Classification Techniques for Material Identification in Soil Science Images

MOACIR PEREIRA PONTI JUNIOR[1], NELSON D. A. MASCARENHAS[1]

[1]UFSCar – Universidade Federal de São Carlos, Rod. Washington Luiz, 235, 13565-905, São Carlos, SP, Brasil.
{moacir,nelson}@dc.ufscar.br

Abstract. Three classifiers and multiple classifier combining rules are presented to identify materials in soil science images obtained from a CT scanner with different energies.

1. Introduction

An X and γ-ray CT scanner has been used by Embrapa to generate images of a phantom built with materials found in soil. Images with size 65x65 pixels of this phantom were obtained with transmission of energies 40, 60, 85 and 662 keV (Figure 1). It has a basis of plexiglass, and 4 cylinders containing: water (left), aluminum (top), phosphorus (right) and calcium (bottom).

A previous work successfully used the classifiers Maximum Likelihood, ICM and K-Means to identify materials in those images [1]. To observe the behavior of other techniques, new classification methods are proposed.

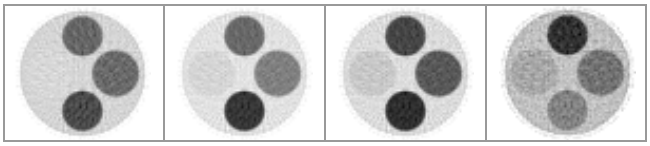

Figure 1: Images obtained with the four energies

2. Classification

2.1 Classifiers

The goal to achieve the best possible classification performance led to the use of different classification methods. We chose the classifiers K-Nearest Neighbors, Parzen and Logistic, due to their performance on trial experiments.

2.2 Multiple Classifier Combining Rules

Although one of the classification methods would yield the best performance, the sets of misclassified objects do not necessarily overlap. Results of different classifiers can offer complementary information that combined can improve performance. In this work, will be developed combination strategies based on the following decision rules: Voting, Maximum, Minimum, Mean and Median, presented in [2].

3. Performance Evaluation

The Kappa coefficient will gave the average of the classification result on a -1 to +1 interval.

4. Preliminary Results

We developed an experiment using an image acquired with 662 keV energy, taking 64 samples over each of the 6 classes: *water*; *aluminum*; *phosphorus*; *calcium*; *plexiglass* and *background*. Results are displayed on Table 1 and Figure 2.

	Classifiers			Combination	
	Logistic	**K-NN**	**Parzen**	**Median**	**Mean**
Kappa	0.8281	0.8406	0.8500	0.8406	0.8988

Table 1: Kappa coefficients for the classification results

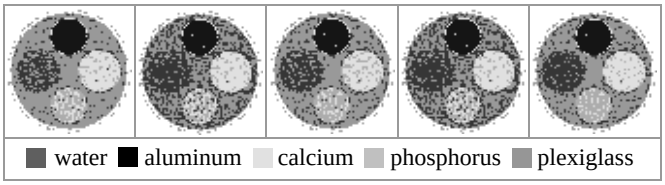

Figure 2: 662keV band images classified with Logistic, K-NN, Parzen and combination rules Median and Mean

5. Conclusion

Using a single image we obtained good performance, showing that combination rules can improve the best result (Mean rule), but also decreases it in some cases (Median rule). The challenge now is to explore new combination methods and to observe how they behave on multispectral images, also observing how classifiers with different characteristics can be combined successfully, and looking for a theoretical basis for the results.

Acknowledgement

We thank CAPES for the student financial support.

References

[1] M.R.P.Homem, "Técnicas de Reconhecimento de Padrões Aplicadas a Imagens Tomográficas Adquiridas com Múltiplas Energias", *Dissertação de Mestrado*. DC-UFSCar (1998).

[2] J.Kittler, M.Hatef, R.P.W.Duin, and J.Matas, On Combining Classifiers, *IEEE Trans. on Pattern Analysis and Machine Intelligence*, v. 20, n. 3 (1998), 226-239.