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 Ophthalmology Practice for the Future



OCT Angiography

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CASEY EYE INSTITUTE

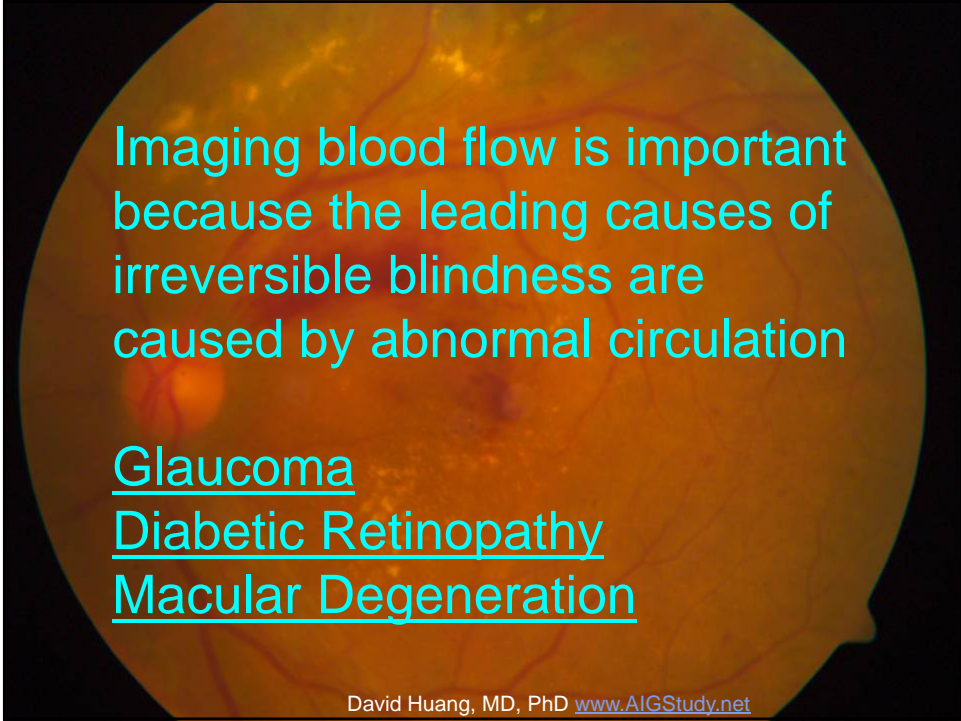
Financial Interests:

Dr. Huang has a significant financial interest in Carl Zeiss Meditec, Oregon Health & Science University (OHSU) and Dr. Huang have a significant financial interest in Optovue, a company that may have a commercial interest in the results of this research and technology. These potential conflicts of interest have been reviewed and managed by OHSU.

OCT captures tissue function as well as structure

Signal	Information	En Face	Cross Section	
Amplitude	Anatomy			Structural OCT
Doppler shift (between consecutive A-scans)	Total retinal blood flow (global circulation)			
Decorrelation (between consecutive B-scans)	Angiography (local circulation)			Functional OCT

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Imaging blood flow is important because the leading causes of irreversible blindness are caused by abnormal circulation

Glaucoma

Diabetic Retinopathy

Macular Degeneration

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High-Speed Swept-Source OCT



Experimental System - Not FDA-approved

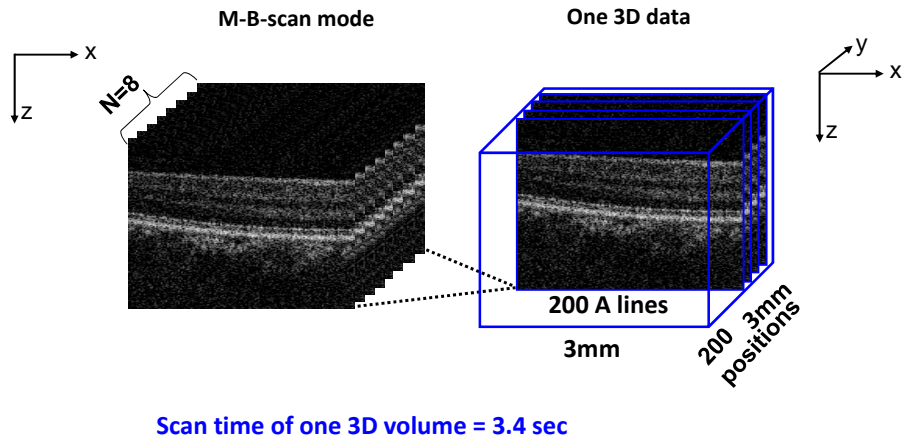
Developed by MIT Optic & Quantum Electronic Group (Fujimoto) and OHSU Center for Ophthalmic Optics and Lasers (Huang)

Performance features:

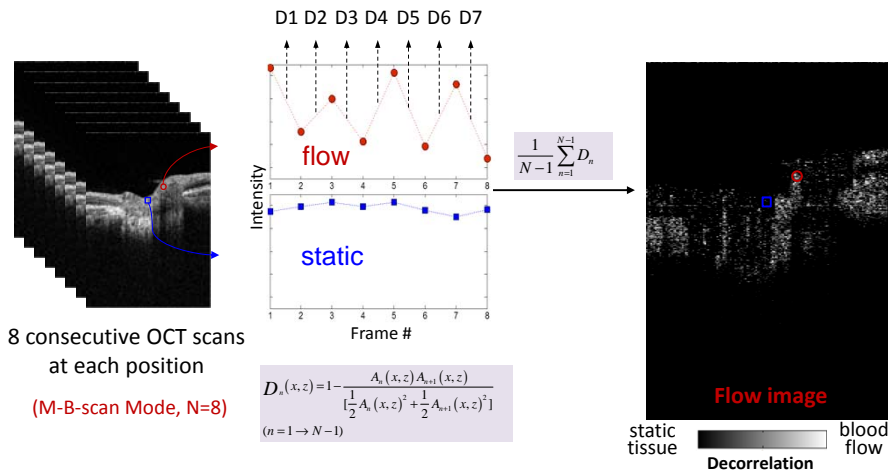
- 100,000 axial scans/sec
- 1050 nm tunable laser (deep penetration)
- 5.3 μm axial resolution in tissue

Potsaid B, et al., Optics Express 2010; 18:20029

OCT Angiography Scan Pattern

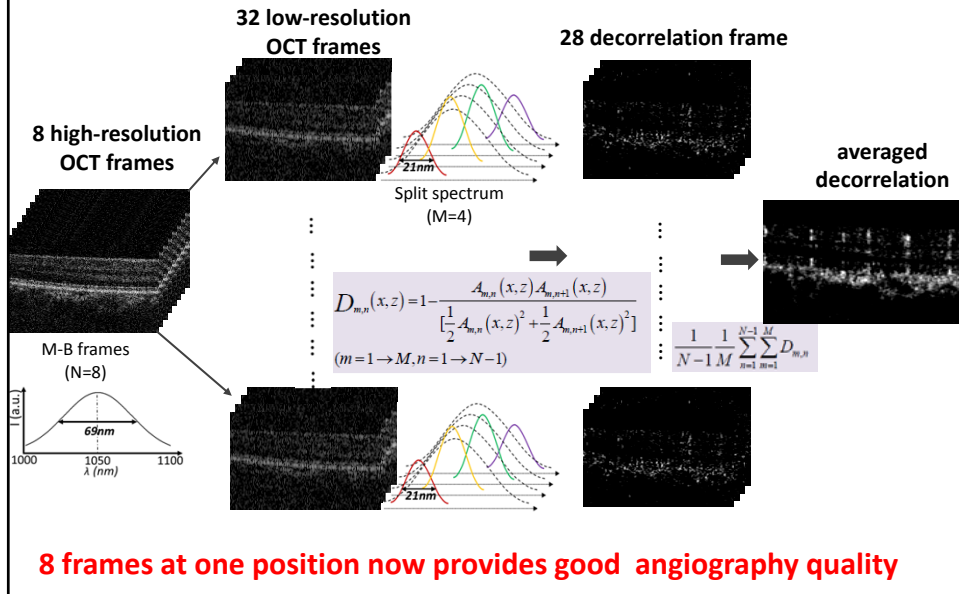


OCT amplitude-decorrelation angiography uses intrinsic contrast – no dye injection!



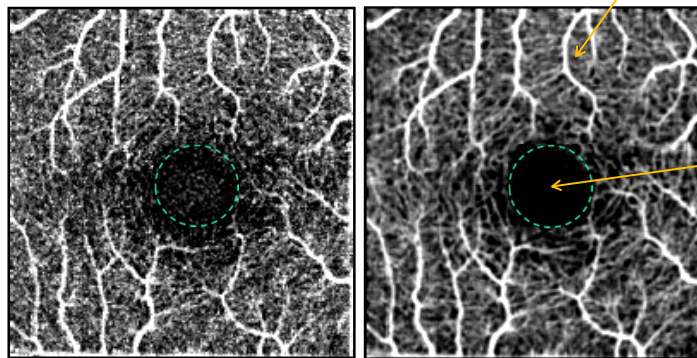
Problem: 8 frames at one position do not provide sufficient angiography quality

Solution: Split-Spectrum Amplitude Decorrelation (SSADA) Algorithm



Comparison of Angiography Algorithms

More continuous microvascular network



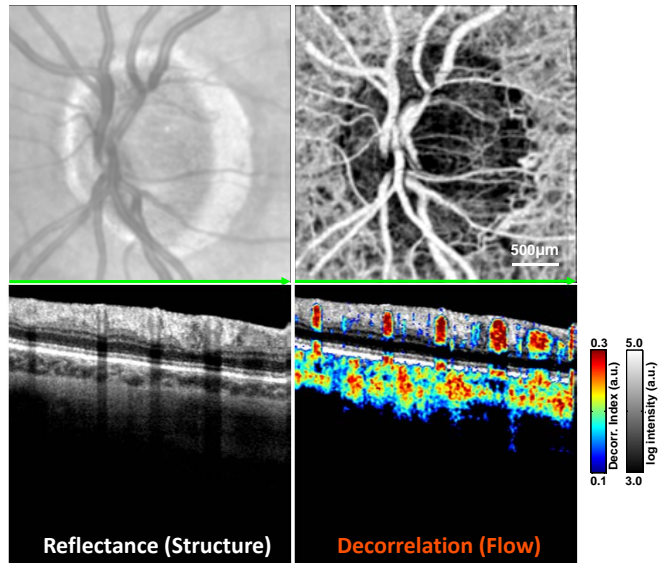
Less Noise
>2x SNR

Jia Y, Tan O, Tokayer J, Potsaid B, Wang Y, Liu JJ, Kraus MF, Subhash H, Fujimoto JG, Hornegger J, Huang D. Split-spectrum amplitude-decorrelation angiography with optical coherence tomography. *Optics Express* 2012; 20:4710

3D OCT Angiography of Optic Nerve Head

SSADA
algorithm
used

3x3x3 mm OCT
3D angiography
acquired in a
3-second scan



Jia Y, Tan O, Tokayer J, Potsaid B, Wang Y, Liu JJ, Kraus MF, Subhash H, Fujimoto JG, Hornegger J, Huang D.
Split-spectrum amplitude-decorrelation angiography with optical coherence tomography. *Optics Express* 2012; 20:4710

3D OCT Angiography of Optic Nerve Head – Layer by Layer

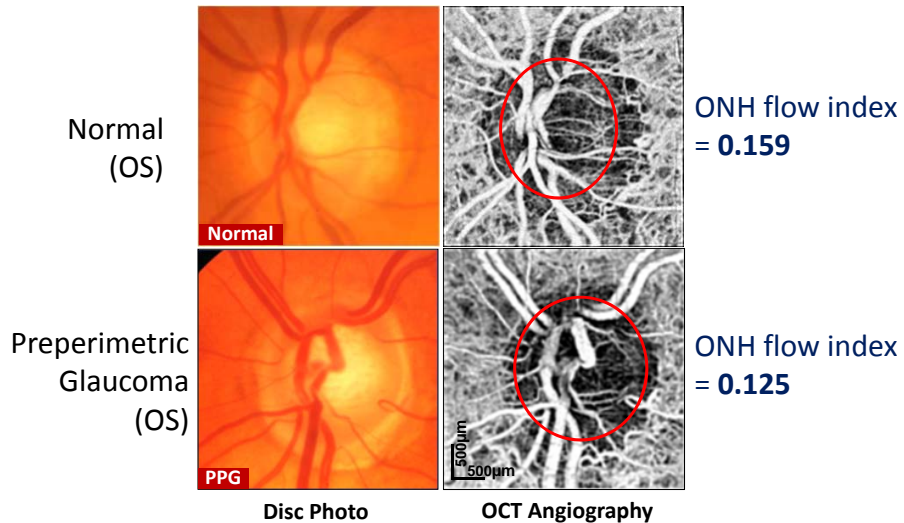
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Split-spectrum amplitude-decorrelation angiography with optical coherence tomography. *Optics Express* 2012; 20:4710

OCT Angiography Showing Reduced ONH Blood Flow in Pre-Perimetric Glaucoma



Jia Y, Morrison JC, Tokayer J, Tan O, Lombardi L, Baumann B, Lu CD, Choi WJ, Fujimoto JC, Huang D, Quantitative OCT angiography of optic nerve head blood flow, *Biomedical Optics Express* 2012; 3:3027

Pilot Study Subject Characteristics

- **Normal**
 - 24 eyes of 24 subjects
 - Age: 52 ± 10 years (mean \pm SD)
- **Glaucoma**
 - 11 eyes of 11 subjects
 - 8 perimetric glaucoma, 3 pre-perimetric glaucoma
 - Age: 68 ± 10 years

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Variability of Disc Flow Index (2x 2y registered OCT angiogram)

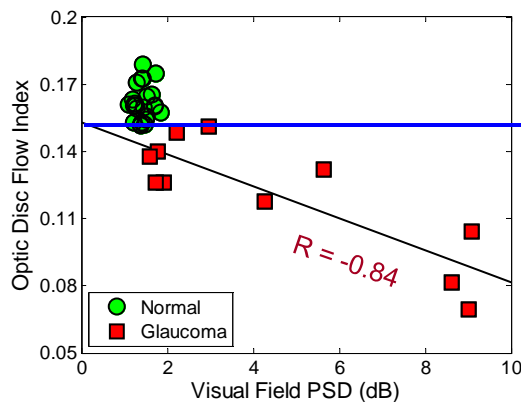
Normal Subjects

Intra-Visit Repeatability (n = 4)	Inter-Visit Reproducibility (n = 4)	Inter-Subject Variability (n = 24)
1.2%	4.2%	5.0%

Less variable than OCT NFL measurement !

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ONH flow index highly correlated with visual field



No overlap
between normal &
glaucoma groups

100% sensitivity
100% specificity

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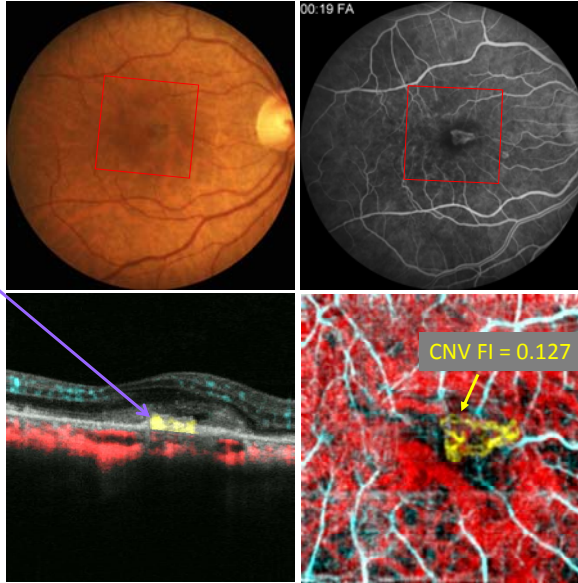
OCT Angiography of Age-Related Macular Degeneration: Type I Choroidal Neovascularization (CNV)

CNV between RPE & Bruch's membrane

3-Color OCT Angiography

- Inner retinal flow
- Outer retinal flow
- Choroid flow
- Structural OCT

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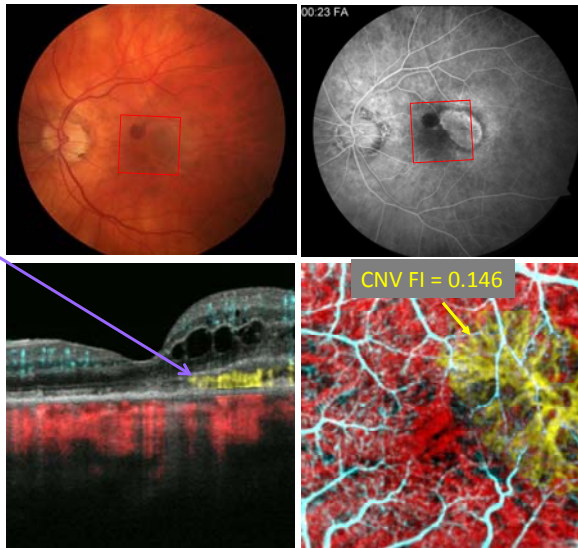
Type II CNV

CNV above RPE

3-Color OCT Angiography

- Inner retinal flow
- Outer retinal flow
- Choroid flow
- Structural OCT

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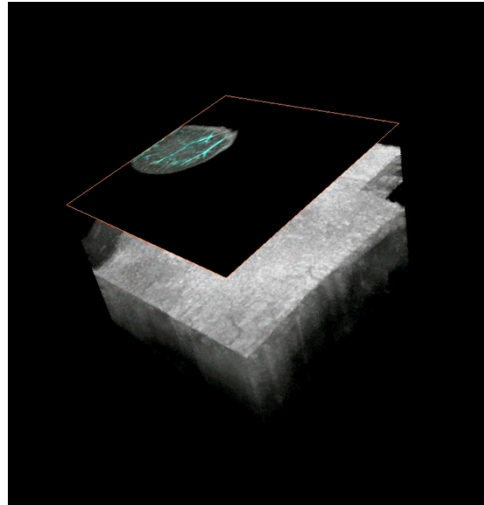


3D OCT Angiography Fly-Through Layer by Layer

Type II CNV

3-Color OCT Angiography

- Inner retinal flow
- Outer retinal flow
- Choroid flow
- Structural OCT



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OCT Angiography (SSADA) v. Fluorescein/ICG Angiography

OCT Advantages

- 3 dimensional
 - Easily separates disc, retinal, and choroidal circulations
 - Distinguish CNV above or below RPE
 - Sections & projections along any plane
- Quantitative
 - Flow index
- No injection
 - No vomiting or anaphylactic reaction

OCT Disadvantages

- Small field (3-4 mm)
 - Field will increase with higher speed
- No visualization of leakage and stain
 - But can visualize fluid space and retinal thickening

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National Eye Institute

NATIONAL INSTITUTES OF HEALTH



R01 EY013516 www.AIGStudy.net



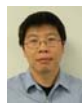
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