

# Automatic laterality finding in widefield fundus images for use in broad line fundus imaging devices

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## PURPOSE

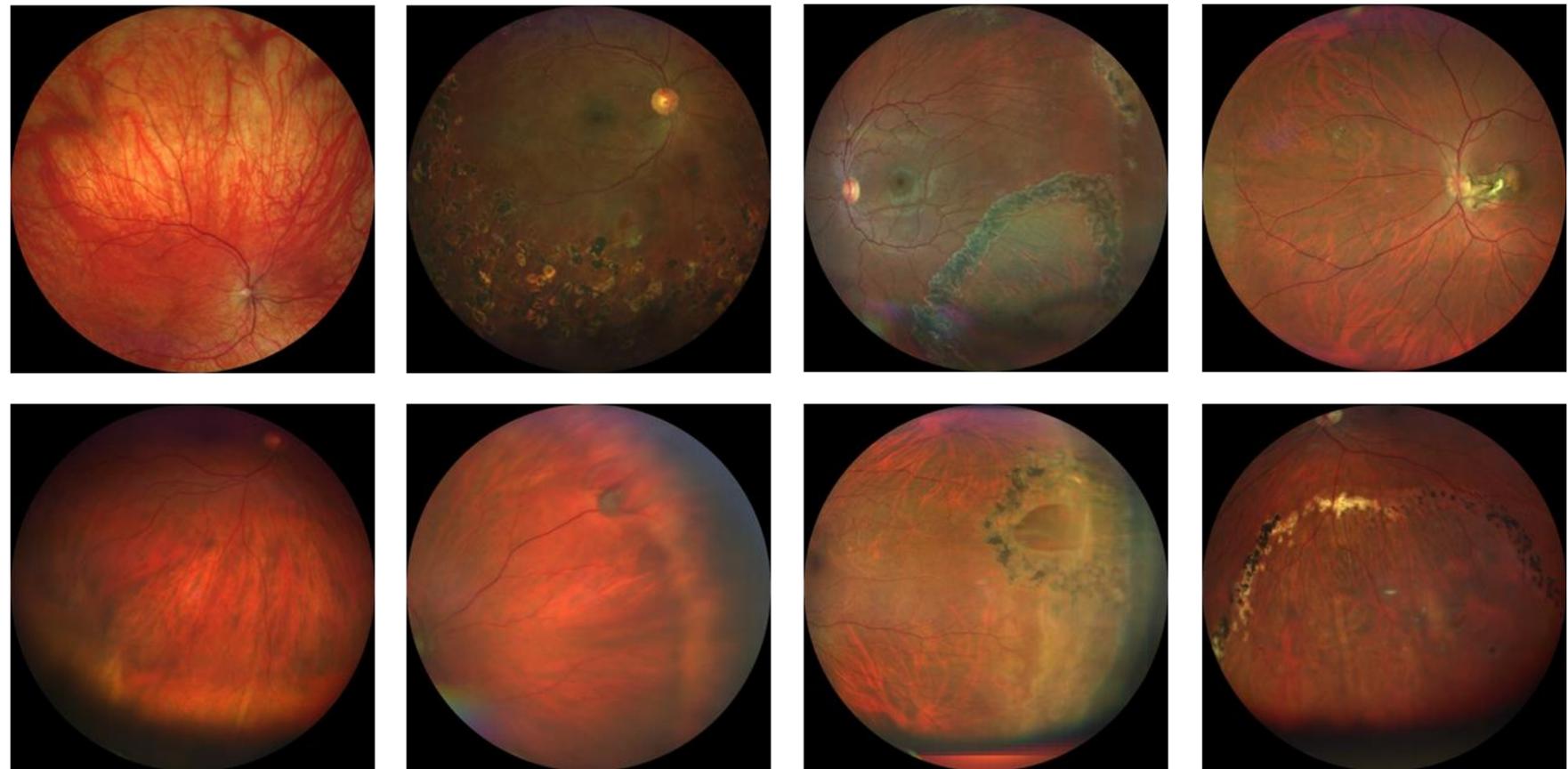
Determination of laterality is critical for fundus image analysis workflows. A laterality finding algorithm would simplify the workflow by automatically determining the laterality of widefield fundus images and reduce errors caused by manual inputs from ophthalmic photographers or sensor detection. Such an algorithm would benefit all fundus imaging devices, but specifically handheld devices, without physical sensors.

## METHODS

- **Training data** consists of 2374 images taken using CLARUS™ 500 (ZEISS, Dublin, CA) of pixel size 3072x3072 each with OD and OS labels (OD = 1296, OS = 1078).
- **Test data** consists of 1756 images with OD and OS labeled by an expert grader (OD = 1010, OS = 746).
- Data augmentation methods are used to increase the size of data set by two folds.
- The training and test data has a mixture of healthy and diseased eyes collected using different fixations in a typical clinical setting.
- As a preprocessing step, images are down-sampled to 512x512 pixels after using an anti-aliasing filter and histogram adjustment.
- The Convolutional Neural Network (CNN) block consists of three layers of CNN followed by one fully connected layer.
- Rectified Linear Unit (ReLU) activation is used for each CNN layer followed by Sigmoid activation for the fully connected layer.
- An inverted Dropout with a 0.5 probability is applied as a regularization scheme to prevent the network from over-fitting.
- The binary labels generated from the network is compared with labels marked by expert graders in the test data set.

## RESULTS

- The algorithm achieved an accuracy of **98.42%** in detecting OD labels and **98.93%** in detecting OS labels.
- The **combined accuracy** of the network is **98.63%**.
- Figure 1 shows examples of images for correct and incorrect deductions.
- The analysis of images with incorrect deductions shows most of images lack either an optic nerve head or parts of major blood vessels in the retina.



**Figure 1:** The images in the top row are correctly classified by the algorithm for laterality and the images in the bottom row are incorrectly classified.

## CONCLUSION

- The proposed algorithm provides an accurate and fast solution for automatically finding laterality for handheld or tabletop fundus imaging devices.
- To the best of our knowledge, this is the first automated method for laterality determination in widefield broad line fundus images.