

*Consiglio Nazionale delle Ricerche
**Università Europea di Roma
***Aeronautica Militare Italiana, ReSMA



Automatic Cloud-Coverage Evaluation by a Ground Based, Total-Sky Camera

C.Rafanelli^o, G. Casagrande^{o**o}, E. Piervitali^o
G.Casu^{o*}, F. Malaspina^{o**}, F. Foti^{o**}, E. Vuerich^{o**}

^{*} Consiglio Nazionale delle Ricerche ^{**} Università Europea di Roma ^{**} Aeronautica Militare Italiana, ReSMA

Introduction

We have developed an image-processing procedure to obtain an automatic cloud-coverage evaluation. Images to be analyzed are captured by a ground-based digital camera, equipped with fish-eye lenses. The images are in the visible-light spectrum; the cloud-coverage evaluation is performed taking into account RGB and Hue parameters. By setting appropriate RGB values the algorithm provides for the discrimination of different colors, separating typical cloud palettes from those of the clear-sky. When a solar flare is present in the picture, it can be recognized and isolated by setting an appropriate Hue demarcation value.

This algorithm has been implemented in a JAVA program, which was then tested against a series of 502 images. The program output, expressed in octaves of coverage, was verified by comparison with cloud coverage evaluations made by three, independent human observers on the same images set. The automatic system accuracy proved higher than the human operators' one throughout the entire image series.

Method

The system is composed of software algorithms that by a computer when software should periodically "capture" images of the entire sky area. The main software module is the so-called Local Control Module (LCM), which is designed to manage other modules by which the system is operated. The software modules which constitute the main sky camera will capture an image. Despite its recording time, appropriate frame acquisition (frame capture) is achieved.

The file is then opened by the Image Processing Module (IPM), which performs the evaluation of cloud coverage. The resulting values are given as a digital image, which can be used for the study of the sky camera. The IPM also manages other modules that are used for the acquisition of images, e.g. software modules for the acquisition of images, etc.

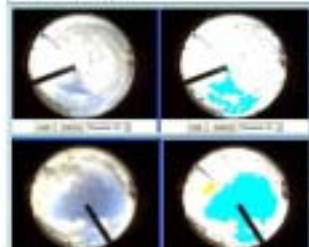
The output may include data from the LCM but also from other modules, through appropriate interface modules, as called "Digital-to-Analog" (D/A). This can be implemented by means of a software module by user information dissemination.



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Conclusions

The purpose of the experiment was to verify the feasibility of an automatic cloud-coverage evaluation system which could replace a human operator for continuous observations in marginal environments. Such a system could have several applications in meteorology and in environmental science as well: a measure of cloud coverage could indeed be correlated with solar radiation assessment in local area expedition analysis. The tested device can be coupled with traditional instruments, either as a stand-alone system or as part of a wider network, for wider-area-data-processing.

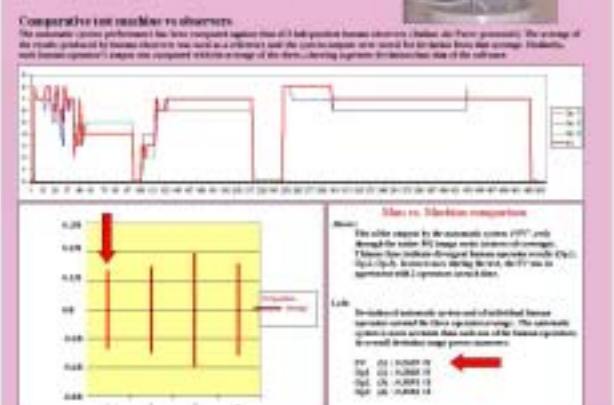
The performed tests have shown that not only the system itself is feasible, but also that it can be more reliable, under normal conditions, than standard routine observations made by operators.

Results

Measurements:
Timing range: 08:00-12:00
Date: 08/07/2004
Location: ...

Initial conditions:
Observer: ...
Observer: ...
Observer: ...

Timing series:
Observer: ...
Observer: ...
Observer: ...



Automatic System Results:
The automatic system results are shown in the table below.

Type of Value	By observer
Time of Day	08:00-12:00
Date	08/07/2004
Location	...