BIOMETRIC SYSTEM IMAGE REGISTRATION USING DOMAIN INFORMATION

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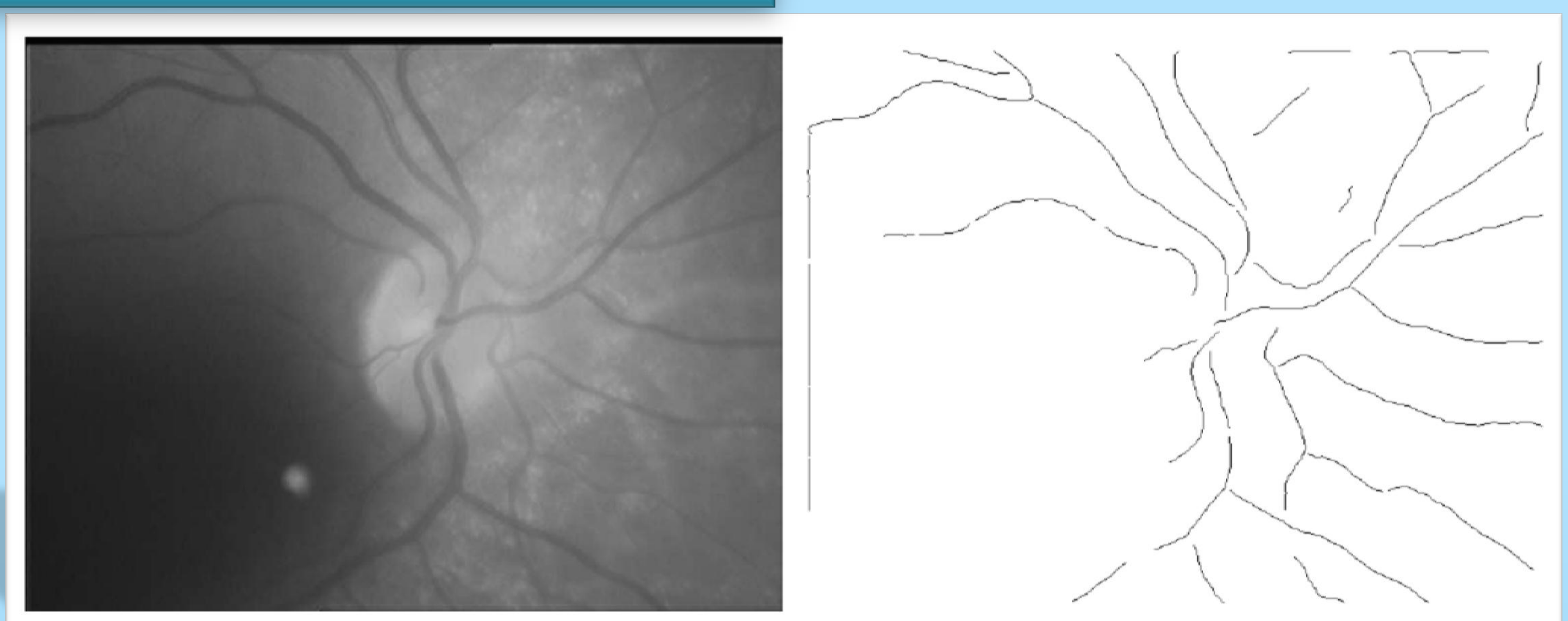
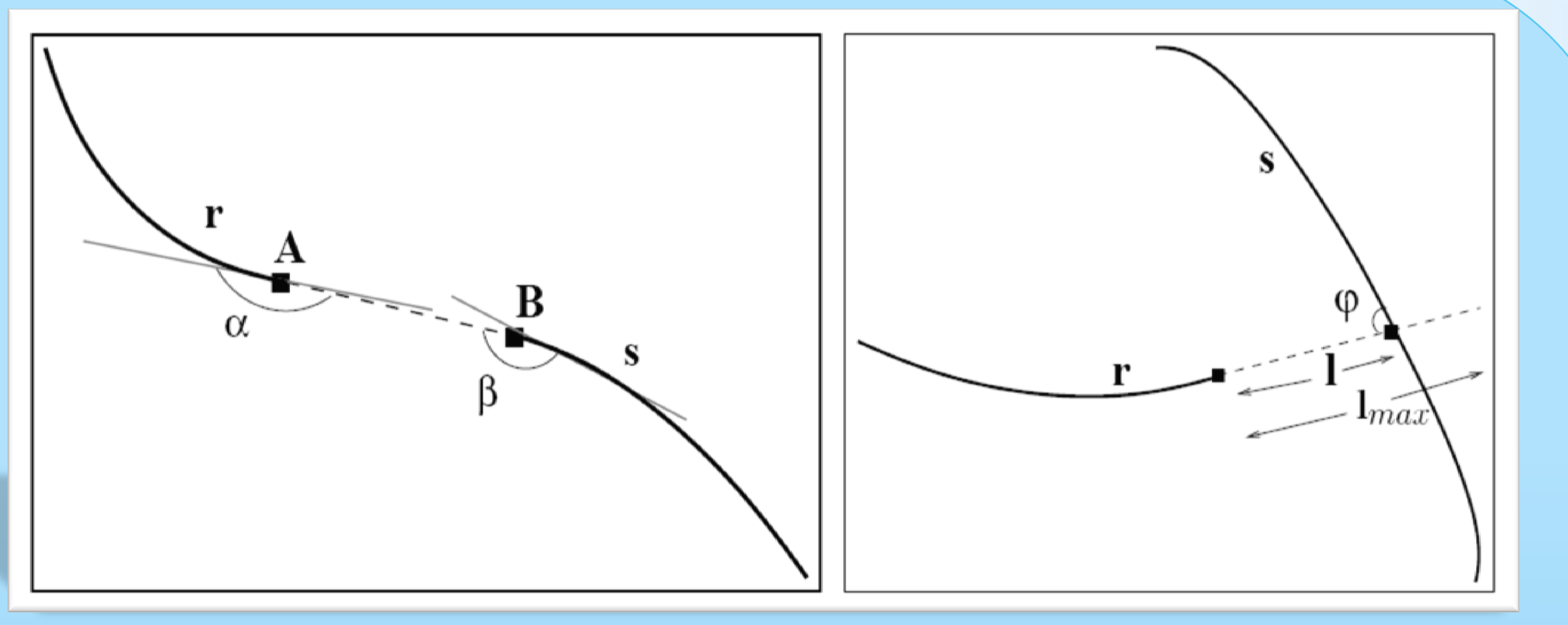
ABSTRACT

In this work a methodology for the classification of retinal feature points is applied to a biometric system. This system is based in the extraction of feature points, namely bifurcations and crossovers as biometric pattern. In order to compare a pattern to other from a known individual a matching process takes place between both points sets. That matching task is performed by finding the best geometric transform between sets, i.e. the transform leading to the highest number of matched points. The goal is to reduce the number of explored transforms by introducing the previous characterization of feature points. This is achieved with a constraint avoiding two differently classified points to match. The empirical reduction of transforms is about 20%.

RETINAL RECOGNITION SYSTEM



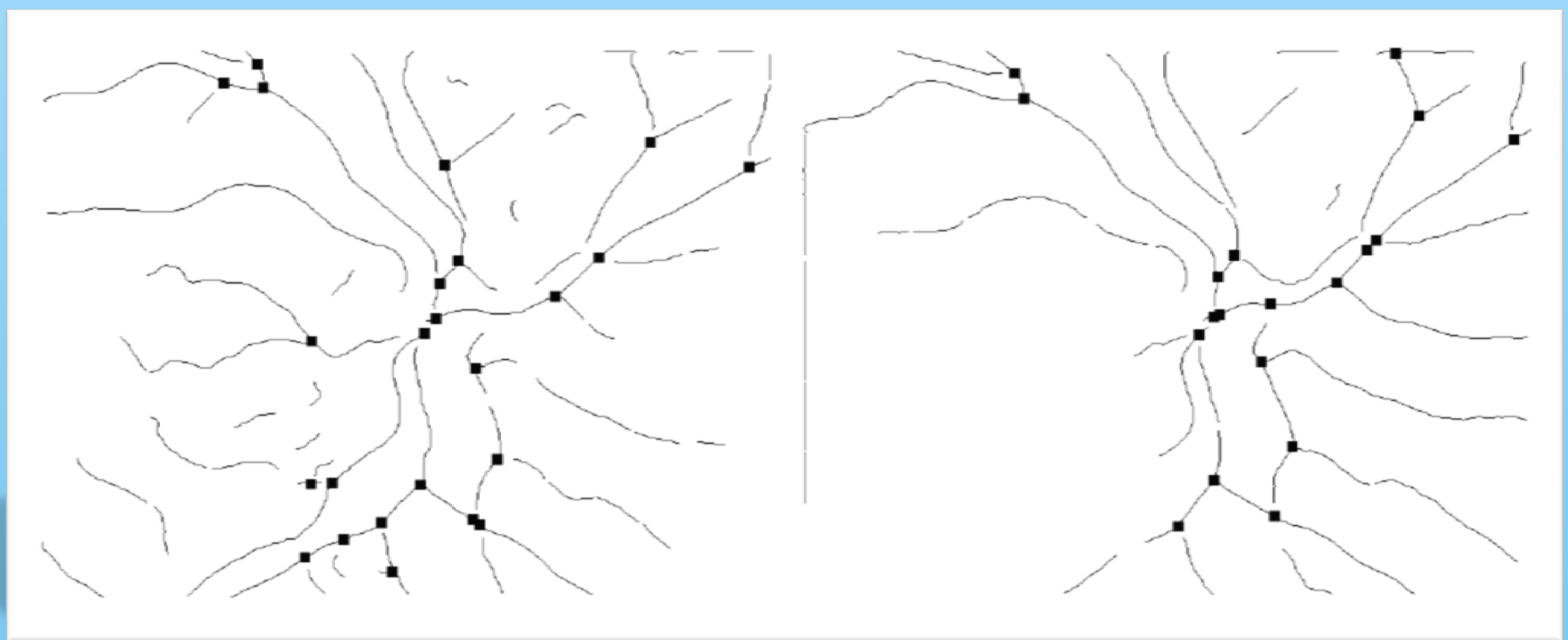
To obtain a good representation of the tree, the creases of the image are extracted obtaining the vessels skeleton. Using the whole crease image as a biometric patter has the problem of the codification and storage. To solve this, the biometric patter consists in a set of landmarks from the crease image.



To detect feature points, creases are tracked to be labelled as segments in the vessel tree, marking their endpoints. Bifurcations and crossovers are detected by finding segments endpoints close enough to eacho other and analysing orientations.

For the matching, a stored biometric pattern, v, is compared to the pattern extracted in the previous step, v'. Eye movement, consisting only in translation, rotation and sometimes a very small scale change; forces an alignement step.

A Similarity Transform schema is used to model patter transformations. To find the best transformation a search is performed in the tranformation space, which size increases with the number of points in v and v'.



Once the patters are aligned, two points of different patter match if the distance between them is smaller than a given threshold, D_{max}. Using the number of matched points a similarity metric, S_γ, can be established.

The matching process weakness is the high amount of transformations that need to be calculated to find the optimal one. To solve this, more information about the domain is introduced. By characterising the feature points into crossovers or bifurcations, an efficient contraint can be added only allowing points of the same class (or unclassified) to match.

FEATURE POINT CHARACTERISATION

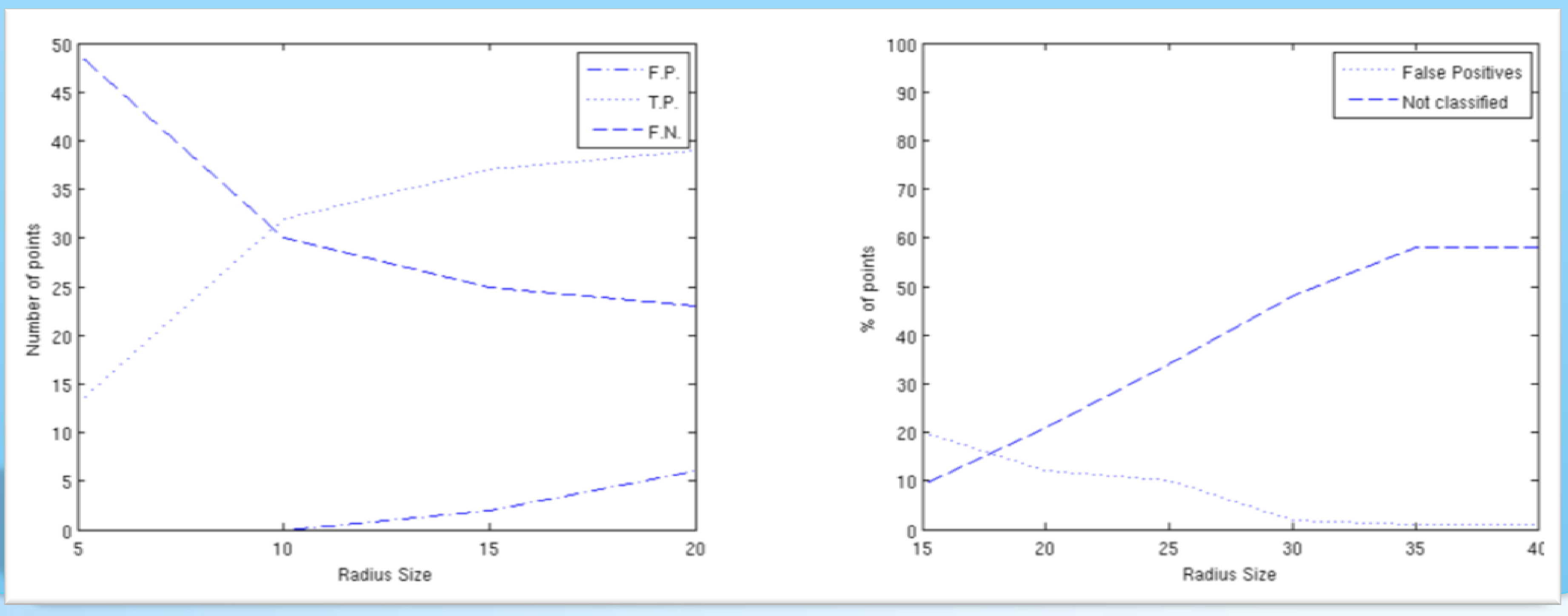
A vote system with three radius sizes is used and the number of votes for each point, F, to be classified as crossover or bifurcation is calculated (equations 1 and 2). The highest value will decide the classification of the point, F.

$$C(F) = 2 * C(F,R_1) + C(F,R_c) + C(F,R_2) \quad (1)$$

$$B(F) = B(F,R_1) + B(F,R_c) + 2 * B(F,R_2) \quad (2)$$

A topological classification is needed analysing the points in pairs. If two points are connected by a vessel segment and the distance is smaller that two times the given radius, Rc, both points are merged into a bifurcation.

The rest of feature points need to be analysed with another threshold, Rb, to take a decisión of wich points are accepted as bifurcations. To be marked as bifurcations, a pair of feature points cannot be inside the cricumference of redius Rb.



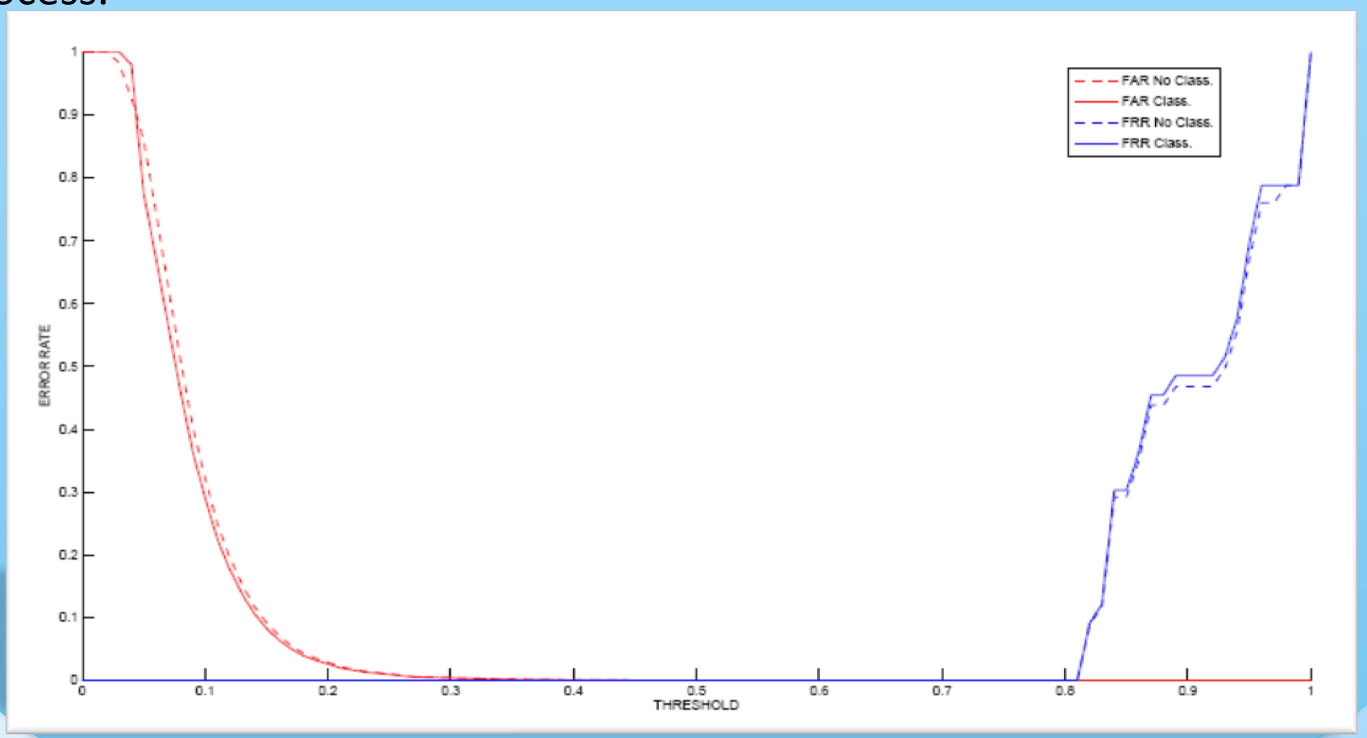
RESULTS

A set of 30 images from 15 infividuals from VARIA database were used. Images centred in the optic disc labelled by medical experts.

Total	Removed	Mean	Std
38617	7238	18.74%	5.97%

In the first test, the performance of the classification system in terms of Rc and Rb was evaluated. Figure 5 shows the results. Selecting Rc=10 and Rb=30 the global sensitivity of the system is 67% and the **specificity 95%.**

In the second experiment the biometric system performance using the characterisation of points is tested. All the images were compared versus all. The classification performance of the system (FAR and FRR curves(remains the same while reducing the computation loaf of the matching process.



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