Postgraduate student: **Magiati Margarita**

Thesis Title:

cDNA Microarray image processing based on robust segmentation techniques

Abstract:

The purpose of the present study was initially to investigate the effectiveness of different wavelet filters, for the most effective suppression of noise in microarray cDNA images. In the second stage the objective was the implementation of a segmentation algorithm for a more effective delineation of the spots from the surrounding background. The innovation of this thesis is that the proposed modified Markov random fields' algorithm (MRF) uses an additional feature, obtained by the application of the stationary wavelet transform (SWT) to images.

In this thesis, images derived from cDNA microarray experiments were used as templates for creating simulated images at five different levels of noise, for the evaluation of the implemented segmentation algorithms. Moreover, a systematic evaluation of filters based on wavelets was performed, in order to achieve the improvement of microarray cDNA images by means of noise suppression. For this purpose, SWT was used combined with various types of mother wavelets. The images obtained after the suppression of noise were analyzed and the MRF algorithm was applied to them in order to assess the impact of the noise suppression process to the stage of segmentation. The purpose of this procedure was the selection of the appropriate parameters, basically concerning the type of wavelet, in order to use them in later analysis. Moreover, a semiautomatic algorithm for the gridding of the images was implemented. Regarding the segmentation of images, three algorithms were implemented: the k-means, the MRF and a modification of the MRF using wavelets (Wavelet-MRF). For the quantification of the results in terms of noise suppression the mean square error (MSE), and signal/MSE were measured. Regarding the performance of segmentation techniques, the segmentation matching factor SMF and the coefficient of determination r^2 were calculated.

According to the results, more effective noise suppression was achieved by the soft thresholding technique combined with the biorthogonal 1.3 mother wavelet, scoring the lowest MSE and the highest signal/MSE and SMF. Regarding the segmentation of images, the k-means algorithm achieved the lowest SMF and the lowest r^2, followed by the MRF, while the Wavelet-MRF algorithm showed the best performance. At high levels of noise, MRF and Wavelet-MRF algorithms show significant difference compared to the k-means, while at low noise levels the difference is much smaller, showing that these algorithms are better suited to high noise levels. Furthermore, the use of wavelets in the Wavelet-MRF algorithm improves the results of the MRF, confirming the importance of the information provided by wavelets, as well as the need to explore more features that could contribute effectively to the MRF segmentation algorithm, for further improvement of its segmentation accuracy.

Examining Committee:

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