P1: Pixel classification through Mahalanobis distance for identification of grapevine canopy elements on RGB images

Herrero-Langreo A. ([1]), Barreiro P. ([1]), Diago M.P ([2]), Baluja J. ([2]), Ochagavia H. ([2]), Tardaguila J. ([2])

(1) Laboratory of Physical Properties and Advanced Technology in Agrofood (LPF-TAG). ETSI Agrónomos. UPM; 28035, Madrid, Spain.

(2) Instituto de Ciencias de la Vid y del Vino (Universidad de La Rioja, CSIC, Gobierno de La Rioja), 26006 Logroño, Spain.

Background and Aims: Vine vigour and fruit-cluster exposure to sunlight in a grapevine canopy fruiting zone has been shown to strongly correlate with key fruit composition and diseases incidence. In this framework, the use of automated image analysis for the identification of plant elements is an important issue to be addressed for vineyard assessment (Dunn and Martin, 2004). In addition, optimum segmentation method is strongly application dependent and thus needs to be tested for each particular case (Cheng et al., 2001). The objective of the present work is to propose and test a simple, rapid and practical method for the identification of two relevant elements of grapevines canopy: clusters and green leaves.

Methods and Results: The analysis was applied to twenty colour images corresponding to various defoliation treatments in a commercial vertical shoot-positioned Tempranillo *Vitis vinifera* L vineyard located in Spain's La Rioja region.The set of images was divided in two subsets: 10 for calibration and 10 for testing the classification performance. Mahalanobis distance was considered to assess pixel colour similarities. This distance takes into account the covariance between variables (Red, Green and Blue –RGB- values in this case), which has reported to induce to misclassifications on RGB images with other approaches (Cheng et al., 2001). For each class (each element present in the images), RGB values of 100 pixels were registered as a reference. For the image classification, each pixel of the images was assigned to the most proximate class according to Mahalanobis distance. Pixel classification into clusters and green leaves classes was validated: these two classes were manually identified on 10 images and compared with the automated classification to assess the percentage of error. Figure 1, shows an example of segmented images through Mahalanobis distance.

 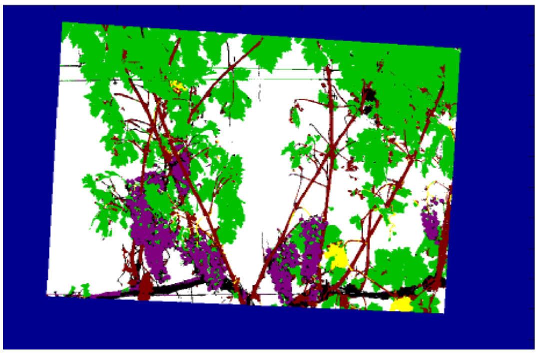

Figure 1. RGB and classified grapevine image according to minimum Mahalanobis distance to reference colour pixels for 6 classes (clusters, green leaves, yellow leaves, canes, trunk, and canopy porosity). A wooden frame (1.15 m x 0.7 m) was included in the images as a spatial reference.

Conclusions: A simple and computationally inexpensive method for pixel classification was proposed and applied to the identification of elements of the vineyard canopy (fruit-clusters, leaves, canes, trunk, and canopy porosity). Fruit-clusters and green leaves classifications were quantitatively validated. Potential applications include yield and fruit quality prediction and diagnostic of canopy status with onboard systems.

References

Cheng H.D., Jiang X.H., Sun Y. and Wang J. (2001). "Color image segmentation: advances and prospects." Pattern Recognition 34, 12:2259-2281.

Dunn G.M. and Martin S.R. (2004). "Yield prediction from digital image analysis: A technique with potential for vineyard assessments prior to harvest". Australian Journal of Grape and Wine Research 10:196-198.

Acknowledgements: Authors wish to thank TAGRALIA-CM program**.**