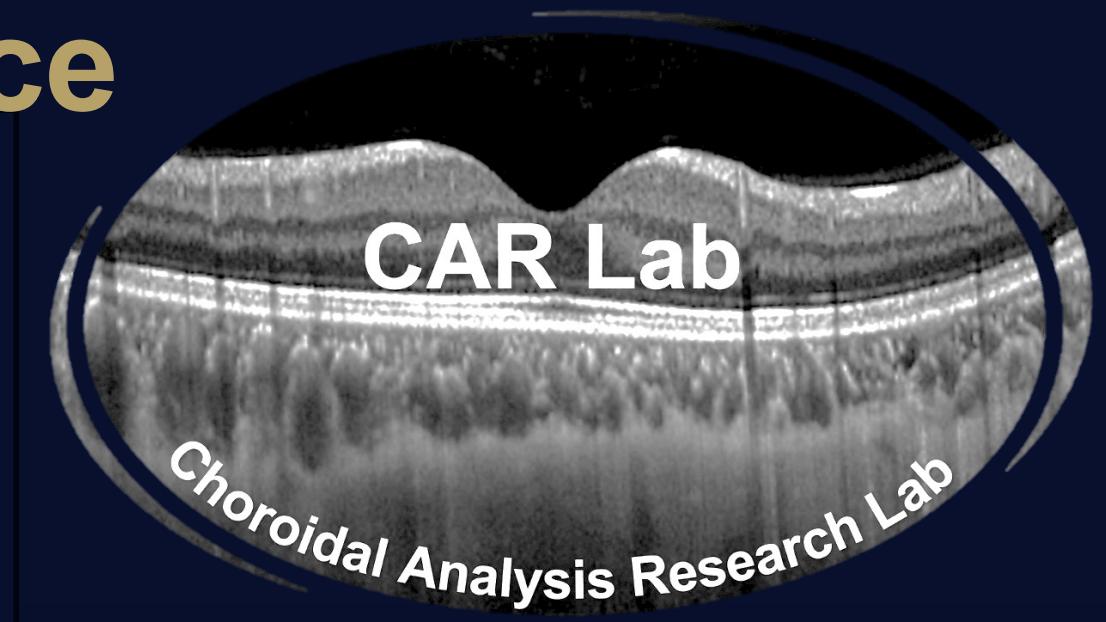




Retinal sublayer segmentation based on deep learning using optical coherence tomography B-Scans: Training multilayer masks vs boundary labels

Adarsh Gadari³, Bollepalli Sandeep Chandra¹, Mohammed Nasar Ibrahim¹, José-Alain Sahel², Jay Chhablani², Shan Suthaharan³, Kiran Kumar Vupparaboina¹

¹Department of Ophthalmology, University of Pittsburgh, Pittsburgh, PA, United States; ²University of Pittsburgh School of Medicine, Pittsburgh, PA, United States; ³University of North Carolina at Greensboro, Greensboro, NC, United States;



INTRODUCTION

- Eye diseases like age-related macular degeneration (AMD) and diabetic retinopathy (DR) exhibit localized retinal structural changes.
- Enabling quantitative assessment of retinal sublayer thickness shall assist in early detection, accurate disease diagnosis and monitor treatment response [1].

METHODS

- Reference segmentations, validated by experts, are used to create 177 EDI image triplets as shown in Figure 1.
- Compared qualitative assessment of standalone convolutional deep learning models (U-Net [2], Res U-Net) and conditional Generative Adversarial Networks [3] under layer boundaries and mask conditions.

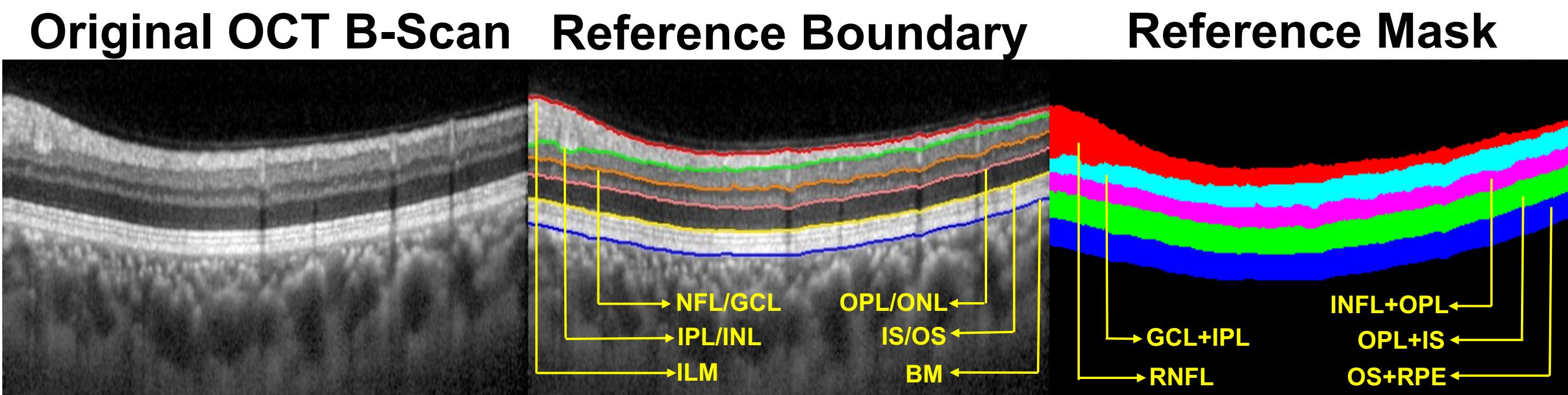


Figure 1. Representation of the layer boundaries and mask for the EDI OCT images. Where, **ILM**: Inner limiting membrane, **NFL**: Nerve fiber layer, **IPL**: Inner plexiform layer, **INL** : Inner nuclear layer, **OPL**: Outer plexiform layer, **ONL**: Outer nuclear layer, **IS/OS**: Inner segment/Outer Segment, **BM**: Bruch's membrane

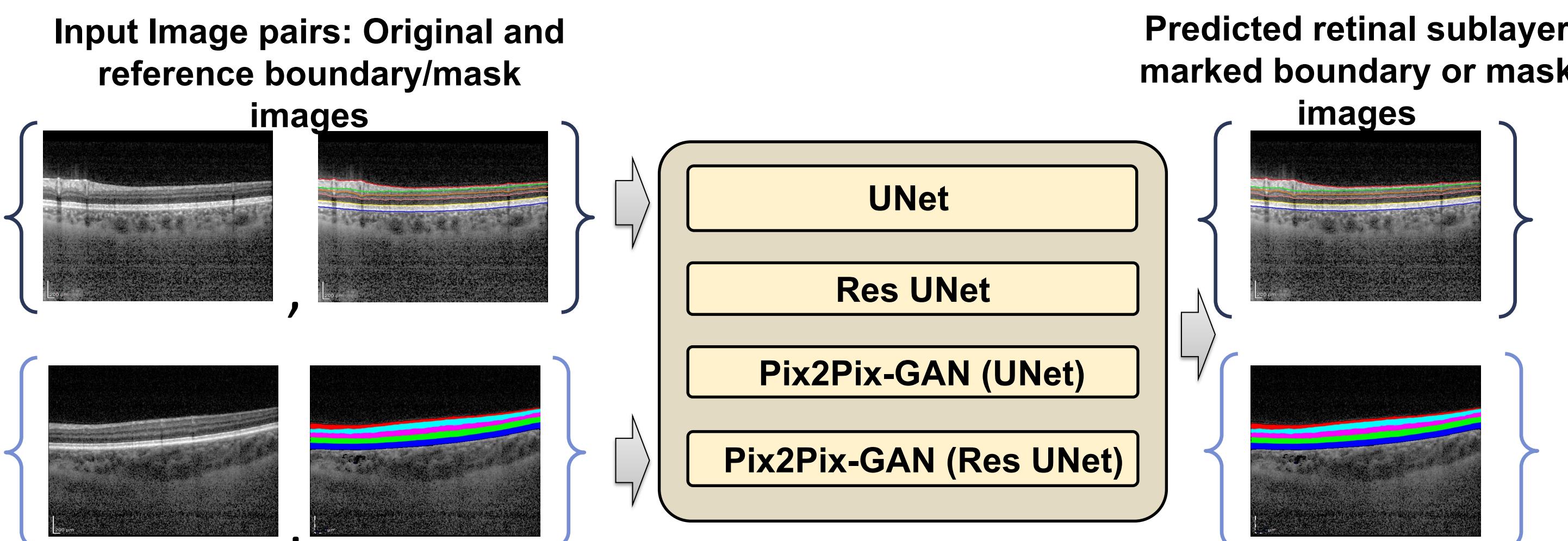


Figure 2: Pictorial representation of the methodology, where we input the image pairs and retrieve a predicted image

RESULTS

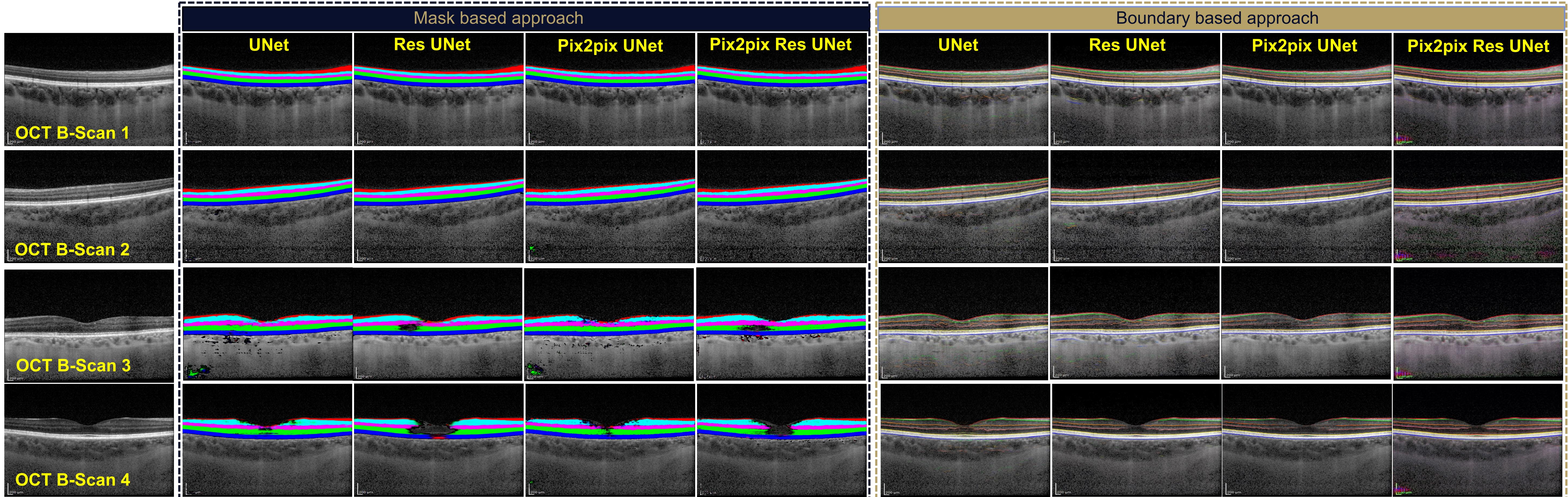


Figure 3: Mask vs Boundary-based models: Comparison of segmentation outputs

CONCLUSIONS

- Consistent across the models, the boundary-based segmentation received higher score.
- Comparing the quality of images, Pix2Pix GAN with Res U-Net outperformed other methods, especially with poor quality images.
- However, on good-quality images, all the models yielded comparable results.
- Generative Adversarial Networks based on boundary segmentations serve as a better model than other deep learning models.

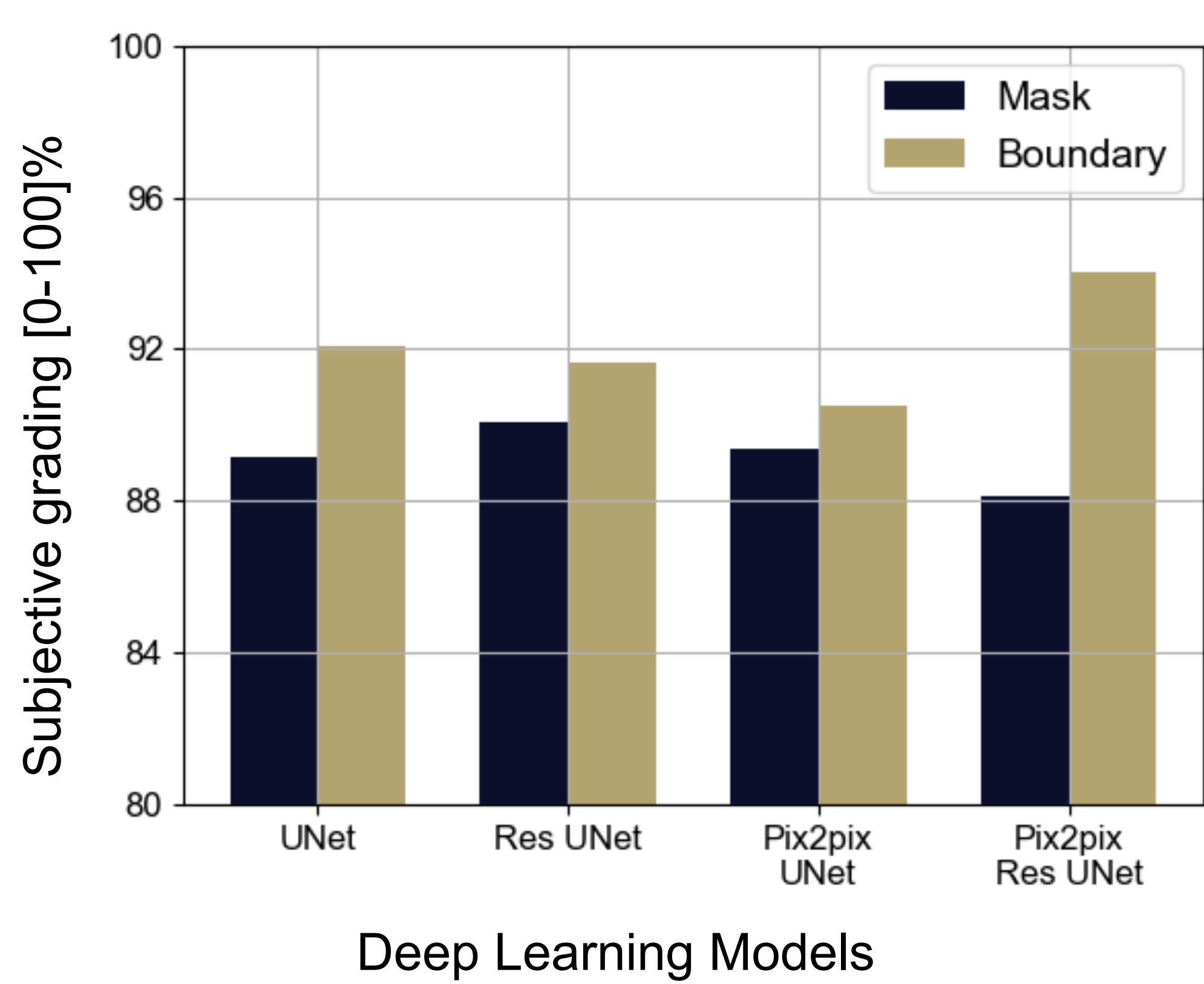


Figure 4: Subjective grading for mask and boundary predictions for various deep learning models.

REFERENCES

- Gadari et al., "Robust Retinal Layer Segmentation Using OCT B-Scans: A Novel Approach Based on Pix2Pix Generative Adversarial Network." ACM-BCB 2023
- Ronneberger et al., "U-Net: Convolutional Networks for Biomedical Image Segmentation" MICCAI 2015
- Isola et al., "Image-to-Image Translation with Conditional Adversarial Networks" CVPR 2017

Funding: This work was supported by NIH CORE Grant P30 EY08098 to the Department of Ophthalmology, the Eye and Ear Foundation of Pittsburgh; the Shear Family Foundation Grant to the University of Pittsburgh Department of Ophthalmology; an unrestricted grant from Research to Prevent Blindness, New York, NY; and partly by Grant BT/PR16582/BID/7/667/2016.

