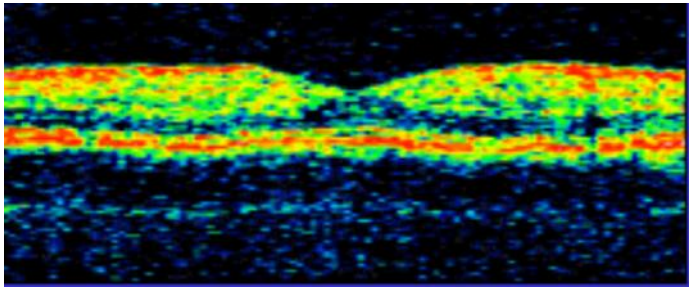
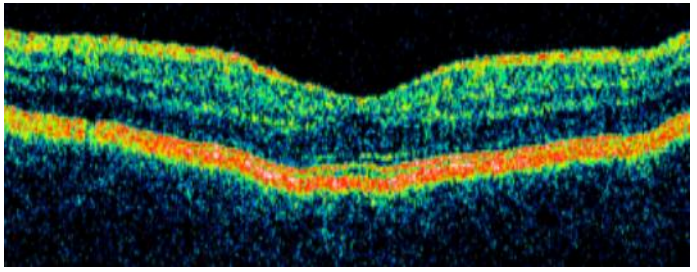
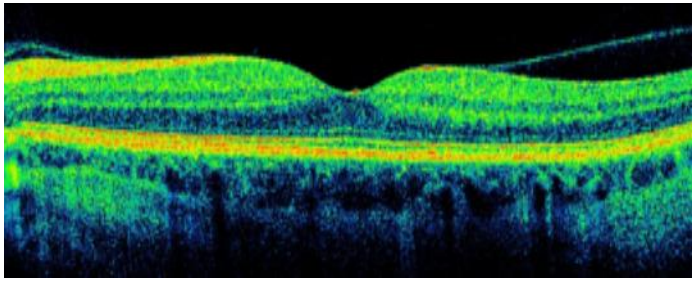
THE PHYSIOPATHOLOGY of the retinal vasculature would be better understood if more were known about blood flow in these vessels. Because of the unique quality of transparency in the eye, methods depending on direct observation of the retinal vessels seem especially inviting. Already reported by various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

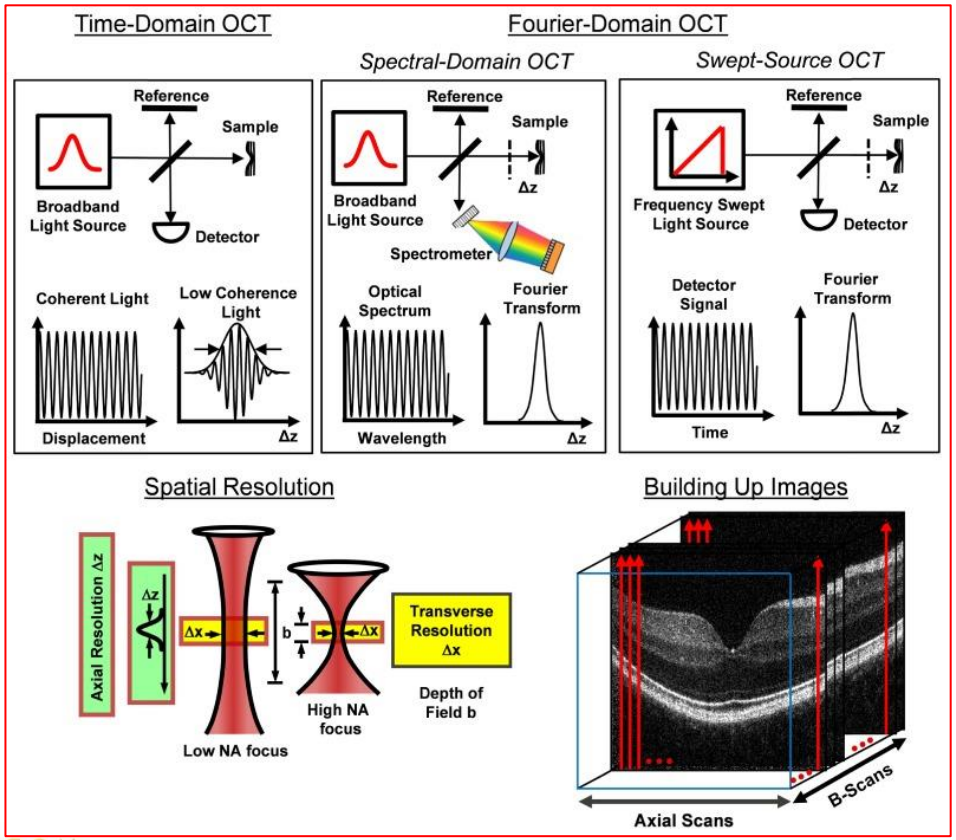
In order to modify the activating light, the blue no. 47 filter was placed in the path of the beam from the electronic flash and from the incandescent viewing source. This made it possible to see, as well as to photograph, the fluorescence

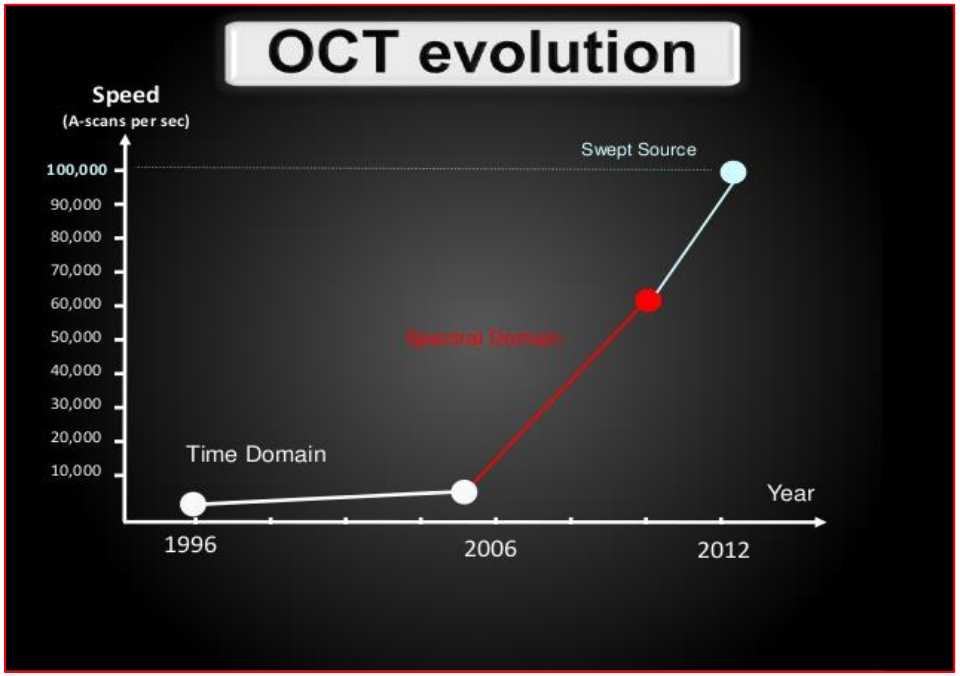

- **The first fluorescein angiogram taken in November 1959, of the right eye of David Alvis with Harold R.Novotny**



| Model Image | Year | Single line Scan | Scans Sec | Resolution (microns) | B Scan |
|---|---|---|---|---|---|
|  | OCT 1995 N: 200 al 1999 | 100 A-scans x 500 points | 100 | 20 |   |
|  | OCT2 2000 N:400 al 2002 | 100 A-scans x 500 points | 100 | 20 |  |
|  | OCT3 Stratus 2002 N: 6000 al 2006 | 512 A-scans x1024 points | 500 | 10 |  |
|  | Cirrus HD-OCT 2007 N: 10000 al 2012 | 4096 A-scans x 1024 points | 27,000 | 5 |  |

- 100's of companies supplying OCT systems and components;
- 1,000's of researchers at leading international universities advancing the frontiers of OCT
- 10,000 OCT journal articles on clinical, fundamental scientific, and materials applications
- ~50,000 installed OCT systems
- system market approaching $1B/year
- reducing healthcare costs, including ~$10B in estimated Medicare savings in the US



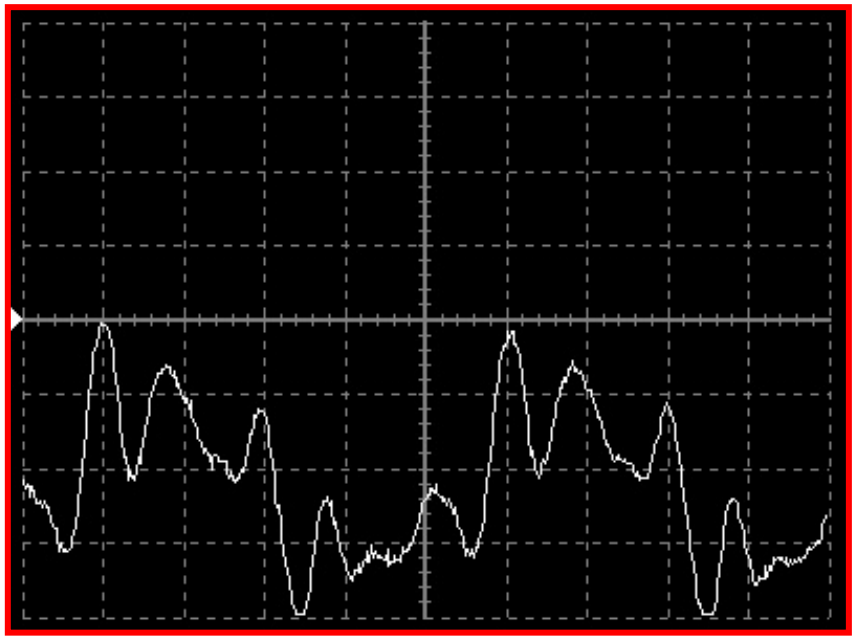



**Una delle più belle e utili formule che siano mai state scritte, alla base del progresso tecnologico degli ultimi 200 anni!**

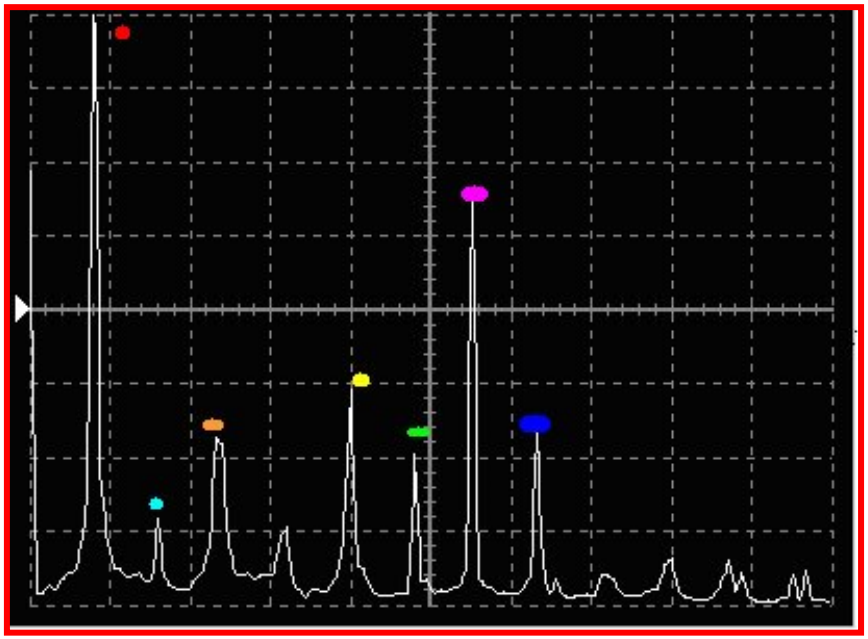
$$X(f) = \int_{-\infty}^{+\infty} x(t) \cdot e^{-j\,2\pi\,f\,t}\,dt$$

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

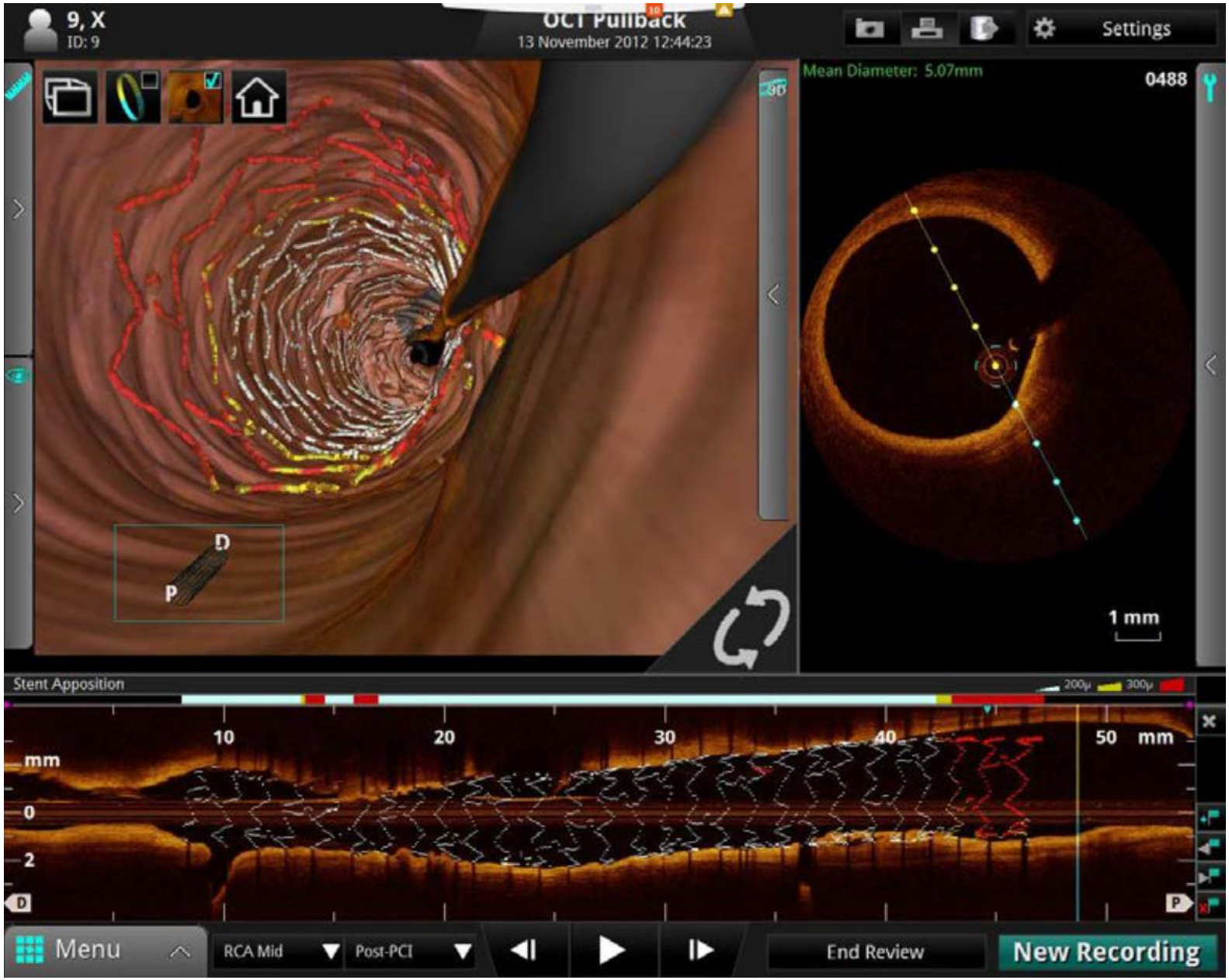
**Trasformata e Antitrasformata di Fourier**



**L'onda di 'La' del clarinetto che varia nel tempo viene registrata tramite oscilloscopio**
***x(t) dominio del tempo***



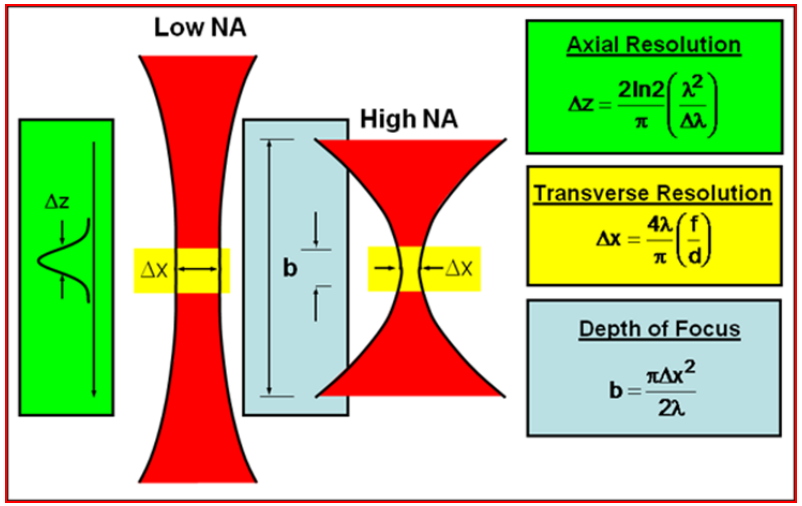
**Il 'La' del clarinetto scomposta in sotto-onde nel dominio delle frequenze**
***X(f) dominio delle frequenze***



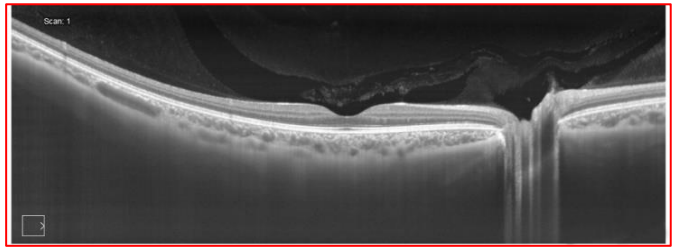

Screen shot of one view from the St. Jude medical cardiovascular SS-OCT imaging system user interface

# Choosing an OCT System

- *Significant performance parameters that are coupled in OCT systems include: axial resolution & imaging depth, lateral resolution & field of view, and A-Scan rate & field of view:*
- Improving axial resolution decreases the maximum possible imaging depth.
- Improving lateral resolution contracts the field of view.
- A faster A-Scan rate results in reduced sensitivity
- A shorter wavelength improves lateral resolution but increases scattering from small features in tissue and other media



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

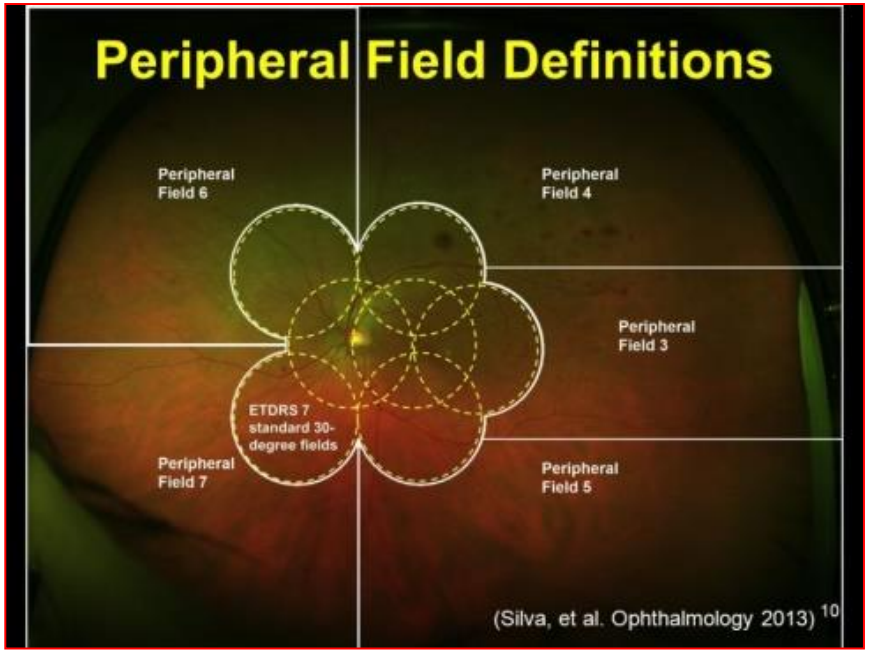


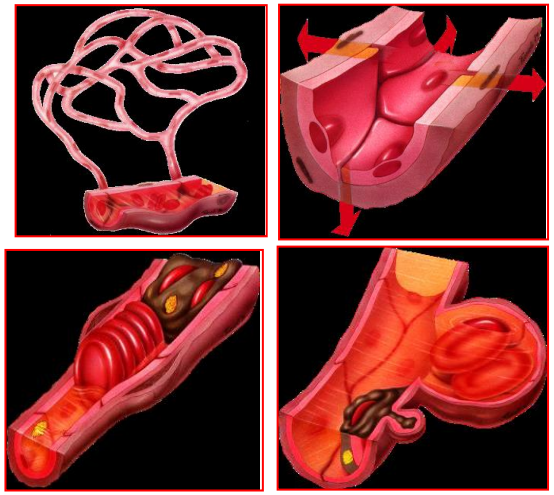
Plex Elite Zeiss HD Spotlight 16mm B-scan of normal eye

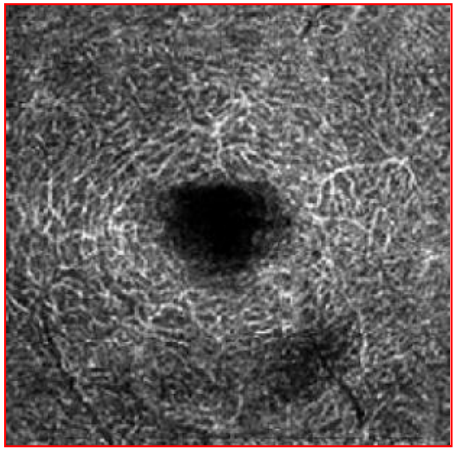


Superficial capillary

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



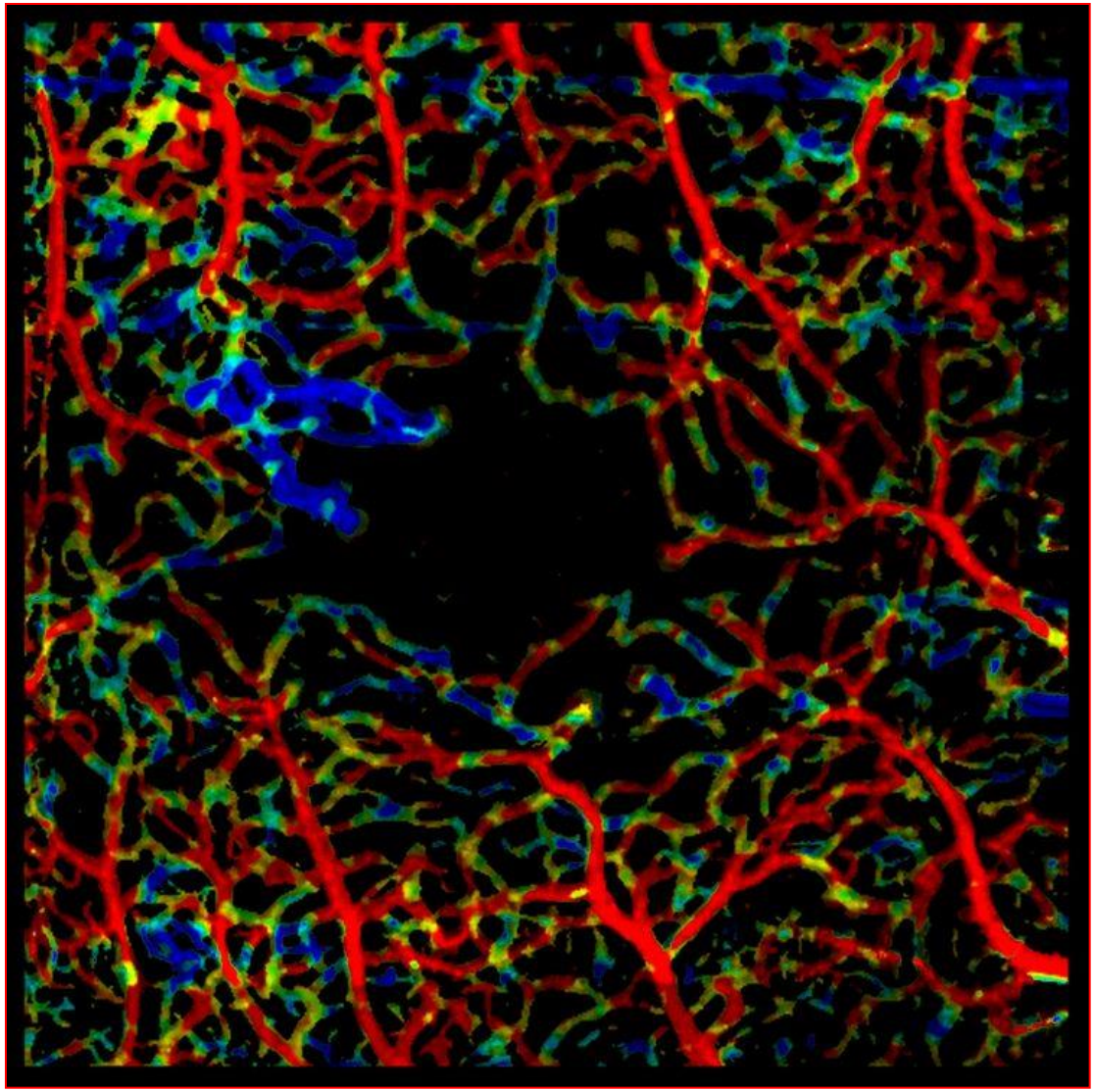


Deep capillary

# 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.

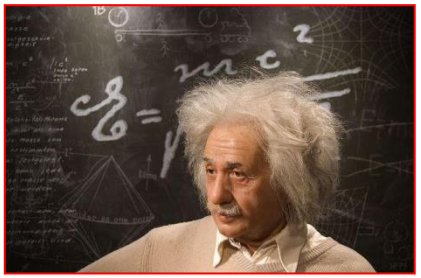


**Variable Interscan Time Analysis (VISTA)** is a step towards quantitative optical coherence tomography angiography (OCTA) that allows determination of relative blood flow speeds. As a next innovation, the VISTA developers have created 'VISTA visualisation', a method for mapping the VISTA data into 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**

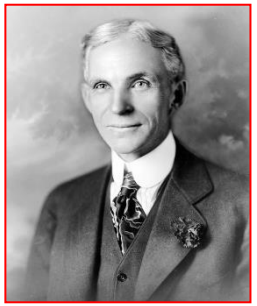
VISTA visualisation in a 30-year-old proliferative diabetic retinopathy patient taken over a 3mm × 3mm field of view **(red indicates faster blood flow speeds; blue indicates slower speeds).** Courtesy **OCT Research Group, MIT-NEEC**

*Tutto dovrebbe essere reso il più semplice possibile,*
*ma non più semplicistico*



A. Einstein 1879 – 1955

*C'è vero progresso solo quando i vantaggi di una nuova tecnologia*
*diventano per tutti*



Henry Ford 1863-1947

*Misura ciò che è misurabile, e rendi misurabile ciò che non lo è*

G. Galileo 1564 – 1642

*Se ascolto dimentico, se vedo ricordo, se faccio capisco*

Confucio 551 a.C. – 479 a.C.



# Thank you for your kind attention!