

# Automated volumetric choroidal neovascularization segmentation and quantification in swept-source OCT angiography using machine learning

Luis de Sisternes, PhD<sup>1</sup>; Homayoun Bagherinia, PhD<sup>1</sup>; Katherine Makedonsky, OD<sup>1</sup>; Ala El Ameen, MD<sup>2</sup>; Giovanni Gregori, PhD<sup>3</sup>; Philip Rosenfeld, MD, PhD<sup>3</sup>; Mary Durbin, PhD<sup>1</sup>

<sup>1</sup>Carl Zeiss Meditec, Inc., Dublin, CA; <sup>2</sup>Créteil University Hospital, Créteil; <sup>3</sup>Bascom Palmer Eye Institute, Miami, FL

Poster # 3487-A0330

## PURPOSE

Volumetric characteristics of choroidal neovascularization (CNV) are difficult to quantify in swept-source OCT angiography (SS-OCTA) due to difficulties making volumetric manual annotations. We propose a method to automatically segment and quantify CNVs in a volumetric manner in SS-OCTA data, enabling the automated characterization of CNV activity

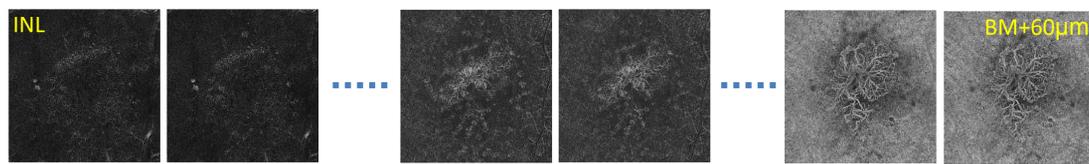
## METHODS

**Input data:**  
SS-OCTA PLEX® Elite 9000 volumes with AngioPlex OCT Angiography (ZEISS, Dublin, CA)

### Volumetric Projection Artifact Removal

### Overlapping thin slab generation:

- 20µm thickness with ≥50% overlap
- Spanning between inner nuclear layer (INL) and Bruch's membrane (BM)+60µm



### Feature Extraction:

- Features extracted for all slabs in 100µm radius circular patches with ≥75% overlap.
- 30 textural features in each patch (Haralick, Frangi magnitude and direction).
- Location feature (relative to BM to internal limiting membrane (ILM) distance).

### Machine learning model:

- Random Forest model trained with manual annotations (357 slabs with 5.4M patches from 24 CNV and 2 non-CNV eyes).
- Each extracted patch is evaluated to output a score related to CNV presence.

### Segmentation Reconstruction in Volume:

- Patch score set within the volume spanned by patch (10µm thickness 100µm radius)
- Morphological operations to refine segmentation (remove small regions).

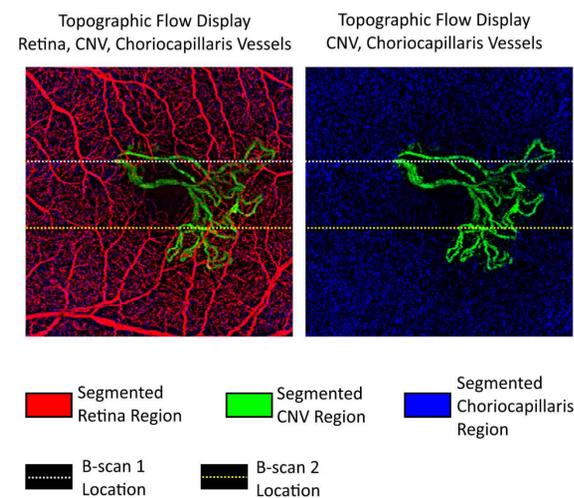
### CNV Quantification:

- CNV volume and enface area: Absolute and relative
- CNV vessel and perfusion density
- CNV intrusion through BM: absolute and relative maximum and average values

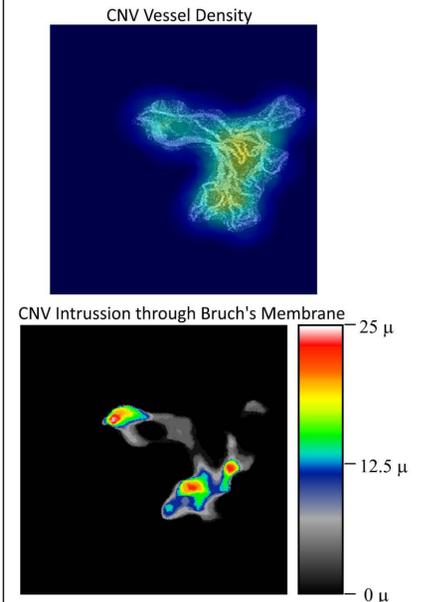
## RESULTS

Number in evaluation CNV / non-CNV	Accuracy CNV detection within volume	Segmentation sensitivity (median)	Segmentation specificity (median)	Segmentation Dice Coef. (median)
28 / 18	100%	0.86	0.96	0.63

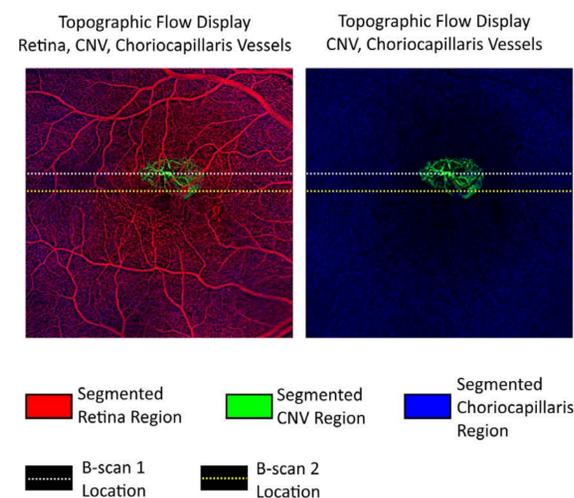
### EXAMPLE SEGMENTATION DISPLAY



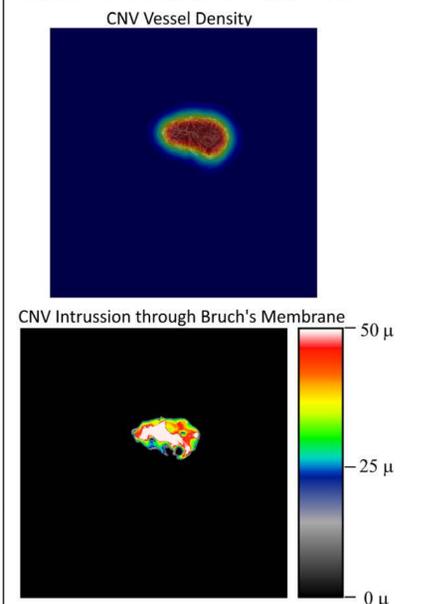
### EXAMPLE FEATURE DISPLAY



### EXAMPLE SEGMENTATION DISPLAY



### EXAMPLE FEATURE DISPLAY



## CONCLUSIONS

Our novel method provides a set of volumetric characteristics of CNV within SS-OCTA data that can be computed automatically and seems very promising to monitor CNV activity in patients over time. The features extracted from the automated segmentations provide a comprehensive characterization of CNV within the SS-OCTA volume that would be very difficult to obtain manually.