

## Help with neurological pathologies diagnosis by segmentation of color images of myelin fibers in optical microscopy

J. P. Rodriguez (1,3), R. Vargas (1), J. Rojas Varela (2), A. Clément (2), B. Vigouroux (2), F. Chapeau-Blondeau (2)

(1) Departamento de Biología Estructural, Laboratorio de Estructura Molecular, Instituto Venezolano de Investigaciones Científicas, Apartado Postal 21827, Caracas 1020 A, Venezuela

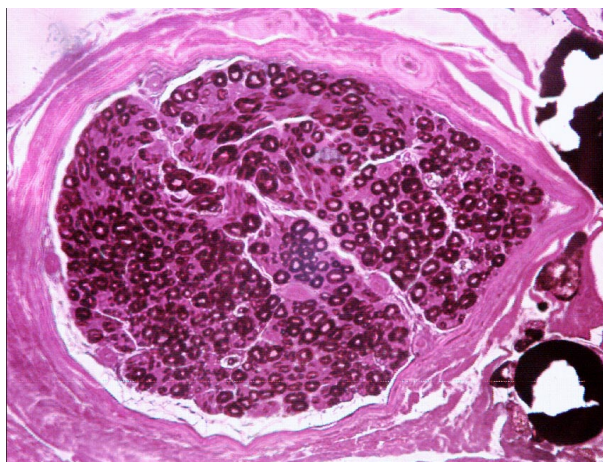
(2) Laboratoire d'Ingénierie de Systèmes automatisés CNRS FRE 2656, 62 Av. Notre Dame du Lac- 49000 Angers – France

(3) CEBIV-IDECYT. Universidad Simón Rodríguez Apdo. 47.947, Caracas 1020A – Venezuela

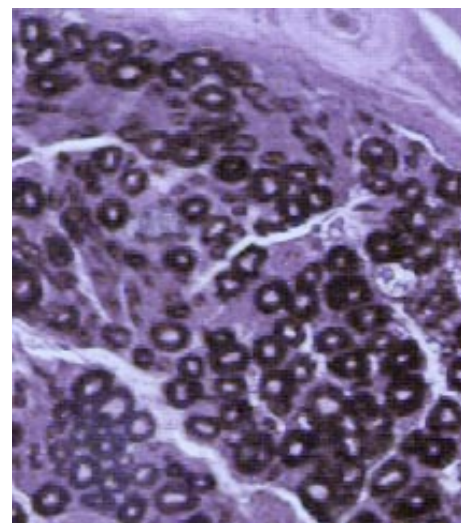
We present results of automatic measurement of myelin fibers through color numerical image processing obtained from an optical microscope. The method allows a quantitative measurement of the distribution of the surfaces of fibers and constitutes an improvement compared to the morphological methods and to other segmentation methods used. The latter cannot process a great diversity of images because of the biological variability of the samples. The images (figure 1) were obtained from histological cuts of nerves with silver impregnation (Rodriguez et al.) with a Pixera professional CCD color camera (1,2 Mpixels, 3x256 RGB) associated the Sigma Scan Pro software and coupled with a LEICA DMLBV microscope. A non-supervised hierarchical classification method has been used (Clement and al.) and it permitted to segment the image contents into three types of areas associated respectively with a class, namely axon, myelin and intercellular space. In figure 2, the histograms resulting from the transformation of RGB images in CIE XYZ rec. 709 colorimetric space and the area of interest providing a better appreciation of the fundamental components of the fibers are presented. Figure 3a gives the segmented image. Figure 3b gives the binarized image in which completely degenerated fibers are observed (isolated points).

The table 1 represents the percentage distribution of the three classes (axon, myelin, intercellular space) according to their centers of gravity. Automatic segmentation is estimated in terms of global error. The suggested method allows a fast and precise classification by providing local measurements with a view to helping to diagnose neurological pathologies and represents an improvement compared to the results obtained by the method of X-rays diffraction (Luzatti and Mateu) which only brings one global measurement.

Key words: Histology, diagnosis, color image segmentation, myelin, fibers counting.

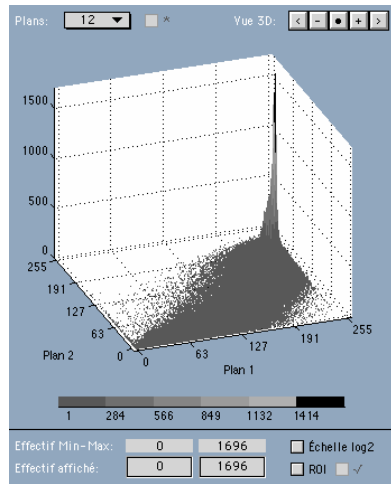


(a)

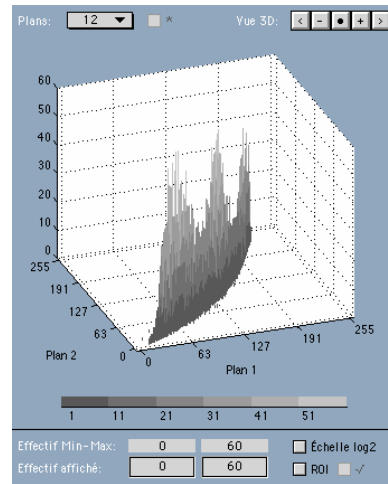


(b)

Figure 1. (a) Histological cut of nerve, (b) Area of interest in CIE XYZ colorimetric space

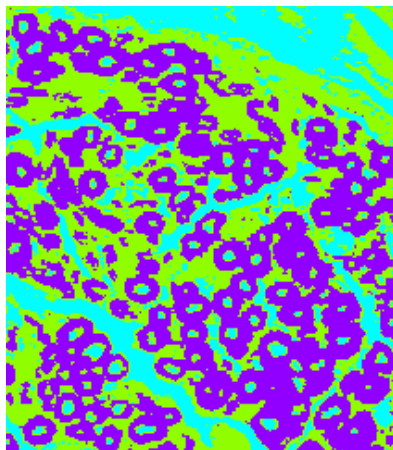


(a)



(b)

Figure 2. (a) Histogram of the image 1a, (b) histogram of the image CIE XYZ space



(a)



(b)

Figure 3. (a) Segmented image 2b, (b) binarized image

CG class	% total number	value
[181 172]	19,67	[0 255 255]
[71 56]	43,76	[128 0 255]
[133 112]	36,56	[128 255 0]
	100	

Table 1. Distribution of the percentages of the three classes according to their centre of gravity (CG).

## References

A.Clément, B. Vigouroux, 2003. "Unsupervised segmentation of scenes containing vegetation (*Forsythia*) and soil by hierarchical analysis of bi-dimensional histograms". Pattern Recognition Letters, n° 24, p. 1951-1957.

V. Luzzati, L. Mateu, 1990, "Order-Disorder Phenomena in Myelinated Nerve Sheaths", I. A. Physical Model and Its Parameterization: Exact and Approximate Determination of the Parameters. Journal Molecular Biology. 215, 373-384

J. P. Rodriguez, A. Parthe, R. Vargas, L. Mateu, L, J. Rojas Varela, C. Cavaro-Menard and F. Chapeau-Blondeau. "Method of impregnation argenticum derived from the procedure of nitrate of silver for the nervous tissue". In this congress.

This work was partially financed by the FONACIT G (97000379) and framed within the agreement ECOS-NORD N.200000866 (V00S02)