INSTITUTE FOR REMOTE SENSING APPLICATIONS

Conference on

THE APPLICATION
OF
REMOTE SENSING
TO
AGRICULTURAL STATISTICS

Villa Andrea Ponti, Varese Italy
10-11 October 1989

PROCEEDINGS

Edited by
F. Toselli and J. Meyer-Roux

This Conference was organised by the Agricultural Project
of the Institute for Remote Sensing Applications,
in particular M.J.P. Le Gorgeu, in close collaboration
with the Press and Public Relations Office
of the Joint Research Centre
Ispra Site
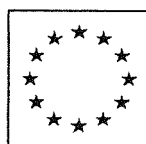
JOINT
RESEARCH
CENTRE

CLASSIFICATION IMPROVEMENT OF SPOT DATA BASED ON THE USE OF FILTERED DATA AND CONTEXTUAL FEATURES. STUDY OF THE LOIRE ET CHER REGION.

C. Kontoes

Commission of the European Communities, Joint Research Centre, L.I.P., TP. 670, I-21020 Ispra (Va), Italy.

ABSTRACT

The study deals with the classification improvement of SPOT data, based on (a) a spatial filtering technique and (b) the introduction in a post classification level of auxiliary contextual information. As it is shown a such contextual information may be derived by the use of variance feature.

INTRODUCTION

This study is carried out in the frame of the pilot project of Remote Sensing techniques applied on agriculture statistics, the scope of which is the crop area estimation using a combination of ground survey and high resolution satellite data. In particular the work should result in the development of new and accurate techniques in data processing and data classification and the production of thematic maps and statistics, describing the cover classes for the whole study area.

STRATIFICATION OF THE STUDY AREA

A division of the study area into subregions, being uniform in terms of topographic and edaphic characteristics as well as in terms of agricultural crop production systems was considered indispensable in order to reduce the sampling variability by creating homogeneous groups of sampling units (COCHRAN, 1).

DATA SOURCES - DATA PROCESSING

Data sources

(a) Satellite data: 3 SPOT(XS) scenes of 1.B preprocessing level.

(b) Field data: Ground truth information provided by the French Ministry of Agriculture (SCEES) referred to a set of 65 sampled segments.

(c) Ancillary data: 1) French Carte Topographique 1:25000 (Lambert conic conformal projection), 2) Areal photos.

Data processing

(a) Digitization.

(b) Map to Image registration. The precision of the global transformation equals 1 pixel.

(c) Histogram Matching. The Linear Histogram Operation Analysis (LHAO) was carried out in order to overcome the radiometric calibration differences of the two sensors of SPOT satellite (VOLCHOK, 4), (see fig.3).

(d) Clustering of the training data, using the LARS algorithm (SWAIN, 2). A cluster analysis assures that the training sample doesn't violate the assumption of gaussian statistics.

(e) Supervised Classification. The maximum likelihood as well as the minimum distance classification are the two types of pixel based supervised classification techniques which have been applied to the satellite data. The mean overall classification accuracy achieved, for the two types of classifier was 50.06% and 47.13% respectively. Thus, it was decided to perform data filtering and contextual post classification processes, aiming to obtain better classification results.

CLASSIFICATION IMPROVEMENT

The use of the Nagao Matsuyama edge preserving smoothing filter aimed to reduce the in field radiometric variance without eroding the field borders. Its performance resulted into the minimization of the intra class variances and the maximization of the inter class variances providing (a) an improvement of 15.61%, in the case of maximum likelihood classifier and (b) an improvement of 9.26%, in the case of minimum distance classifier. Fig 1, illustrates the classification efficiency obtained by the use of filtered data. The efficiency is the result of the rationing of the r.m.s errors of the
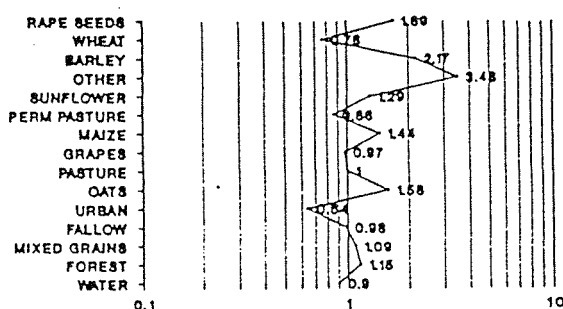

Fig. 1   Per crop classification efficiency

304

plots reported versus classified. From this point on, we are trying to reduc
the pixel labelling ambiguity of the first single pixel classification
attempt, using additional layers of auxiliary information describing the
context of the pixel. A such pictorial information can be derived by the
use of the variance feature estimated inside a resolution cell of 10x10
pixels using as input the channel 3 of SPOT data. The variance feature
provides a measure of the image structure complexity, in terms of the
amount of sharp edges present.

Fig 2, illustrates the range plots
for variance for the 15 crop types.
Four distinct subgroups of crops may
be described, as follows :

(a) Agriculture + Horticulture +
Orchards, (b) Agriculture + Urban,

(c) Forests, (d) Water

The supervised and the unsupervised
clustering of the study area into the
4 land uses, using variance, provide
quite similar results. Further work

Fig. 2   Range plots for average VARiance

should be directed towards the introduction of the classification map of
the variance data and its associated probability layer into a post
classification attempt which utilizes probabilistic and supervised
relaxation techniques.

CONCLUSIONS

        Filtering the SPOT data using the Nagao-Matsuyama edge
preserving smoothing filter resulted into a classification improvement
of 15.61% attaining a "wall to wall" overall classification accuracy of
65.67%. A post classification approach of the satellite data is considered
indispensable and should be directed towards the use of auxiliary
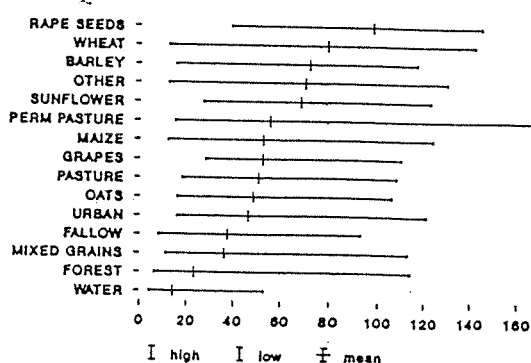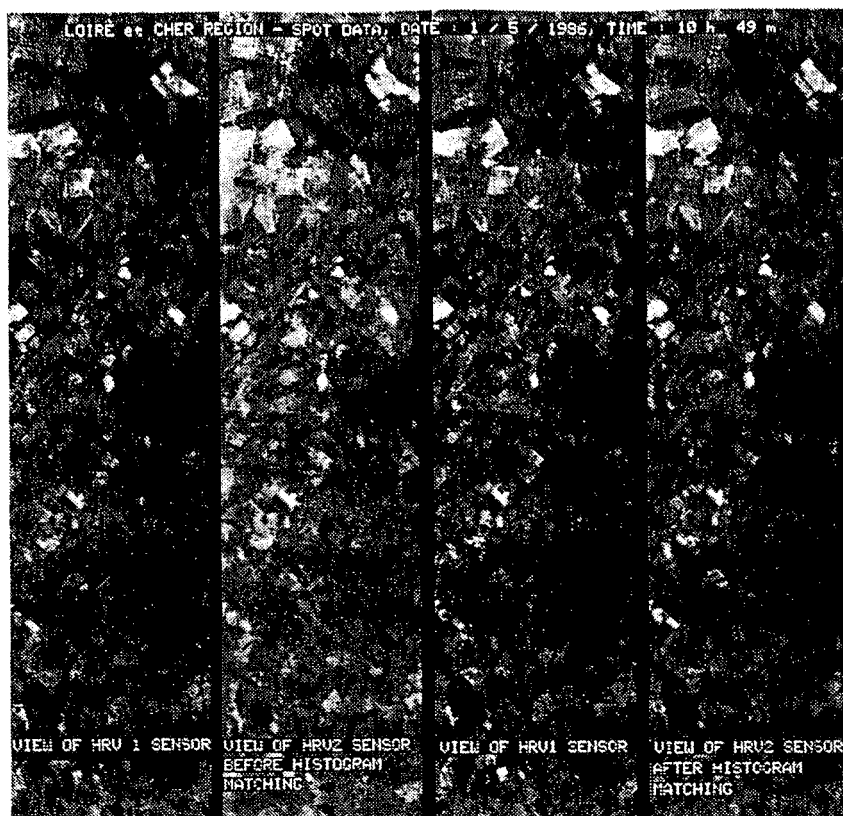contextual information provided by the use of VARiance feature.

Fig. 3   Radiometric calibration of the two SPOT sensors based
on the LHAO operation.

REFERENCES

[1], Cochran W. G., "Sampling Techniques", Wiley publications in
        Statistics, Harvard University, 1953.

[2], Swain P. H., "Pattern Recognition : A basis for Remote Sensing data
        analysis", LARS Information Note 11572 (Purdue University, West
        Lafayette Indiana), 1972.

[3], Stakenborg J., "Adaptive filtering using spatial features", Workshop
        on Advanced Image Processing for planetological and astronomical
        applications, Memoria Della Societa Astronomica Italiana,
        Vulcano 1985.

[4], Volchoc J. W., Schott R. J., "Scene to scene radiometric
        normalization of the reflected bands of the LANDSAT Thematic
        Mapper" Rochester Institute of Technology, Rochester NY 14623.