

Optimum-Path Forest in the classification of defects in Bovine Leather

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Abstract—In this paper, the Optimum-Path Forest (OPF) classifier is applied in the classification of defects in cowhide, a problem of great evaluation complexity. The OPF classifier reduces a pattern classification problem to the problem of partitioning the vertices of a graph induced by its data set. The results revealed a competent performance compared to traditional classifiers, such as Support Vector Machines (SVM), Artificial Neural Networks - Perceptron Multilayer (MLP), Decision Trees (J48) and k-Nearest Neighbor (kNN).

Index Terms—Computer Vision, Machine Learning, Shallow Learning, Optimum-Path Forest.

I. INTRODUCTION

Pattern recognition is a scientific area that points to classify objects in a set of categories or classes. Patterns are usually represented by attribute vectors obtained from samples and partitioned toward classes. The classification of an input sample is the process of finding the class of the highest similarity in the set of learning data. Learning techniques use a set of samples which are distributed in different classes in the feature space, using a training set and finding areas or decision rules for the classification of this subset [1].

Each principal methods through learning pattern recognition are done using statistical analysis. In this model, each pattern is associated with a point in a d -dimensional space. The goal is to determine those features that allow pattern vectors relating to different categories to conquer compressed and disjoint areas in a feature space. The effectiveness of the representation space is determined by how the patterns of different classes can be distributed [2].

Naive methods in the statistical strategy can easily handle classes linearly separable as shown in Figure 1 (a), but in practice, unfortunately, many applications require not linearly divisible classes, as shown in Figure 1(b). Some examples of possible resolutions are Support Vector Machines (SVM) [3], Artificial Neural Networks - Perceptron Multilayer (MLP) [4] and the k-nearest neighbors [5].

The relation of the distance between samples is one of the most relevant features of sample spaces that has not received much recognition in supervised classification. Some recent works that explore this connection have shown promising

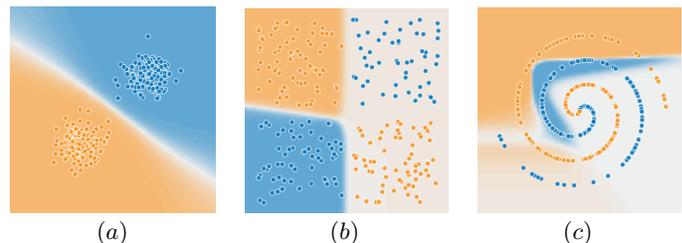


Fig. 1. Examples of feature attribute classification functions: (a) Linear function. (b) Non linear function. (c) Piecewise linear function.

results in supervised and unsupervised learning methods using the OPF (Optimum-Path Forest) classifier [6], [7]. OPF is a supervised pattern classification structure, particularly effective in image classification, which decreases the pattern classification problem to the problem of partitioning the vertices of a graph.

In this paper, the authors implemented the Optimum-Path Forest (OPF) classifier, proposed by Papa et al [8], in the classification of defects in cowhide. The classification experiments are related with traditional algorithms in the area, such as Support Vector Machines (SVM), Artificial Neural Networks - Multilayer Perceptron, Decision Trees (J48) and k-Nearest Neighbour (kNN).

This paper is organized as follows: related work is presented in Section II. In Section III, the description of the materials and methods is shown. The results are presented in Section IV, and the conclusions are in Section V.

II. RELATED WORK

In the last decades, computer vision systems have been developed for automatic visual inspection in several industry segments. However, few works related to defects detection for leather was performed. In this context, an automatic visual inspections system was developed in [9] where the authors created an algorithm combining multiresolution wavelet-based approach and binary thresholding segmentation for defects detection on leather surfaces. The work concludes the system