

# Quantitative analysis before and after self-supervised denoising on OCTA images



Qinqin Zhang, PhD<sup>1</sup>; Eva Hoeck, MSc<sup>2</sup>; Mengxi Shen, MD<sup>3</sup>; Giovanni Gregori, PhD<sup>3</sup>; Philip J Rosenfeld, PhD, MD<sup>3</sup>; Niranchana Manivannan, PhD<sup>1</sup>

<sup>1</sup>Carl Zeiss Meditec, Inc., Dublin, CA, USA; <sup>2</sup>Carl Zeiss AG, Munich, Germany; <sup>3</sup>Department of Ophthalmology, Bascom Palmer Eye Institute, University of Miami Miller School of Medicine, Miami, FL, USA

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## PURPOSE

- The quality of optical coherence tomography angiography (OCTA) images is crucial for the accurate interpretation of morphological changes in the retinal vasculature and affects the quantitative analysis results.
- We demonstrated self-supervised denoising approaches to investigate the repeatability of quantitative parameters, e.g., vessel density (VD) and perfusion density (PD), on OCTA images before and after denoising.

## METHODS

- Self-supervised denoising with Noise2Void [1] and the adaptation StructNoise2Void [2] were trained to consider spatially correlated noise structure.
- 3D and 2D U-Nets were used for 3D OCTA volume denoising and 2D slab denoising respectively.
- Angio 6×6 mm scans with 500 A-lines × 500 B-scans from PLEX® Elite 9000 SS-OCT (ZEISS, Dublin, CA) were used for training and evaluation. To train the models, 54 × 4 images from superficial, deep, retina and choriocapillaris slabs were utilized for 2D slab denoising and 54 × 500 B-scans were used for 3D volume denoising.
- Multi-layer segmentation was performed after 3D volume denoising and the en face OCTA slabs were generated.
- Automatic threshold, based on the en face images, was used to obtain the binary images for VD and PD measurement. VD and PD were calculated in a 6 mm circle of the retina slab (Figure 1) before and after denoising.
- The coefficient of variation (CV) was measured to test the repeatability of the quantitative analysis on retinal slab before and after denoising. A decrease in CV indicates improvement in the repeatability.

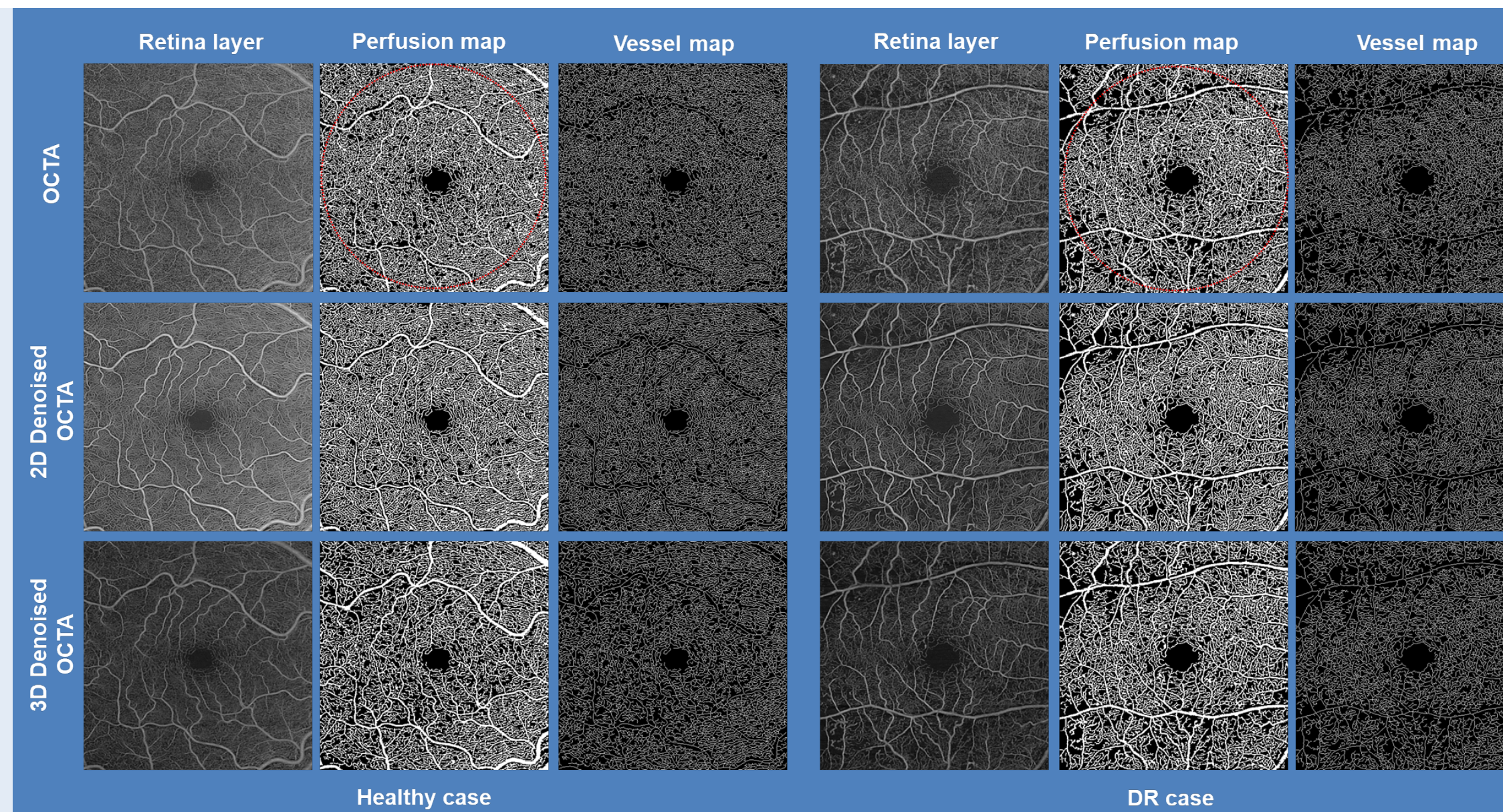


Figure 1: Examples of OCTA images, perfusion area map and vessel length map before and after 2D slab and 3D volume denoising.

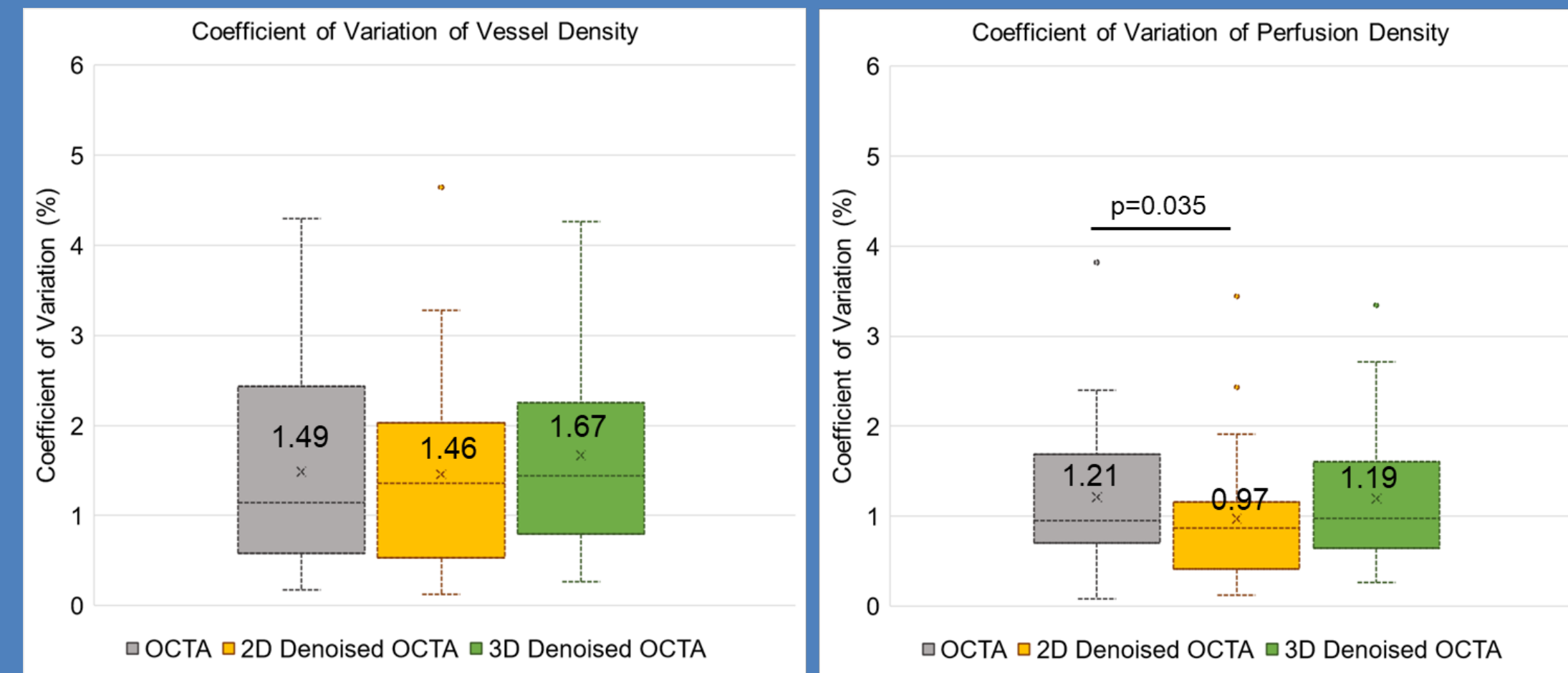


Figure 2: The CV measurements of VD and PD of OCTA images before and after denoising. Mean values (x) of each group are displayed.

Email: qinqin.zhang@zeiss.com

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## RESULTS

- 15 healthy subjects and 15 diabetic retinopathy (DR) patients with three repeated scans were enrolled.
- CV<sub>VD</sub> improved by 2.0% (p= 0.45) after 2D denoising but increased by 12.1% (p= 0.072) after 3D denoising (no statistical difference before and after denoising).
- CV<sub>PD</sub> improved by 19.8% (p= 0.035) and 1.7% (p= 0.43) after 2D and 3D denoising, respectively (Figure 2).

## CONCLUSIONS

- The preliminary results from this pilot study showed the self-supervised denoising approaches on both 2D OCTA slab and 3D OCTA volume may provide improved repeatable measurements in quantifying the vasculature perfusion density.
- The bias that these denoising models may introduce in the VD and PD measurements were not analyzed here.
- Future studies will be conducted to investigate the bias and also to investigate the influence of image quality of OCT/OCTA scans before and after denoising.

## REFERENCES

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