Citology by Morphological Analysis Applied to Malignant Non-Hodgkins Lymphomas

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Introduction

Cell proliferating rate:

The cell proliferating rate of a cancer is given by the number of proliferating cells divided by the total number of cells.

The malignancy of a tumor is related to its cell proliferating rate.

PCNA-cyclin Proliferating cell nuclear antigen is present on proliferating cells and is responsible for a specific coloration.

Description of the Method

The proliferating cells are brown.

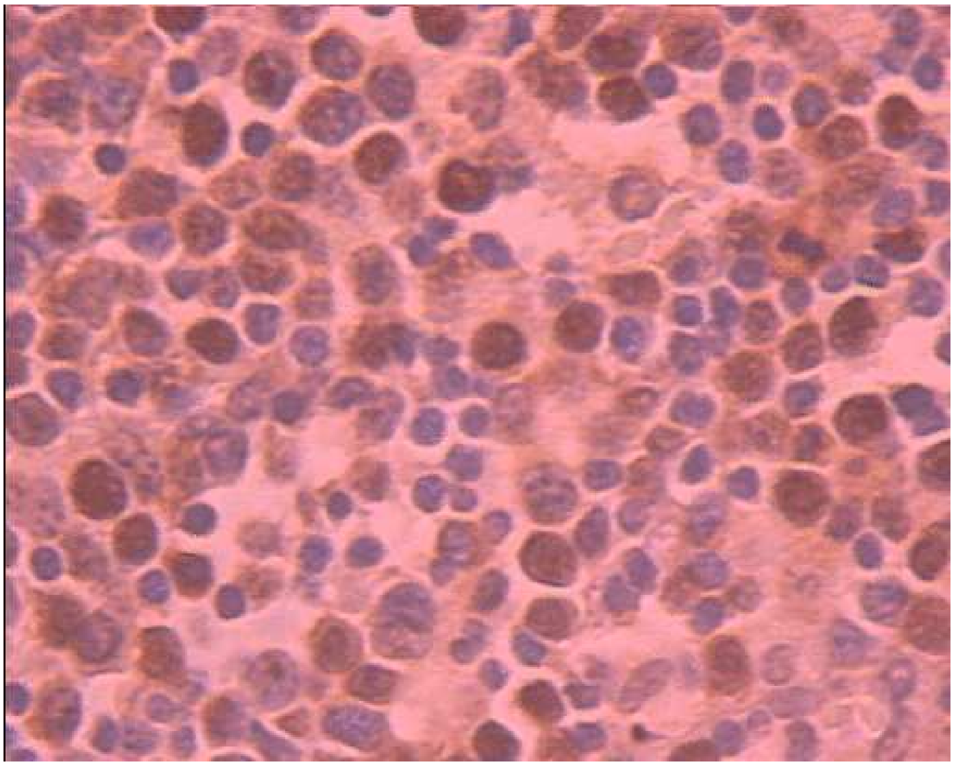

Figure 0.1: A typical image, where we can distinguish two cell subpopulations: the brown one and the blue one

Pre-processing

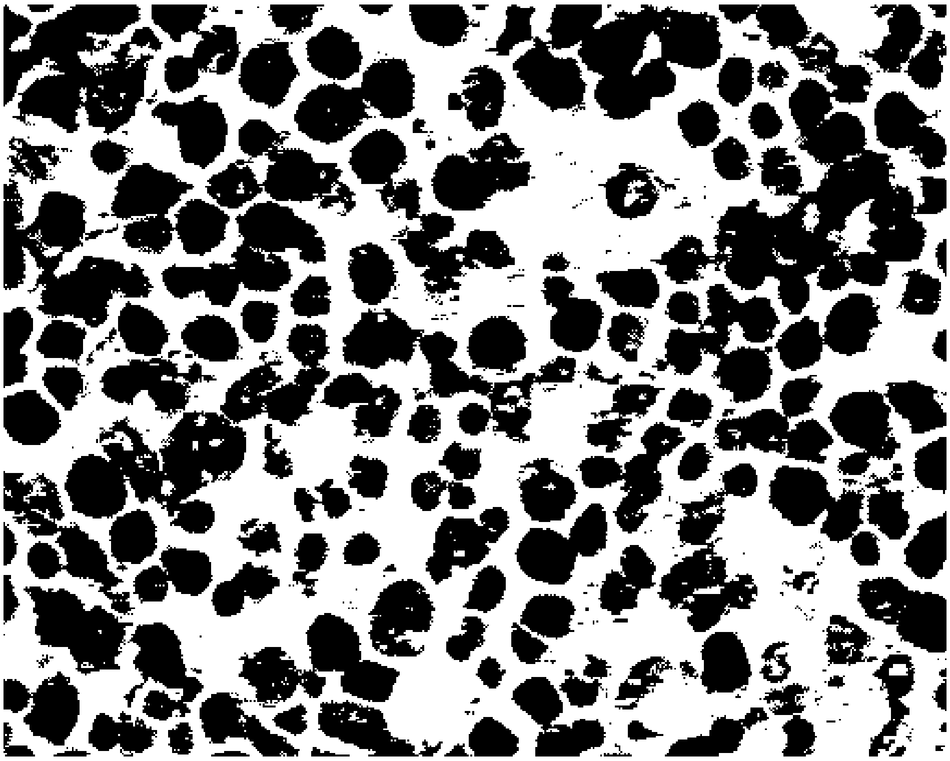

Figure 0.2: Resulting image of segmentation of the background

The process is based on an empirically obtained threshold computed as the average of the intensity of pixels, using the HSI model.

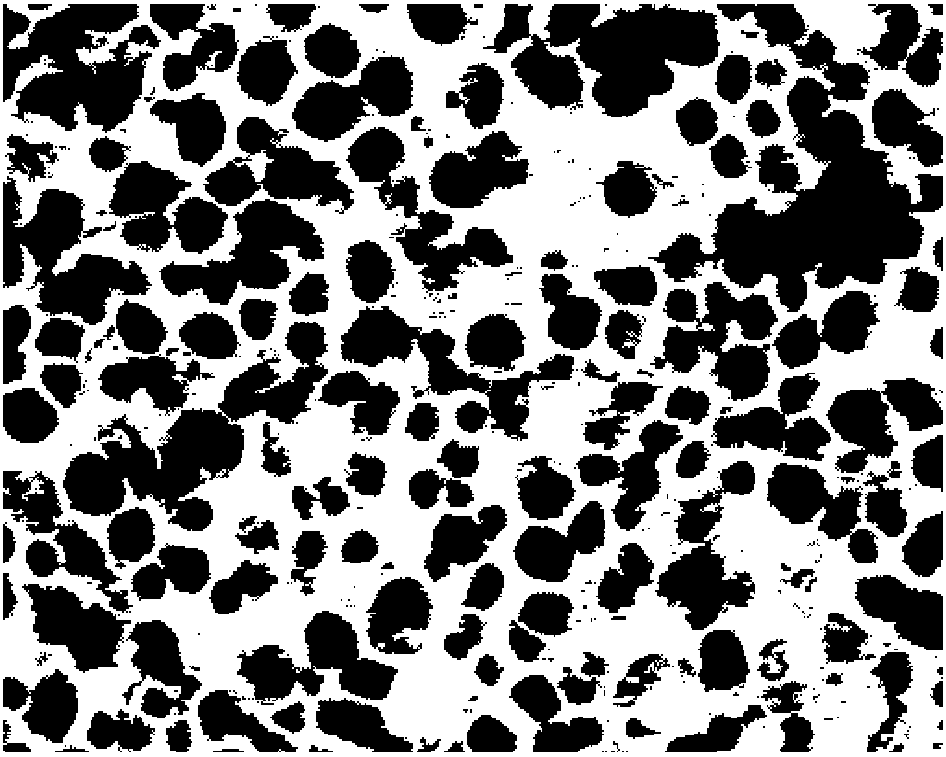

Figure 0.3: Resulting image of eliminating holes inside the cells

This is accomplished by a reconstruction, performed by means of a dilation of a border image, conditional to the original image, inverted.

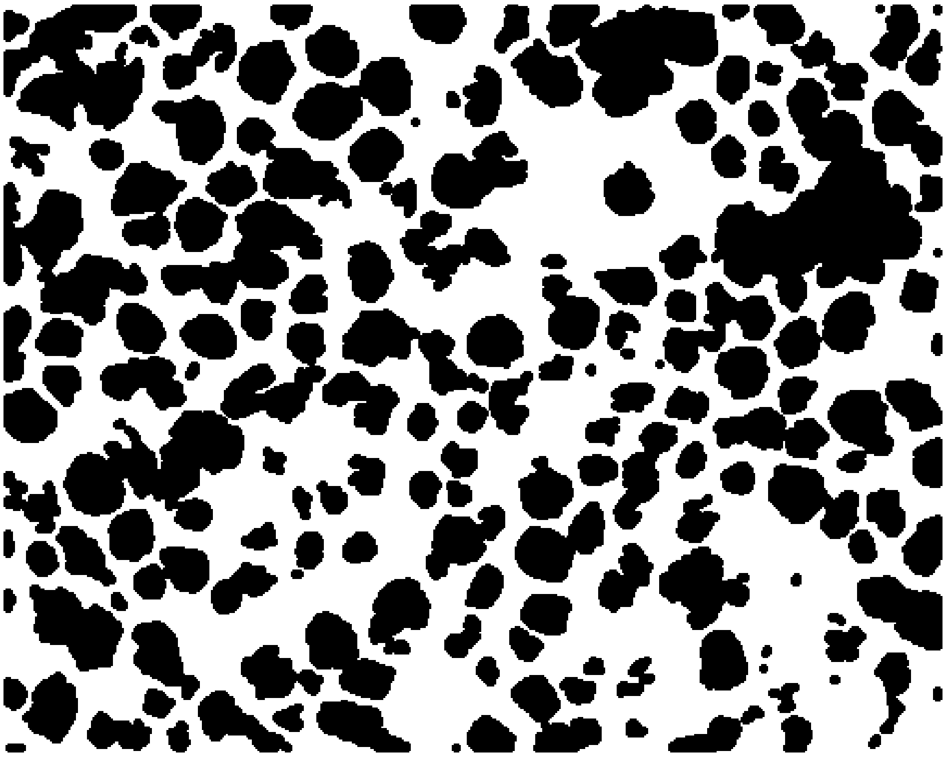

Figure 0.4: Smoothed image, obtained by means of an opening with a rhombus structuring element

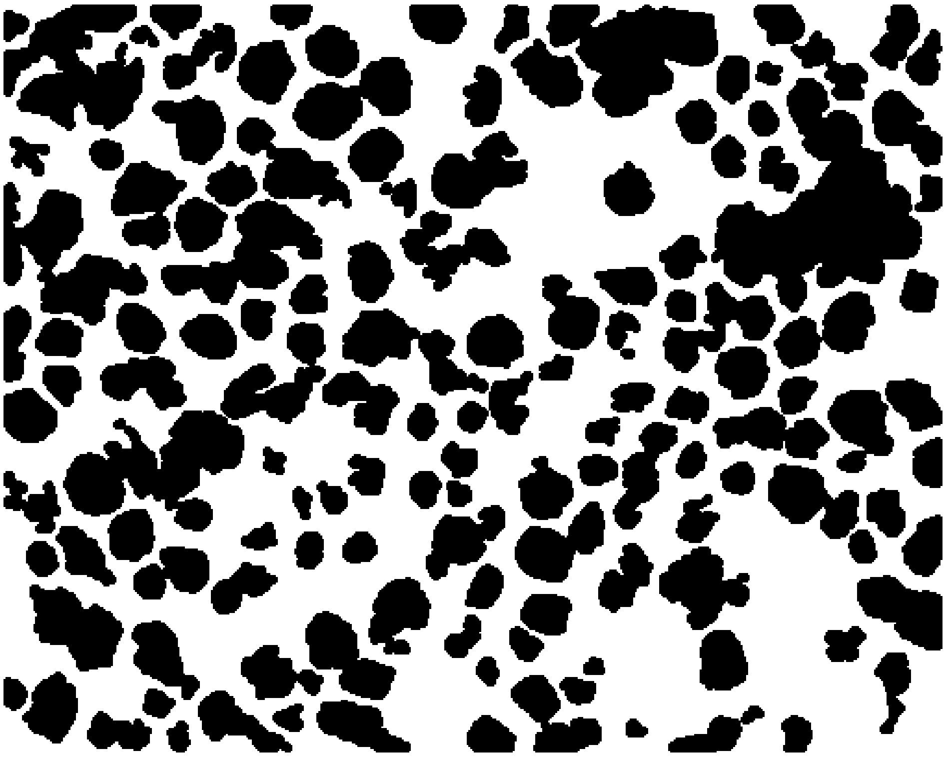

Figure 0.5: Image obtained after noise elimination

Erosion by rhombus in two steps followed by reconstruction by conditional dilation.

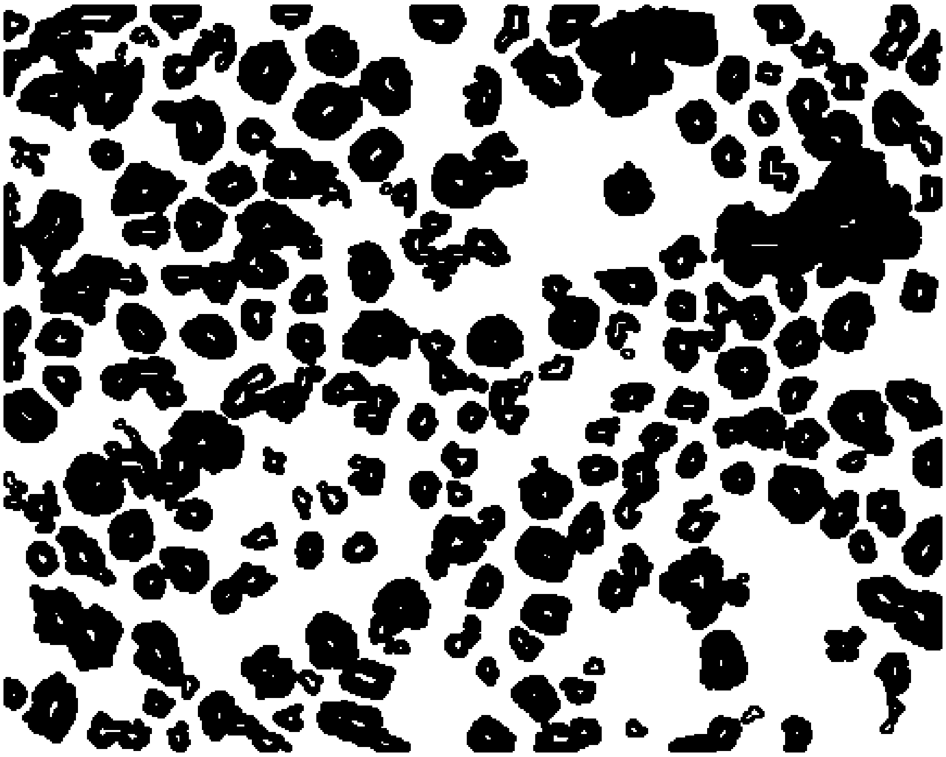

Figure 0.6: Markers obtained by an Ultimate Erosion process

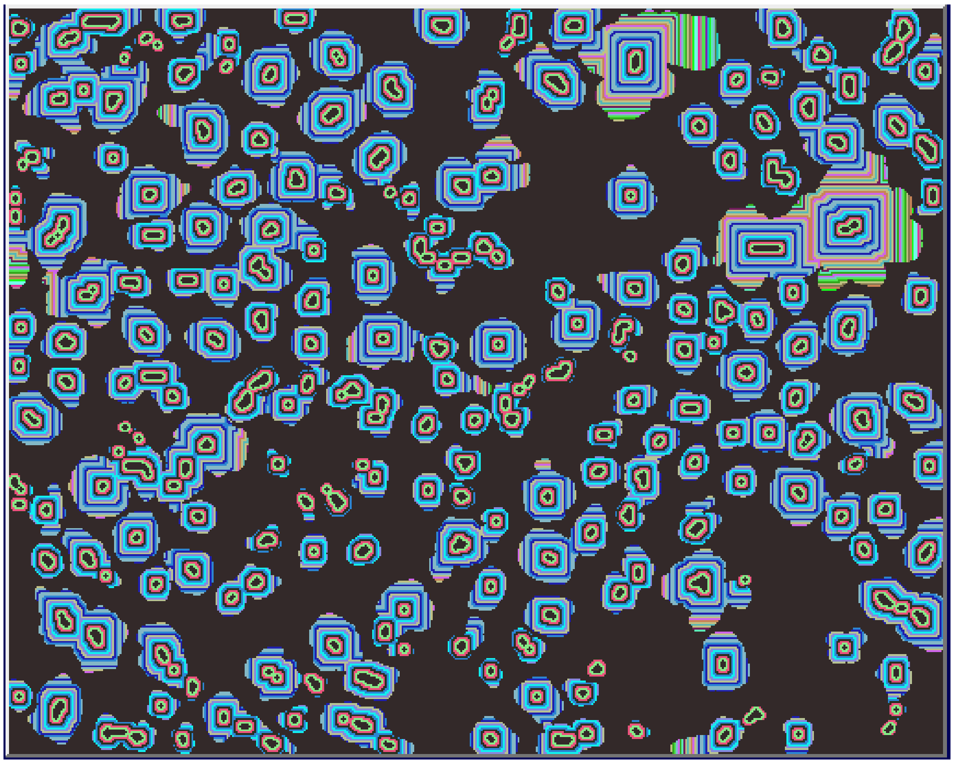

Figure 0.7: Markers and distance function

Segmentation of Cells

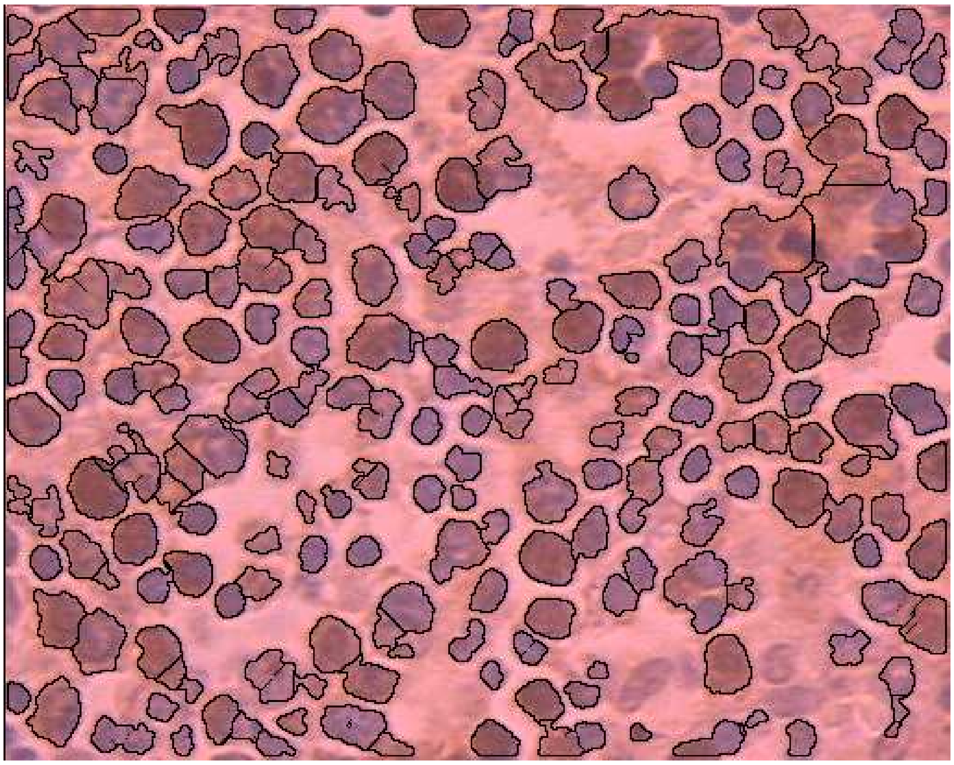

Figure 0.8: Segmentation obtained by SKIZ

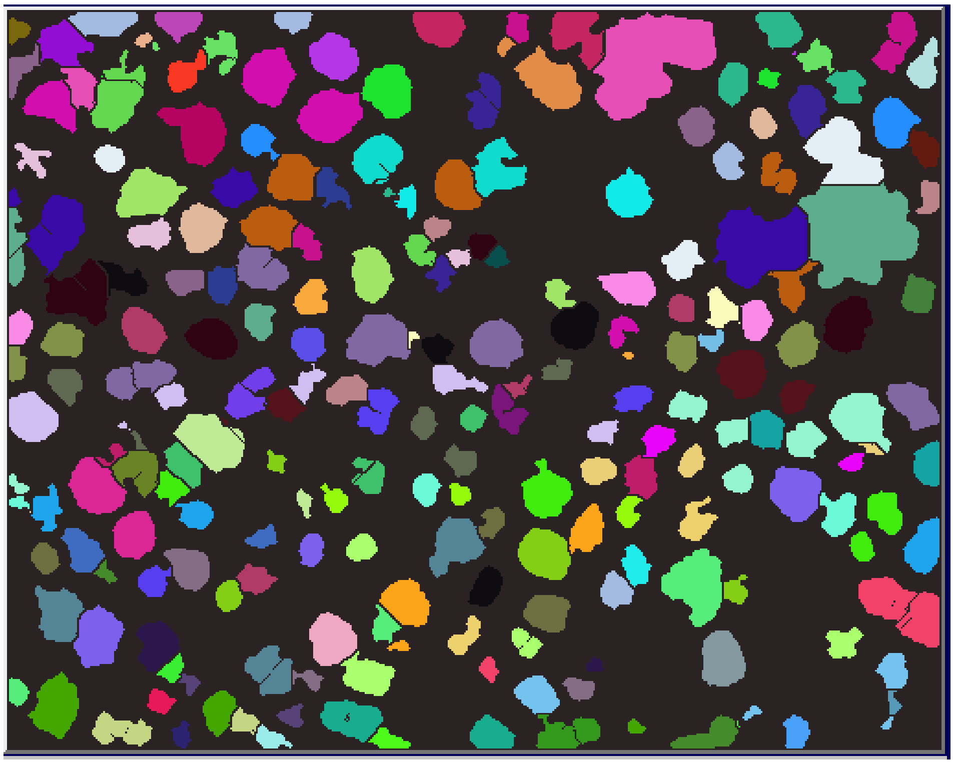

Figure 0.9: Labeling process obtained by means of geodesic idempotent gray-level erosion with a binary planar structuring element

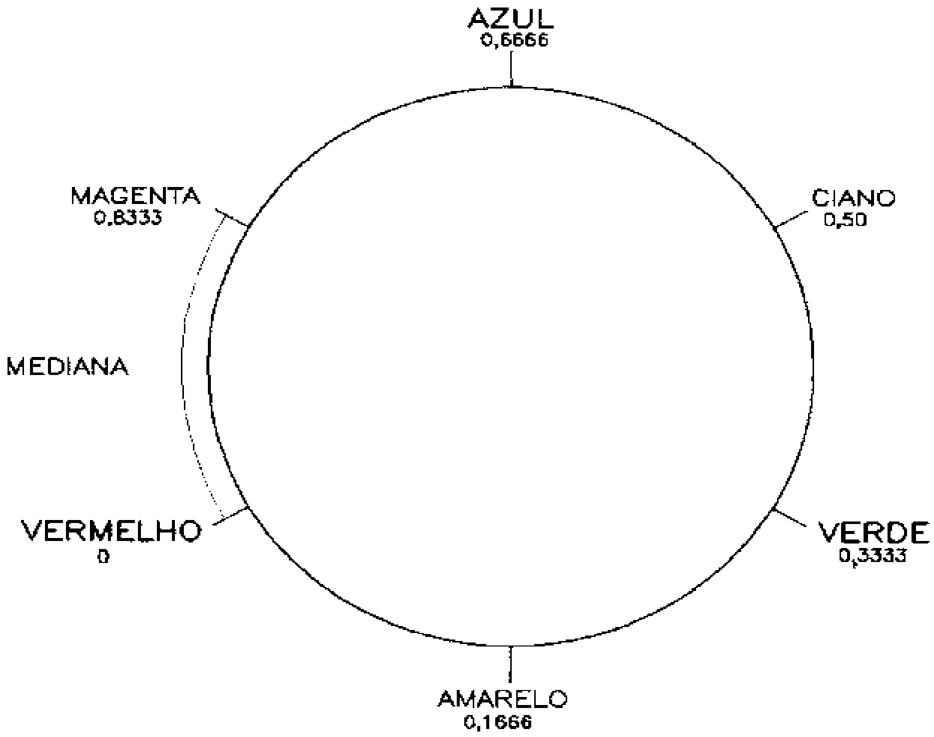

Figure 0.10: HSI circle showing the limits between brown and blue: the value of green and the median between the red and the magenta

Final Segmentation of Cells

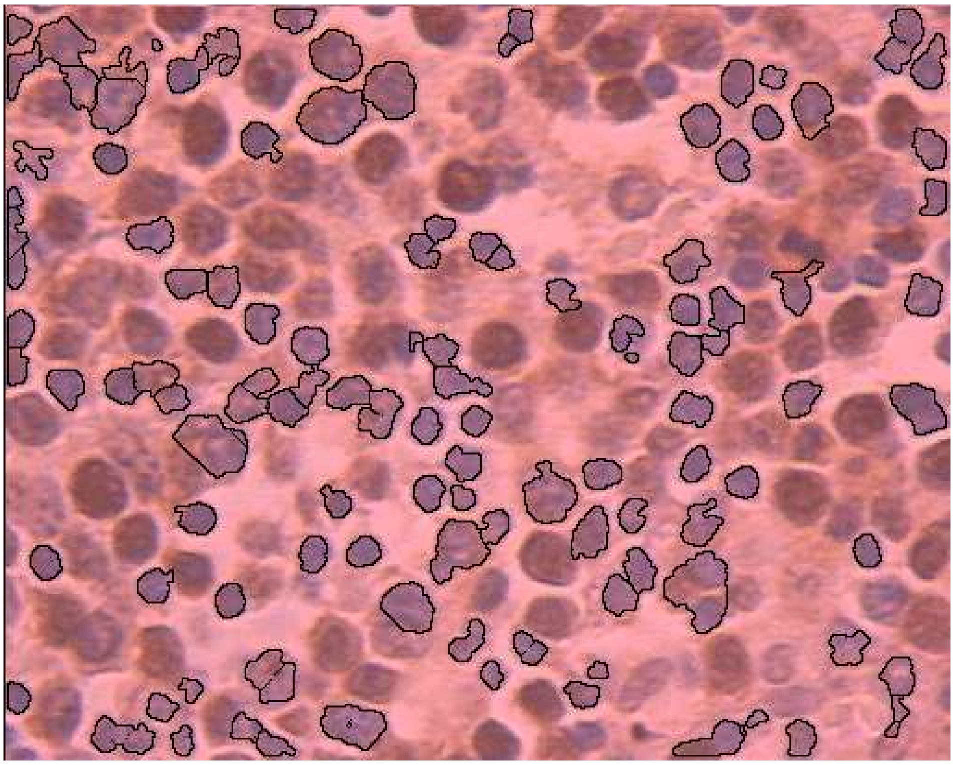

Figure 0.11: Blue cells

Final Segmentation of Cells

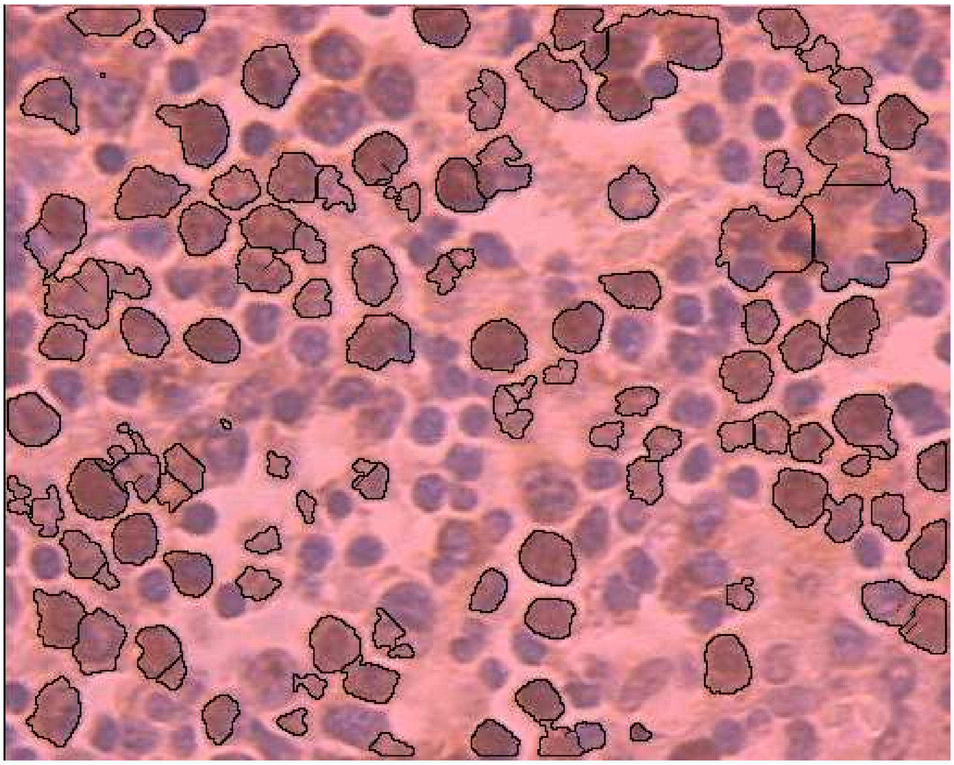

Figure 0.12: Brown cells

Conclusions

The desired citometry was obtained by means of morphological tools, as proposed.

Mathematical Mophology has shown its power and flexibility in processes since pre-processing to segmentation.

Some problems have occurred, however, specially with multiple markers per cell, in the process of ultimate erosion.

This problem has proposed solutions in the literature.

References:

Facon Jacques, "Morfologia matemtica: teoria e exemplos", Curitiba: Champagnat Editor, 1996

Garcia, Rochelle L., Coltrera, Marc D,, Gown, Allen M., " Analysis of proliferative grade using anti-PCNA/cyclin monoclonal antibodies in fixed, embedded tissues: comparison with flow cytometric analysis", American Journal of Pathology, Seattle, vol. 134, n. 4, pp 733-739, april 1989

Joblove, George H., Greenberg, Donald. "Color spaces for computer graphics", in Annual Conference on Computer Graphics and Interactive Techniques (5: 1978: Atlanta), pp 20-25

Vincent Luc, "Morphological grayscale reconstruction in image analysis: applications and efficient algorithms", IEEE Transactions on Image Processing [S.l], vol. 2, n. 2, pp 176-201, april 1993

Weber Andra, "Citometria por anlise morfolgica aplicada a linfomas malignos no-Hodgkin", master thesis, CEFET-Pr/CPGEI, january 1997.