Our goal is to analyze and visualize the distribution of blood vessels in fundus images to support the medical diagnosis by providing quantitative measurements and detecting diseases and abnormalities like diabetes.

Methods: Data
- Our images are taken by a CANON CF-60UVi fundus camera
- All the images have a resolution of 3504x2336 pixels
- 15 color fundus images of healthy subjects
- 15 color fundus images of diabetic retinopathy patients
- Manual segmentation done by experts
- Automatic segmentation results [1]

Methods: Generated Maps
Three maps are generated for both the manual and automatic vessel segmentations. These maps are visualized using color coded images to aid the medical diagnosis:

1. **Vessel density map:**
   - generated by counting the number of vessel pixels in a large neighborhood (radius is 100 pixels)
   - (see Figure 2)

2. **Vessel distance map:**
   - encodes distance of each pixel to the closest segmented vessel
   - (see Figure 3)

3. **Vessel thickness map:**
   - shows the thickness in the center line of each vessel
   - (see Figure 4)

Methods: Classification & Evaluation

Four classifiers were trained to discriminate between healthy and diabetic retinopathy subjects using a physician’s diagnosis as gold standard:
- Naive Bayes
- K-Nearest Neighbors
- AdaBoost

The best results were generated by AdaBoost. The following table its accuracy, TP/FP rates and area under the ROC curve:

<table>
<thead>
<tr>
<th>Segmentation</th>
<th>TP rate</th>
<th>FP rate</th>
<th>ROC area</th>
</tr>
</thead>
<tbody>
<tr>
<td>manual</td>
<td>0.933</td>
<td>0.067</td>
<td>0.953</td>
</tr>
<tr>
<td>automatic</td>
<td>0.805</td>
<td>0.200</td>
<td>0.931</td>
</tr>
</tbody>
</table>

Commercial Relationship

A. Budai, None; J. Hornegger, None; G. Michelson, None

References