Snakes Based Tracking and Texture Analysis of Microscopic Images*

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Abstract

Snake based tracking over a textured potential is applied to recover the 3D structure of a complex organ, the eye, from a sequence of slices. Grey level images are first analysed by a probabilistic method to derive a suitable potential. Then, the snake is initialised by hand and, finally, its energy function is minimised. Temporal discontinuity problems due to the nature of the images (microscopic slices tinted and taken by hand) are solved.

Key Words : Snakes, Tracking, Texture Analysis, Microscopic Images.

1 Texture Segmentation and Background Elimination

This framework is devoted to help morphologists to automatically obtain quantitative measures like the number of photoreceptors inside the retina from images like the one in Figure 1. The retina is given by the U-shaped grey dotted area that covers the globus (in white).

Eye image preprocessing is performed by the following probabilistic framework for texture analysis. First: original grey information is mapped to three possible intensity levels (low, medium, and high) to obtain a potential. Given a spatial location its final level is obtained by *locally averaging the levels of its neighbours inside a bounded window and finally applying a suitable threshold*. Preprocessing results are shown in Figure 2. Second: background pixels are erased and Gaussian smoothing is applied (see the result in Figure 3). Finally, the probability, for each pixel, of membership to the inner and outer border is computed. Each border will be a snake[1],[3] attractor (see Figure 4).

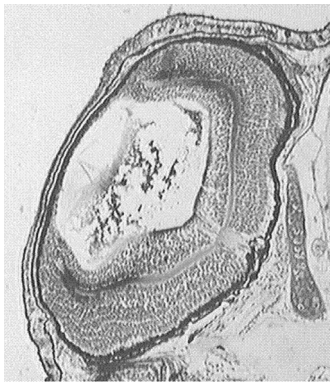

Figure 1: Eye of a salamander. Slice derived from a transversal cut.

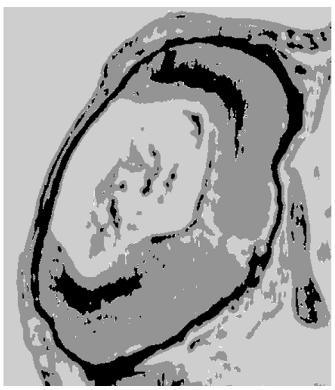

Figure 2: Thresholding after grey mapping.

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Figure 3: Background elimination.

Figure 4: Inner border after probability estimation.

2 Initialisation and Tracking

Once the potential is extracted two snakes are initialised close to both the inner and the outer borders (see Figure 5). Given the previous analysis the number of local minima is reduced. Minimization is performed by gradient descent. Iteration over time gives the 3D structure[4] (see Figure 6). Temporal discontinuity problems in correspondence are solved by desiging an adaptive spatio-temporal window. Future work will be devoted to automatic initialisation based on deformable templates (given the elliptical shape of the inner zone), to estimate the number of photorreceptors and, finally, to solve problems derived from the non-homogeneous texture over time due to tinting the slice by hand.

Figure 5: Result after iteration over the first frame.

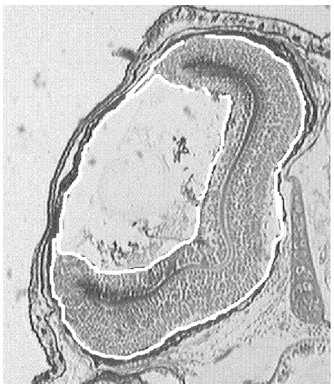

Figure 6: Results after iteration over the second frame.

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