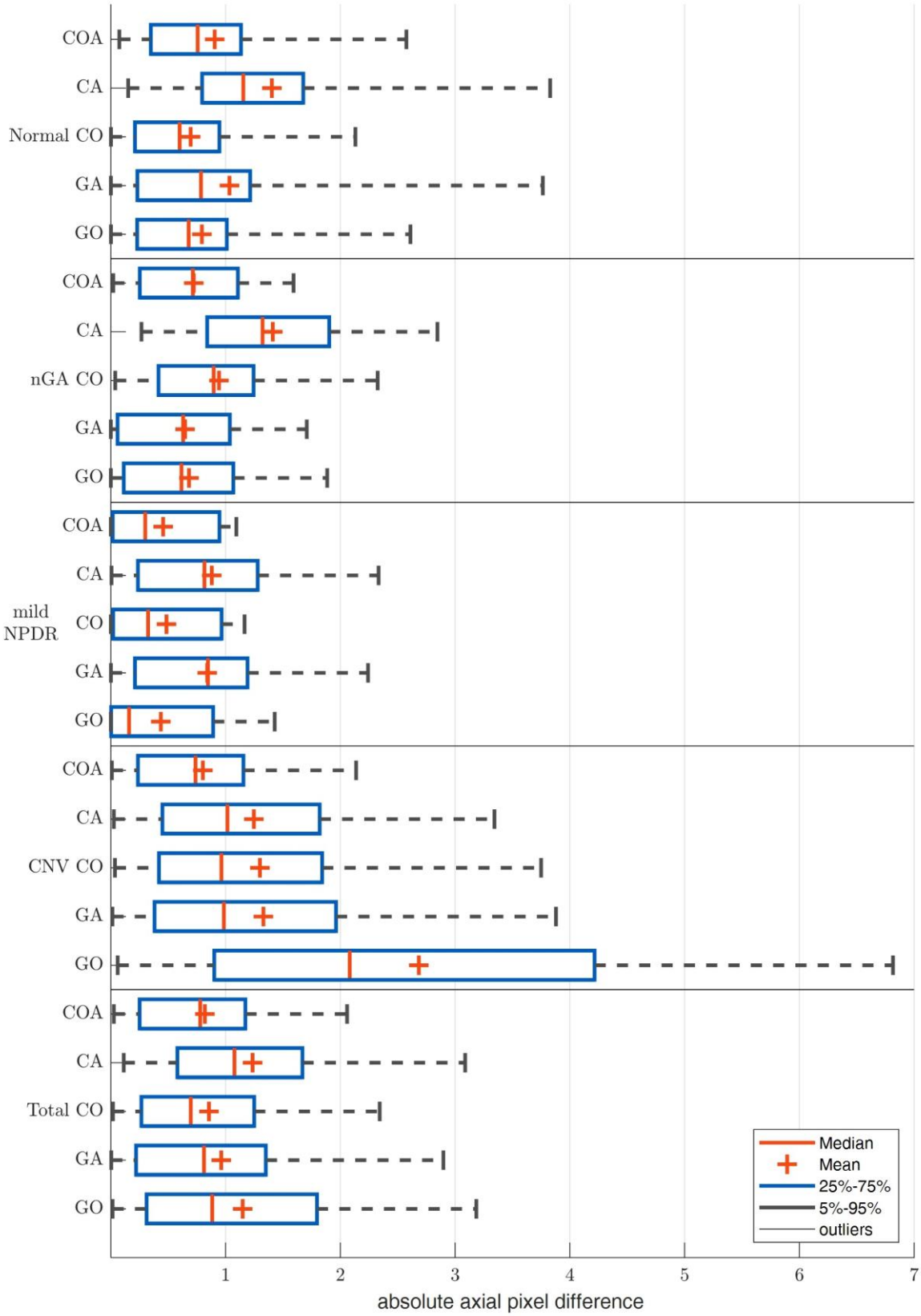
Deep learning based hybrid OCT-OCTA segmentation of Bruch's membrane in pathology

Purpose: Segmenting Bruch's membrane (BM) is an important step for analysing the choriocapillaris in optical coherence tomography (OCT) and OCT angiography (OCTA). Manual segmentation of volumetric OCT/OCTA is impractically laborious, motivating automatic approaches. However, the development of automatic algorithms for BM segment is hindered by the presence of pathology, which often leads to significant chorio-retinal distortions. In this study we introduce a novel segmentation algorithm that uses convolutional neural network (CNN) to compute the edge-weights of a joint OCT-OCTA graph-cut algorithm.

Methods: We compare the performance of our CNN-weighted joint OCT-OCTA algorithm to that of four other graph-cut methods, whose edge-weights are determined by: (1) axial-OCT-gradient; (2) axial-OCTA-gradient; (3) CNN trained on OCT; (4) CNN trained on OCTA. The training, validation and test set each consist of four manually labelled volumes (500 B-scans each) per group: healthy controls, choroidal neovascularization (CNV), mild non-proliferative diabetic retinopathy (NPDR), and nascent geographic atrophy (nGA). All algorithm parameters were determined on the validation set, and the CNN architectures of the three learning methods were kept constant to facilitate comparison. The algorithms were quantitatively evaluated by computing the A-scan-wise absolute difference between the automatic and the manual segmentation results.

Results: The absolute pixel-wise errors between the manual and automatic segmentation of the different approaches are summarized in Figure 1.

Conclusions: CNN-weighted joint OCT-OCTA segmentation appears promising to work reliably over a wide range of pathologies, particularly in the CNV group. Further studies with larger cohorts are needed to elucidate the advantages of combining OCT and OCTA information in segmentation.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absolute axial pixel difference