

Merged 3D volume of optic nerve head using transfinite interpolation

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1. Introduction

The total area of an optic nerve head drusen is often hard to see due to signal loss under the druse in OCT scans. By using two sets of B-scans acquired in two different directions, horizontal and vertical, a merged 3D volume is created. The merged volume contains more information and will hopefully help us in a later segmentation of drusen. The two B-scans each represent a volume containing 37 B-scans with dimension 384 A-scans x 496.

2. Methods

2.1 Alignment

The horizontal and vertical set of B-scans each had a set of (x, y) -coordinates for each B-scan as seen on Figure 1a. The overlapping region (as seen on Figure 1c) between the two data sets contained 36 x 36 knot points. The data at each knot point was estimated using linear interpolation across the B-scan. Afterwards, a more detailed grid was used for the final merged volume using transfinite interpolation.

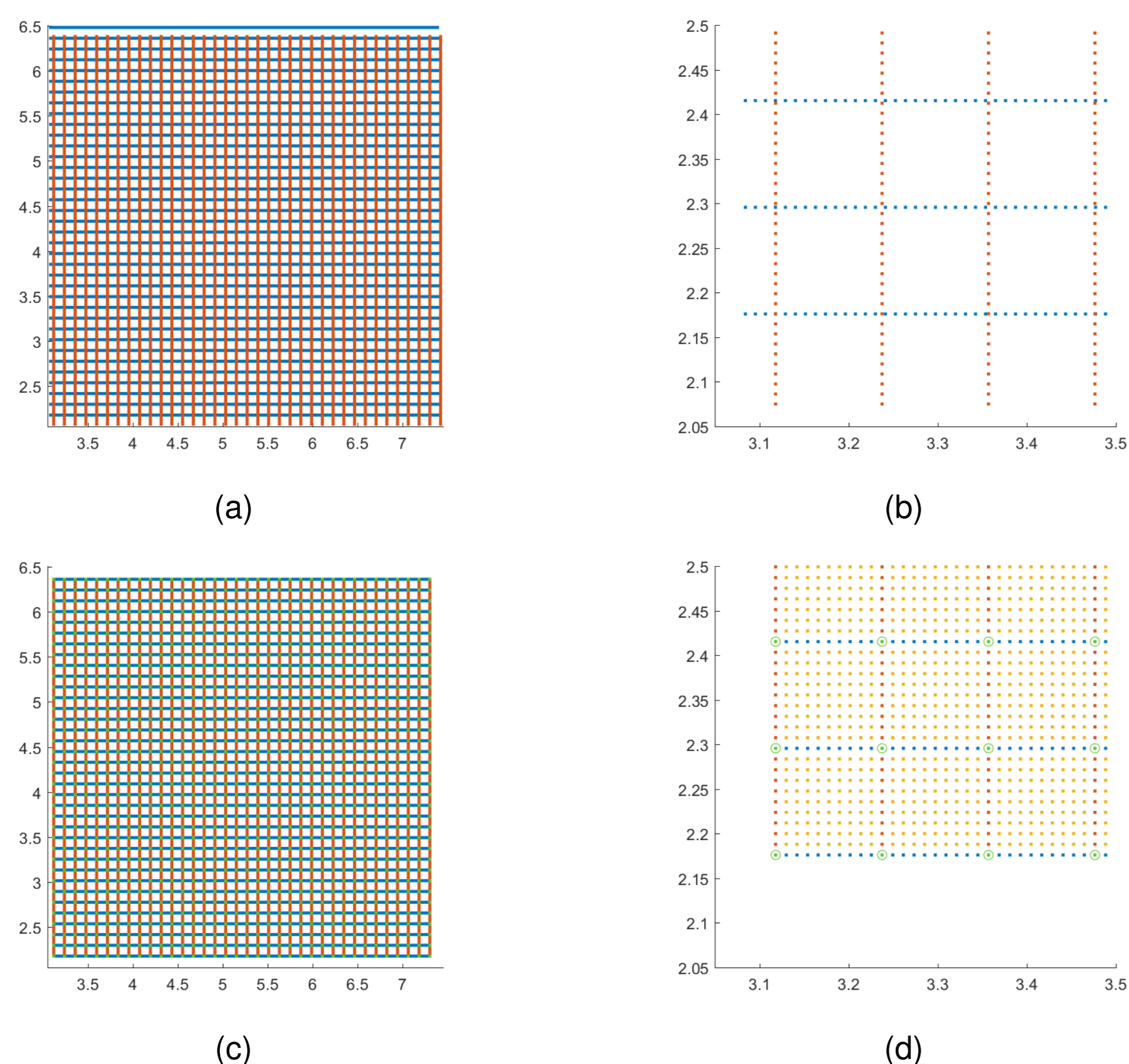


Figure 1: (a) Coordinates for the horizontal B-scans (blue) and for the vertical B-scans (red) at acquisition. (b) Zoom in on the coordinates. As shown, the two data set coordinates do not contain any acquired data in the knot points. (c) The overlapping region between the two data sets is marked and a grid with 36 knot points is used. (d) A more dense grid used for an interpolation to get a merged volume.

2.2 Column shift

A correction for the eye movement was performed by a column wise shift. The column shift was performed on the 36 x 36 grid (knot points) using the cross-correlation between the columns in each volume. The same scan in the two volumes and the difference in optic layer level can be seen on Figure 2.

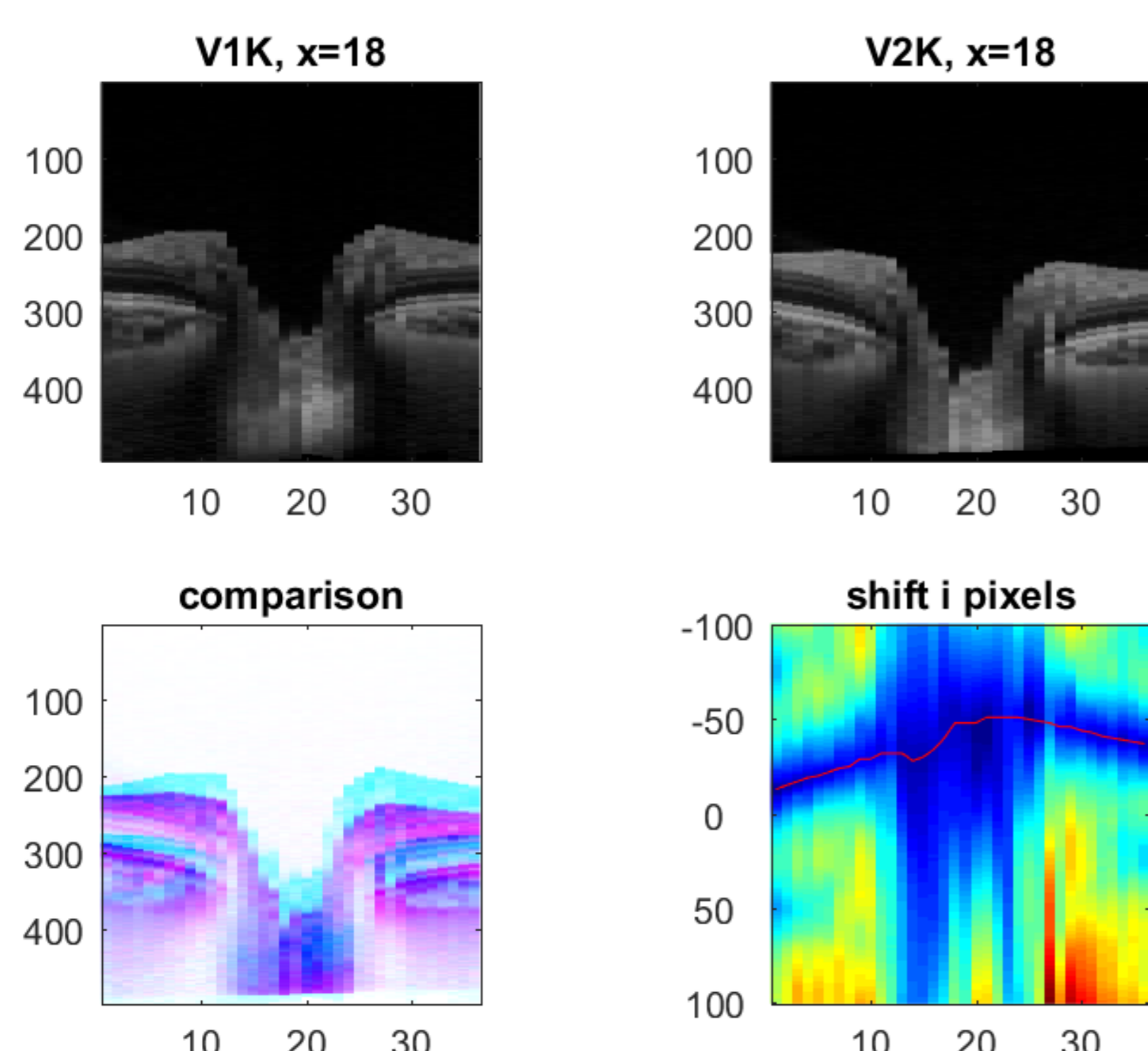


Figure 2: Same scan in the vertical and horizontal scan volume and the difference between them. An estimate of the column shift needed in pixels.

3. Results

Figure 3 shows the same scan after the column shift. Figure 4 shows the overall needed column shift for 36 x 36 grid measured in pixels.

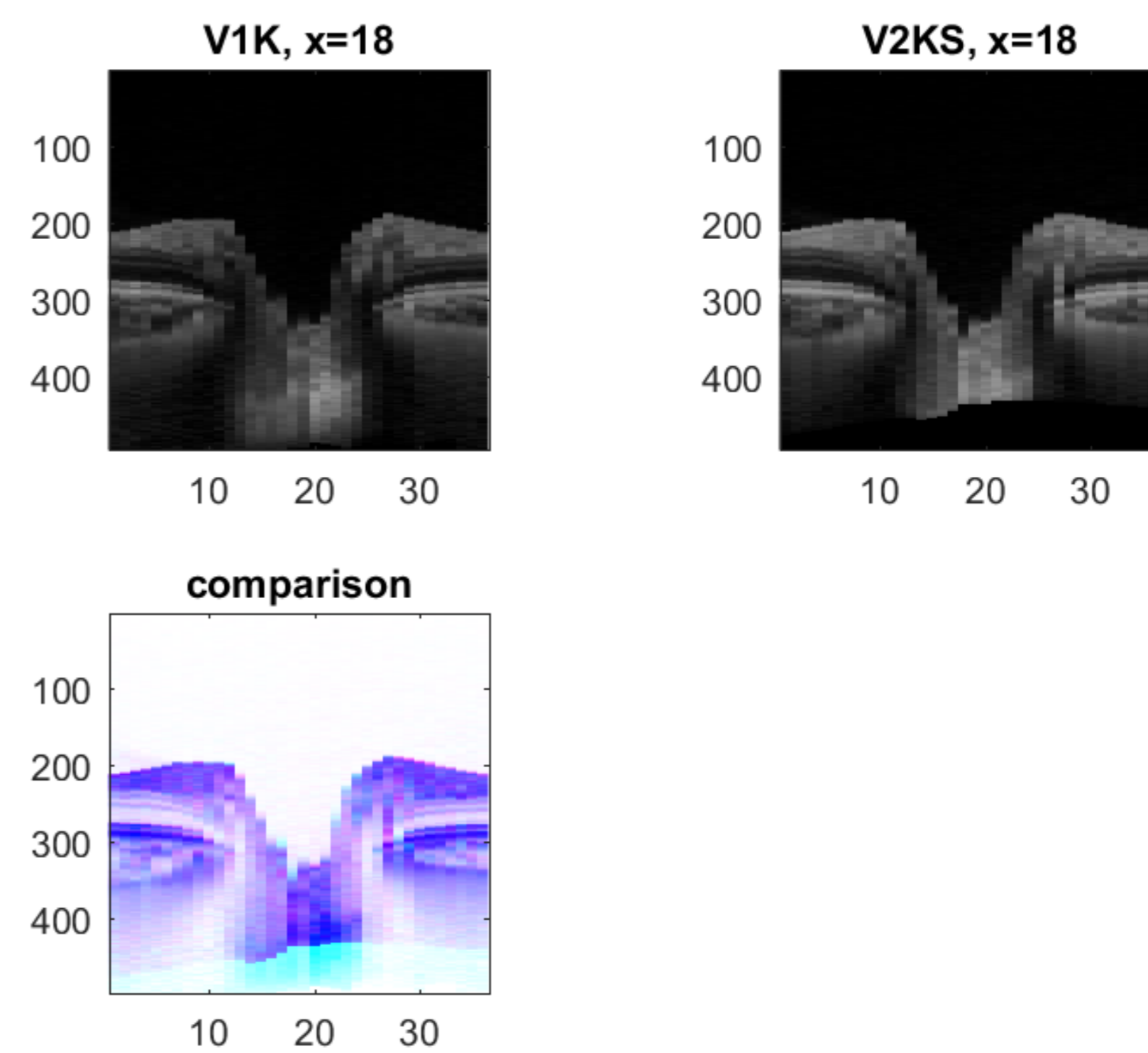


Figure 3: Same scan as shown on Figure 2 after column shift. The difference between them is shown as well.

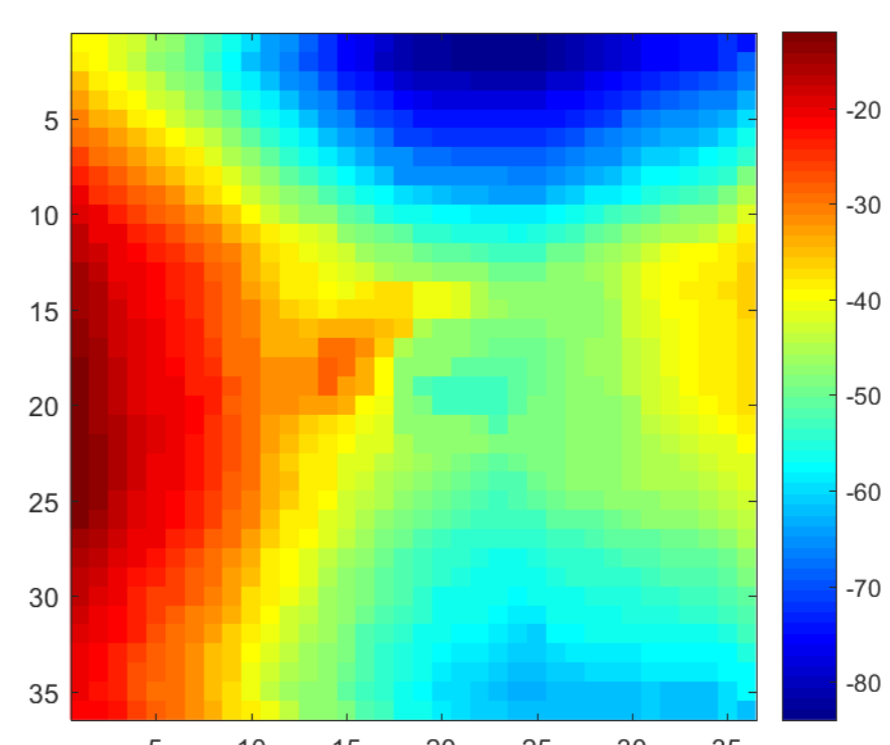


Figure 4: Estimated column shift in all knot points measured in pixels.

After the column shift, the volumes were merged using transfinite interpolation. One slice of the two volumes and the merged volume can be seen on Figure 5.

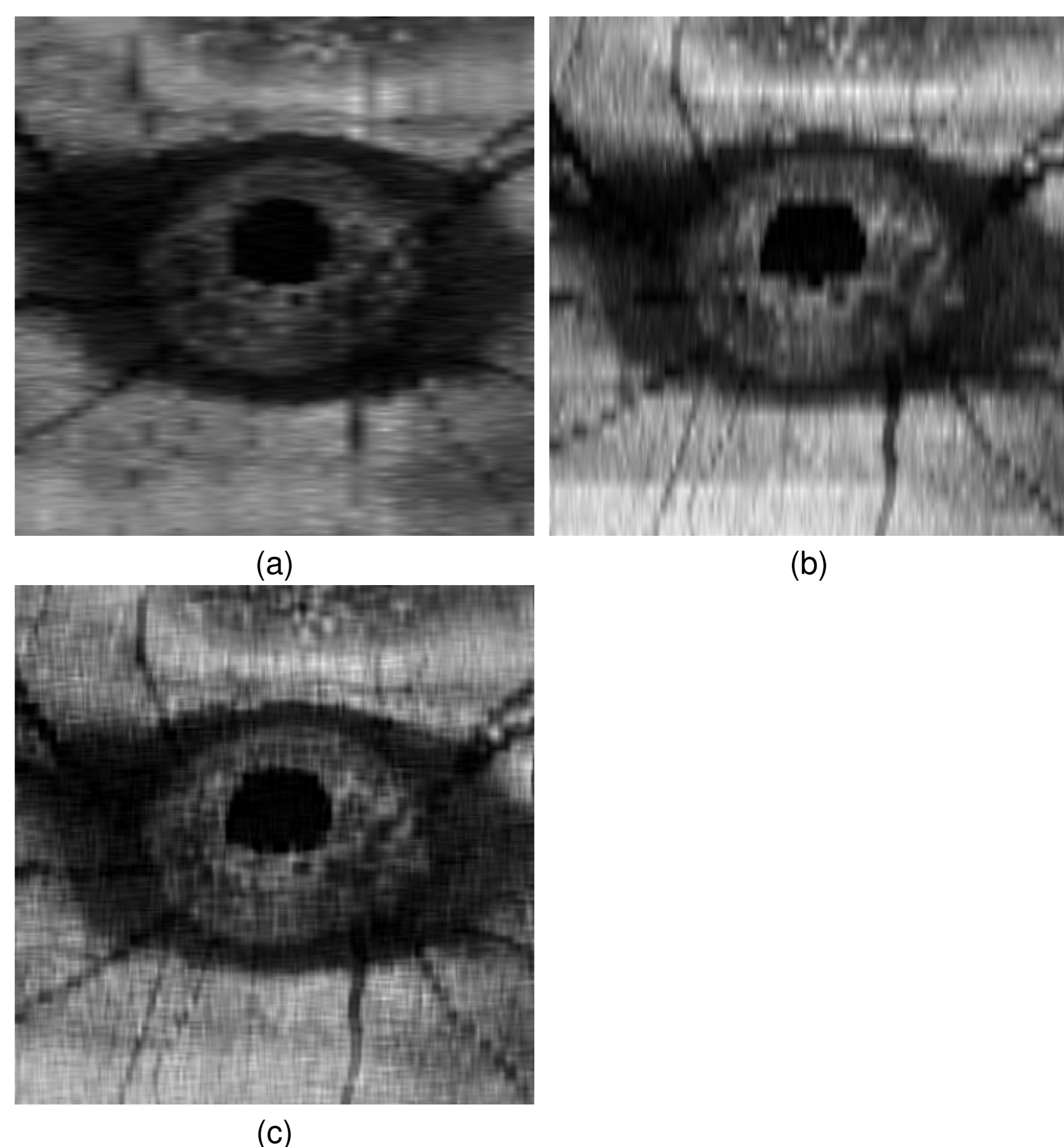


Figure 5: (a) Slice from horizontal volume, (b) slice from vertical volume and (c) slice from merged volume. All volumes have been normalised according to their mean value.

4. Conclusion

A merged volume from two sets of B-scans was made. The overlapping region between the two sets of B-scans acquired in the horizontal and vertical direction was found and 36 x 36 knot points existed. Using linear interpolation, data in the knot points was estimated and a column wise shift between all knot points in the two volumes was performed. Afterwards, a transfinite interpolation was used to estimate data within a more detailed grid creating a merged volume containing more information than the two B-scans set individually.