Wild fires risk in Extremadura's Regional Park and archeological exploration using CHRIS imagery

Research Groups of the University of Extremadura:
Archaeology (Departament of History),
Neural Networks and Signal Processing Group (Departament of Computer Science) and Non-Destructive Techniques (Departament of Physics)
Pre-Evaluation of wild fires in Monfragüe Regional Park using CHRIS imagery

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Objectives

The goal of this proposal is the use of endmember extraction algorithms and unmixing techniques for the computation of CHRIS/PROBA images using a Fire Mathematical Model in order to evaluate:

- Forest fire risk.
- Burned surface.
Introduction

Forest fires have always represented an ecological, social and economical problem for all countries around the world.

Evaluation, simulation and modelling of wild land fires are increasingly been used by fire and land management organizations.
Ecological and social problem

Wild land fires represent a very important problem for the Spaniard region of Extremadura.

August 2003 – Extremadura Forest Fire:
Estimated cost 53 M€
Invaluable and unrecoverable losses in vegetation and animal species.

Last four decades - Spain:
Forest fires affected 6,4 Millions hectares.
100 million trees burnt yearly.
Montfrague Natural Park
Location
Extremadura
South-west Spanish region
Near the Portugal Border.
High biodiversity site.

Scattered Oak trees (Quercus ilex and quercus suber)
Dehesa

Dehesa can be defined as an agro forestry and pasture agro ecosystem which extends itself over the west, south-west and central parts of Spain.

The general characteristic that defines Dehesa is the presence of pasture and trees such as Quercus, especially *Quercus ilex* (Encina) and *Quercus suber* (Alcornoque).
Forest fire risk evaluation using CHRIS/PROBA images.
Methodology

The proposed methodology is based on the automatical extraction of the spectral signature of the endmembers present in the scene (pasture, soil, trees) (AMEE).

Applying Spectral Unmixing we can obtain the endmember \( i \) abundance vector \( w \) at each pixel.

Using the abundance image and meteorological forecast we can compute the Fire Risk Index for every image pixel.
Dehesa

ROSIS Cáceres image
Linear unmixing

ROSIS Cáceres image
Evolution of the fire.
Mathematical fire model

Mathematical models describing surface fire evolution and effects are driven in part by fuelbed inputs such as load, fuel particle size, heat content, moisture of extinction, meteorology, digital elevation maps.....

It is possible to obtain fuelbed variables (using accurate abundance maps).
Burned area evaluation
Burned surface

Usually the burned surface is evaluated using a vegetation index.

Using hyperspectral data is possible to use vegetation abundance maps in order to evaluate the burnt area.

These images can be used by fire and land management organizations in order to obtain maps of burned vegetation and/or to update the vegetation maps.
REMOTE SENSING TECHNIQUES APPLIED TO THE STUDY OF CÁPARRA ARCHAEOLOGICAL SITE (SPAIN)

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THE ROMAN TOWN OF CÁPARRA

It probably was found during the Emperor Augustus Era, close to the newly created Vía de la Plata (Iter ab Emerita Asturicam).

Cáparra was 110 roman miles (1 m. p. = 1480 m) away from Augusta Emerita.

The road forms the *decumanus maximus* (longitudinal axis) of the town.

The *tetrapyllum* (four-gated arch) was placed in the geometrical center of the *decumanus*, at the junction with the *kardo* (transverse axis).

The town, is approximately 15 ha in area, and the *tetrapyllum*, *decumanus* and *kardo* are the axis that configure the town planning.
Archeological CHRIS Image Mining System

Changes induced by our ancestor on archaeological sites can be detected on the actual ecosystems.

The goal of this proposal is to use our background on neural networks supervised learning and the archeologist knowledge of Caparra archeological site, to design an expert system able to detect new locations with higher possibilities of being archeological sites on CHRIS images.
In the 1956 photograph, it is possible to see clearly only the Eastern part of the amphitheatre, due to the presence of trees in the western zone. In the 1987 photograph it is possible to see all the amphitheatre clearly, due to the reduction of the scale and the disappearance of the vegetation.

External dimensions: 66 m x 51 m
Internal dimensions: 59 m x 34 m
Conclusions

GRNPS group present 2 proposal in order to use CHRIS/PROBA hyperspectral images in 2 different ways:

Forest fires risk index and burned area evaluation.
Expert system for archeological data mining on CHRIS imagery.