MIGLIARINO-SAN ROSSORE NATURAL & ARCHEOLOGICAL PARK: EXPERIENCES IN MONITORING COASTAL LANDSCAPE EVOLUTION

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ABSTRACT

This paper was carried out to promote the valorization of a particular naturalistic sea coast area where complex cultural, archeological, and environmental interactions involve the requirement of an articulate monitoring system.
The area of study is part of the coastal macchia mediterranea in Tuscany close to the town of Livorno and presents some morphological interesting aspects that interact with a series of problems concerning the fruition and the control of the anthropic activities. The study area concerns a territory characterized by particular historical and morphological evolutions; some territorial elements suffer by continuous transformations caused by the changes of the sea shore line of some delta of natural and artificial rivers. This study is articulated in a series of technical reports with the goal to delineate standard procedures in the acquisition of these specific thematic data. To achieve this purpose, different digital photogrammetric procedures were planned and then compared with other reference data coming from different kind of sensor (LIDAR) and some conventional photogrammetric analytic survey, focusing the research in testing similar expeditious procedure to achieve a sufficient detail to record any coastal dynamic pattern. This experience was developed in collaboration with the Department of Scienza della Terra - University of Florence in the context of an European Community project supervised by Prof. Enzo Pranzini.

1. SHORT DESCRIPTION OF EQUIPMENTS AND METHODOLOGY

Part of the coastal areas in North Tuscany, particularly between the mouths of Serchio and Arno rivers, is characterized by a landscape with complex environmental, cultural and archaeological interactions, with interesting naturalistic features, as the presence of rich vegetation very close to the seashore ("macchia mediterranea"). Its historical evolution exhibits relevant morphological changes, due both to natural events and anthropic interventions. For these reasons its protection and valorization requires an articulate monitoring system. A particular role is played by photogrammetric surveys, providing a metric documentation of morphological features, as for example the position of the coastline.

Fig. 1 Nadiral view of the study area

A fundamental requirement in the different photogrammetric techniques (rectification or georeferencing of single images, stereoscopic reconstruction of a 3D model) is the availability of well defined points easily recognizable both on the images and on the ground. This is certainly a difficulty on a shore, where generally no particular stable features can be identified. Some features, as coastline or dune and vegetation contours, can be recognized and used for metric elaborations at a certain epoch, but are rapidly varying in time. Therefore accurate surveys can be obtained, but it is not easy to define a stable reference frame for comparisons between different epochs.

Fig. 2 Digital semi-metric camera and data of aerial-survey

The study area was covered by a rich documentation of aerial photos (about 500), taken with a digital camera Nikon D100 (3000x2000 pixels) with two objectives with nominal focal length 28mm and 50mm on board of a light aircraft Cessna 172. These images are organized in three different series. The first one, taken at a height of about 500m, is devoted just to give a panoramic view of the area; the other two series (one at a height of about 650m, to give a global view of the area and its surroundings, the other at about 350m, to have a clear picture of the details) were taken with a criterion suitable for a

photogrammetric survey, i.e. with the camera axis in nadiral direction, and with a taking frequency such to obtain correct stereoscopic images.
Although the camera is not metric, yet a calibration certificate containing information on its internal orientation and the radial deformation of both objectives is available; experiences of elaboration of photogrammetric measurements have shown that a satisfactory accuracy can be obtained in the relative orientation of photogrammetric pairs, though not comparable to the results of a photogrammetric flight with a suitably equipped aircraft for cartography.

Fig. 3 a)The digital photogrammetric strips
b) Light aircraft C172 type

Fig. 4 a) artificial GCP network b) GCP target

As an example, that gives a picture of the quality of the results, Fig.8 shows a comparison of three different determinations of the coastline, with GPS, photogrammetric stereo recording and rectification. The ground network for the absolute orientation was materialized by artificial targets and measured with GPS. The final adjustment results, with residuals not larger than few decimeters, show that this expeditious surveying technique, much simpler and less expensive than a rigorous photogrammetric flight, is nevertheless quite satisfactory for some kinds of monitoring campaigns, where the metric information is not the main purpose, but gives an essential support to a qualitative analysis, as often happens in environment protection and valorization interventions. Yet, no final results are available up to now, as concerns comparisons between surveys carried out at different epochs.

Fig. 5 Map of the stereo-pairs used for the test

Furthermore, it must be remarked that the method previously described enables people working in landscape heritage to get data from which it is possible to carry out diachronic analysis and produce thematic maps.

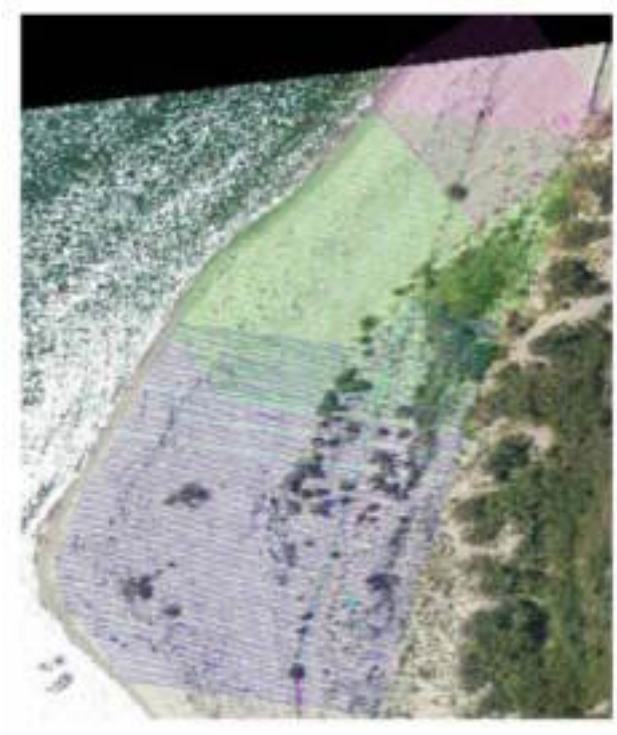

Fig. 6 Vertical section drawing of the beach surface

REFERENCES

Bianchini, L., I. Chiaverini, F. Costantino, D. Ostuni, M. Del Sette, F. Sacerdote, 2002. Sperimentazione di una metodologia di rilievo aerofotogrammetrico e fotointerpretativo da aeromobile leggero con l'ausilio di macchine digitali. In: Atti

della 6. Conferenza Nazionale ASITA, Perugia, pp. 447-452.

Roberts, A., L. Griswold, 1986. Practical Photogrammetry from 35-mm Aerial Photography, PE&RS, LII, pp. 1753-1755.

Shafer, R.V., S.A.Degler, 1986. A 35-mm Photography: An Inexpensive Remote Sensing Tool, PE&RS, LII, pp. 833-837.

Visintini, D., 1996. Elaborazione di foto d'archivio per il rilievo fotogrammetrico di edifici distrutti dal terremoto: l'esempio del castello di Gemona del Friuli. In: Atti del Convegno "La scienza e i terremoti - Analisi e prospettive dall'esperienza del Friuli - 1976-1996", pp. 129-134.

Visintini, D., L. Simeoni, 1999. Un metodo fotogrammmetrico speditivo per il rilevamento e il monitoraggio di frane. In: Atti della 3. Conferenza Nazionale ASITA, Napoli, pp. 1237-1242.

Fig. 7 Countour line map of the beach surface

Fig. 8 Comparison of coastlines obtained with GPS (red), Stereorecording (blue)and rectification (green)