

# Deep learning based GA segmentation in fundus autofluorescence images

Niranchana Manivannan, PhD<sup>1</sup>; Katherine Makedonsky, OD<sup>1</sup>; Cancan Lyu, MD<sup>2</sup>; Giovanni Gregori, PhD<sup>2</sup>; Philip J. Rosenfeld, MD, PhD<sup>2</sup>; Mary K. Durbin PhD<sup>1</sup>

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

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## PURPOSE

Geographic atrophy (GA) is an advanced form of age-related macular degeneration (AMD). Automatic segmentation and quantification of GA lesions are important in determining disease progression and clinical diagnosis. The objective of this research is to develop an automated GA segmentation algorithm for fundus autofluorescence (FAF) images using deep learning

## METHODS

- This retrospective study used 79 FAF-Green images obtained from 62 patients with GA using CLARUS™ 500 (ZEISS, Dublin, CA). The training and testing sets comprised 55 and 24 images respectively.
- Data augmentation methods were used to generate 880 patches of size 128\*128 pixels for training.
- The contracting path of the U-Net consists of four convolutional neural network (CNN) blocks. Each CNN block consists of 2 CNN layers followed by one max pooling layer.
- The bottleneck consists of 2 CNN layers with 0.5 inverse dropout. The expansive path of the network consists of 5 blocks, each block consists of a deconvolution layer, a concatenation layer followed by 2 CNN layers.
- A custom dice coefficient loss was used for training the model.
- The segmentation was fine-tuned by using 'Icing on the Cake' method on the last layer.
- Morphological operations further refined the segmentation by removing small isolated regions.
- Expert graders manually delineated GA regions.
- Segmentations by the algorithm were compared to the manual delineations using visual comparison (qualitative evaluation) and the following quantitative measurements: fractional area difference, overlap ratio and Pearson's correlation between measured areas.

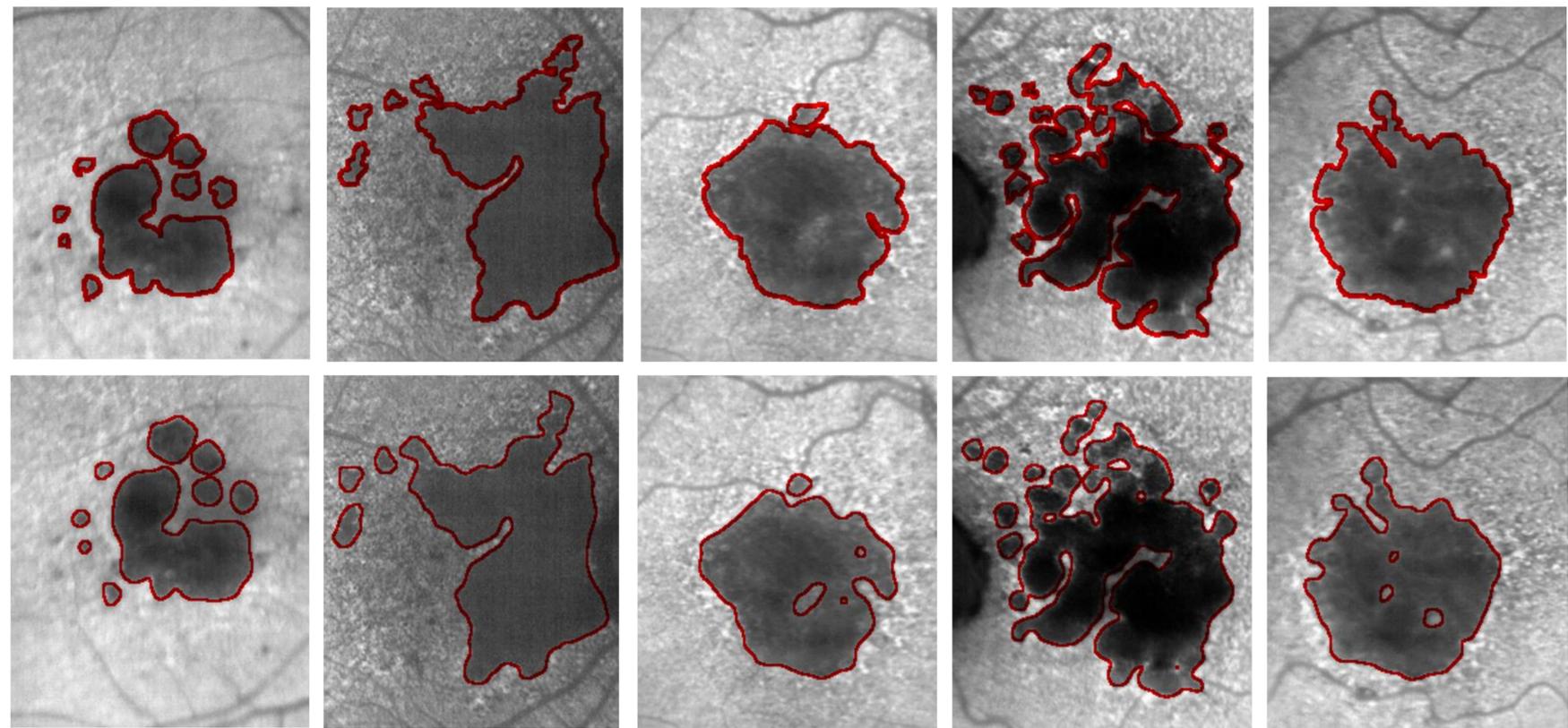
## RESULTS

### Qualitative evaluation:

- Figure 1 shows the results of the proposed algorithm.
- Visual evaluations of the segmentations generated by the algorithm show good agreement with the manual segmentations drawn by the graders.

### Quantitative evaluation:

- The fractional area difference between GA regions generated by the proposed algorithm and the manual segmentation was  $4.40\% \pm 3.88\%$ .
- Overlap ratio between manual and automatic segmentation was  $92.76\% \pm 5.62\%$ .
- Correlation of GA areas generated by the algorithm and the manual segmentations was 0.995 (p-value < 0.001).



**Figure 1:** Manual segmentations done by experts (top row) and the proposed algorithm results (bottom row)

## CONCLUSIONS

Quantitative and qualitative evaluations demonstrate that the proposed deep learning algorithm for segmenting GA in FAF images shows very strong agreement with manual segmentations.