An Automatic Method for Counting Olive Trees in Very High Spatial Remote Sensing Images

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PREFERRED TOPIC: **T3 – CLASSIFICATION AND DATA MINING TECHNIQUES**
A2 – URBAN AND BUILT ENVIRONMENT
PRESENTATION: **POSTER**

ABSTRACT

The last generation of very high spatial remote sensing sensors such as IKONOS and QUICKBIRD sensors has opened up avenues for new applications in remote sensing. Some examples are the analysis of urban scenes for the extraction of road networks or small objects [1]-[2] and forest monitoring [3]. Another potentially interesting application is the detection and counting of olive trees [4]-[6].

Recently, the agricultural institutions around the world have shown a strong interest in identifying and classifying olive trees at a large geographical scale. Such interest is explained by multiple reasons. First, it provides an inventory of the trees that may help in a better planning of the irrigation process. Second, the information about the number of trees is essential for predicting the olive production. Third, the number of trees is used as a fundamental criterion for the access to public grants by olive trees farmers. Usually, the process of counting olive trees is carried out manually on site. Such an operation is very tedious and time consuming due to the typically high number of plantations to monitor. Therefore the utilization of automatic methods, which exploit images acquired by high resolution remote sensing sensors, represents for the public administration a potentially interesting alternative.

In this paper, we present an automatic method for counting olive trees in very high resolution images. This method is composed from two main steps. In the first one, the olive trees are discriminated from other classes present in the image under analysis by means of a Gaussian process classifier (GPC) [7]. The choice of this classifier is motivated by the fact that GPCs are theoretically attractive statistical classification models which permit a fully Bayesian treatment of the considered classification problem. Compared to other kernel methods such as support vector machine (SVM) classifiers, they have the advantage of providing probabilistic outputs rather than discriminant function values. Moreover, they can use evidence for automatic model selection and hyperparameter optimization. Because of the important role of the spatial component in very high resolution imagery, the GPC is fed with different texture and morphological features [8]. The result of this step is a binary

classification-map reporting olive trees (seen as foreground information) and all other classes (viewed as background information). In the second step, the classification map is first pre-processed using the erosion morphological operator to better isolate blobs representing potential olive trees and to reduce noise. Then, the number of olive trees is determined by an automatic count of the isolated blobs. Each blob is considered valid if its size is comprised within a certain range fixed a priori on the basis of the image spatial resolution. In order to evaluate the performances of the proposed method, a very high resolution image acquired over Al-Jouf, Saudi Arabia, in 2007 by the IKONOS-2 sensor was used in the experiments. The obtained results confirm the very promising capability of the proposed method in detecting and counting the olive trees.

Keywords: Feature extraction, Gaussian process classification, very high spatial images, morphological operators, olive tree counting.

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