# Recognition and Classification of Dermatophytes fungi using Support Vector Machines (SVM)

Natalia Debandi[1], Marcela L.Riccillo[1], Marcelo A. Soria[1,2], Ana S. Haedo[1]

*(1). Facultad de Ciencias Exactas y Naturales. Universidad de Buenos Aires. Argentina.*
*(2) Facultad de Agronomía. Universdad de Buenos Aires. Argentina.*

Dermatophytes are fungi that affect the skin causing a series of mycoses. Their identification, as with most other filamentous fungi, requires analyzing samples under the microscope, which is a time-consuming activity requiring specialized training. The correct identification of samples is an essential step for proper medical diagnosis and treatment. The automated analysis of digital images with the aim of recognizing patterns, identification and classification is well established in several fields, like security, medical imagery and others. However, very few applications of image analysis techniques were reported in the field of medical mycology. One of the latest innovations in the field of image analysis is the application of support Vector Machines (SVM) to separate and classify objects by increasing the dimensionality of the dataset that describes them. In this work we show the application of SVM classification to identify the six more frequent species of dermatophytes in human infections.

Fungal samples consisted of glass slides preparations with lactophenol-blue stained mycelia of clinical isolates grown in lactrimel growth medium of the following species, *Epidermophyton floccosum*, *Microsporum canis*, *M. gypseum*, *Trichophyton mentagrophytes*, *T. rubrum*, and *T. tonsurans*. Three different samples were available for each species. For each sample 25 images were obtained and divided in two sets, 10 for training and 15 for testing, their sizes were 160 x 120 pixels in gray scale. Image pre-processing was done with ImageJ v.1.37 (rsb.info.nih.gov/ij/). SVM analysis was performed with MATLAB 7 (The Mathworks, Massachusetts) and the LIBSVM library v.2.82 (www.csie.ntu.edu.tw/~cjlin/libsvm) using a polynomial kernel of second degree.

This study was divided in three parts. In the first part SVMs were trained with images from two species and then used to classify the images in the test dataset, the best average rate of successful classifications, 65%, was obtained when test images originating from the same sample as those in the training set. In the second part, the effect of image pre-processing was tested. Different techniques, alone and in combination were applied, and the best results were obtained with histogram equalization followed by background smoothing. The average of successful classifications increased up to 90%. Given the heterogeneities among images and the normal presence of artefacts in microscope images, these rates were quite satisfactory. However, in order to be useful a dermatophyte classifier has to be able to identify a single species among any of the six considered. To investigate this, the performance of several SVM multiclass classifiers were analyzed, the best results were obtained with a modified one-vs.-all algorithm that for some samples reached a success rate of 94%.

These results suggest that the use of SVM for the analysis of mycological images could be a valuable tool for assisting laboratory identifications.