ETH-Zurich

Space technologies to support
the conservation of natural and cultural heritage

Modern Technologies for the Conservation of Cultural Heritage

FRANCO NICCOLUCCI – ANDREA D'ANDREA

niccolucci@unifi.it – dandrea@unior.it

Summary

1. **Remote sensing and pattern recognition. Use of aerial and satellite imagery for:**

   1. **site detection and monitoring.**
   2. **site and monument recording and management.**
   3. **land use monitoring and planning**

   - Discovering/Recognising Paleo-Environment & new Settlements
   - Mapping Landscape & Archaeological Features

Summary

1. Data capture and management. Data acquisition from other repositories, historical maps and spatial technologies (GPS, Hystorical Maps, Surveys).

   1. GPS
   2. Scanning & Geo-referencing Historical/Modern Maps
   3. Surveys

Summary

1. GIS use for Cultural Heritage management. Use of GIS systems for:

   1. managing geo-data relevant for CH management (Landscape reconstruction)

   2. mapping the risk for heritage sites deriving from anthropic and/or natural activities and events.

      1. Managing Archaeological Spatial-Data
      2. Archaeological Risk Maps

Summary

1. Data capture (Laser 3D).

    1. LaserScanner3D

WARNINGS!!

Some Useful Remarks (for surviving...)

F. Bacon

"Truth emerges more easily from mistake than from confusion", **Novum Organum (1620)**

A. Einstein

"...as far as the propositions of mathematics refer to reality, they are not certain; and as far as they are certain, they do not refer to reality.", **Geometry and Experience (1921)**

ICOMOS Charter
Protection and Management of the Archaeological Heritage

- The protection cannot be based upon the application of archaeological techniques alone. It requires a wider basis of professional and scientific knowledge and skills.

- The archaeological heritage is a fragile and non-renewable cultural resource. Land use must therefore be controlled and developed in order to minimize the destruction of the archaeological heritage.

ICOMOS Charter
Protection and Management of the Archaeological Heritage

- Archaeological knowledge is based principally on the scientific investigation of the archaeological heritage. Such investigation embraces the whole range of methods from non-destructive techniques through sampling to total excavation.

- Non-destructive techniques, aerial and ground survey, and sampling should therefore be encouraged wherever possible, in preference to total excavation.

ICOMOS Charter
Protection and Management of the Archaeological Heritage

- Excavation should be carried out on sites and monuments threatened by development, land-use change, looting, or natural deterioration.

- Excavations should be conducted in accordance with the principles embodied in the 1956 UNESCO Recommendations on International Principles Applicable to Archaeological Excavations and with agreed international and national professional standards.

Some Basic Issues

- A general reconstruction of the paleo- and modern environment can be inferred from geological, geo-archaeological and palynological evidences, as well as historical records (maps, reports, etc).

- We can use many methods and technologies for capturing, collecting and integrating this data

- The issue is: How I can manage this huge amount of data?

Discovering/recognising Paleo-Environment

Ethiopia – Aksum

Ethiopia – Aksum

Discovering/recognising Paleo-Environment

Ethiopia – Aksum

The ruins of the ancient city of Aksum are found close to Ethiopia's northern border. They mark the location of the heart of ancient Ethiopia, when the Kingdom of Aksum was the most powerful state between the Eastern Roman Empire and Persia.

The massive ruins, dating from between the 1st and the 13th century A.D., include monolithic obelisks, giant stelae, royal tombs and the ruins of ancient castles.

Discovering/recognising Paleo-Environment

Main Goals

•Description and analysis of the environmental context, as well the reconstruction of the local environmental history

•Analysis of the geographical setting in order to define better the territory of the ancient archaeological settlements and thus the extension of the archaeological area.

Discovering/recognising Paleo-Environment

Main Goals

• Geological study of a region in order to contribute to a better understanding for the conservation and preservation of the archaeological area, and site use.

• Reconstruction of the environmental history of a region for contributing to a more detailed interpretation of the processes of site formation, and for providing a background to a predictive models of site distribution in the area

---

Discovering/Recognising new Settlements

ITALY - Pontecagnano

Discovering/Recognising new Settlements
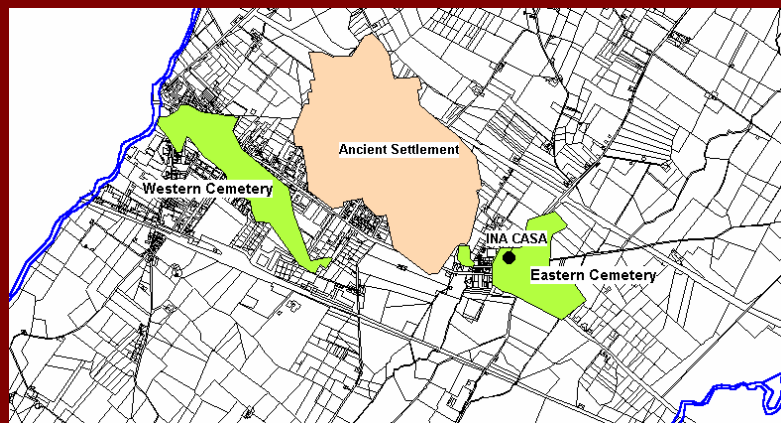
ITALY – Pontecagnano

Pontecagnano is a large Etrusco-Campanian settlement in southern Italy, 70 km south of Naples, where over 8000 tombs dated from the 9th century BC to the Roman period have been excavated so far.

Discovering/Recognising new Settlements
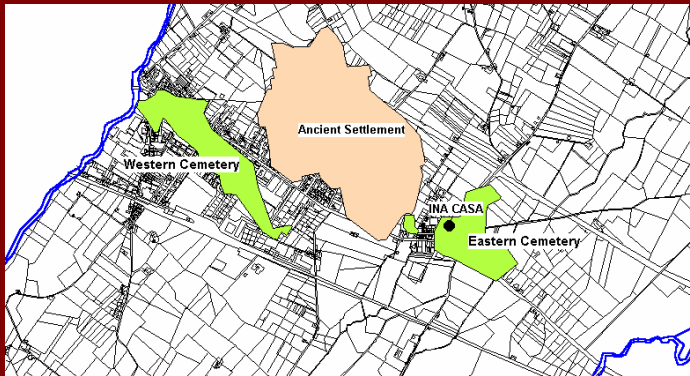
ITALY – Pontecagnano

The ancient town occupies a travertine platform delimited by two streams, the Picentino to the west and the Frestola to the east.

9

Discovering/Recognising new Settlements
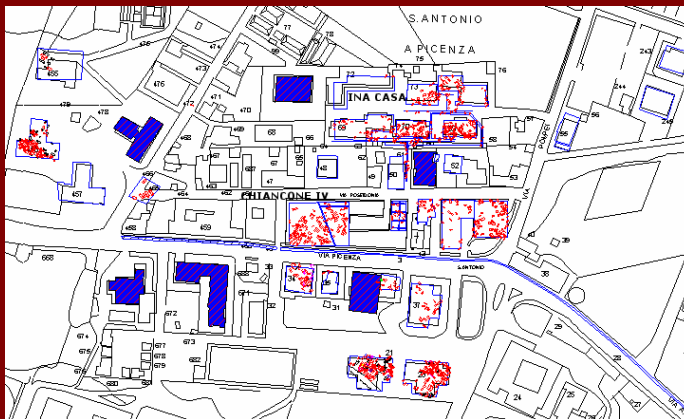
ITALY – Pontecagnano

While the exploration of the ancient town has been limited to part of its center, the necropolis, having been overrun by the urban expansion of the modern town of Pontecagnano, has been investigated more thoroughly.

Discovering/Recognising new Settlements

ITALY – Pontecagnano

To face this rapid urban expansion, since the Sixties a systematic excavation of the funerary evidence has been going on.

10

Discovering/Recognising new Settlements

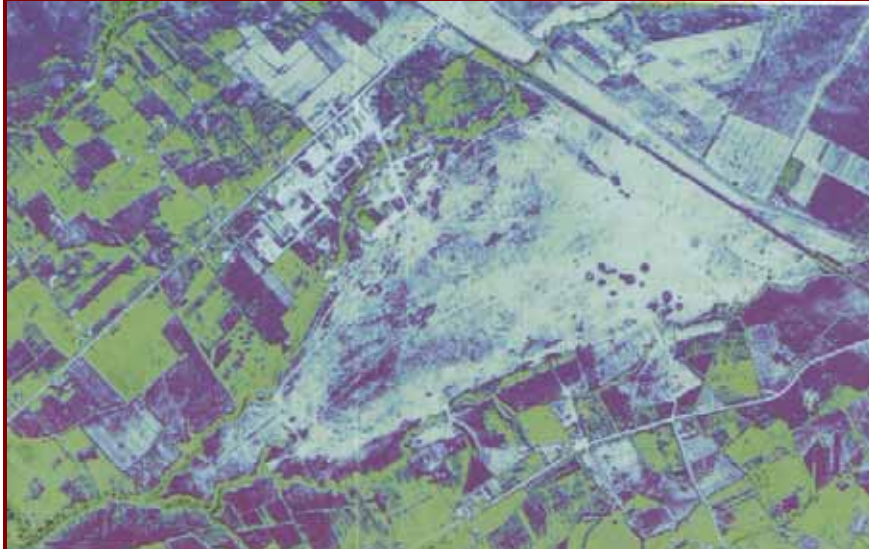**ITALY – Pontecagnano** Geo-archaeological map

Discovering/Recognising new Settlements

ITALY – Pontecagnano Aerial Photo-Interpretation by A. D'Andrea

Discovering/Recognising new Settlements

ITALY – Pontecagnano Aerial Photo-Interpretation by A. D'Andrea

YEMEN – Baraquish   Mapping Landscape Features

Mapping Landscape Features

YEMEN – Baraquish

Baraqish is an old city close to Marib, located in the semi-arid area on the road to Hazm Al-Jawf.
Baraqish stands on top of a hill with a magnificent castle sealed off by a highly fortified wall, as high as 8 meters in some places.
The wall has 57 towers and town gates, one in the east and one in the western part of the wall.
The most striking feature of the city is the ruins of the temple, located in the southern part of the city. The temple reflects the dominant from of architecture used by the Ma'eenis and consists of 16 columns and beams

Mapping Landscape Features

YEMEN – Wadi Bayhan

Mapping Landscape Features

YEMEN – Wadi Bayhan

The Wadi Bayhan Valley since the first millennium B.C. to the first centuries of the Christian era was the centre of the ancient South Arabian kingdom of Qataban.

The rains, which are linked to the monsoons, cause as in the past violent irregular floods which fill the main Wadi Bayhan and the small tributary wadies, thus creating favourable hydrological conditions for their exploitation for irrigation.

Discovering/Recognising new Settlements

ITALY – Cuma

Discovering/recognising Paleo-Environmental

ITALY – Cuma

Aerial Photo-Intepretation

by B. Marcolongo *et Alii*

Discovering/Recognising new Settlements

ITALY – Cuma Aerial Photo-Intepretation by B. Marcolongo *et Alii*

Aerial Photo 1995

Discovering/Recognising new Settlements

ITALY – Cuma – Modern Landscape and Aerial Photos

Preservation of Archaeological record

Preservation of the archaeological record depends on several factors:

1. Cultural and natural processes that affected the formation of the archaeological area and the archaeological deposits in sites

2. Local environment hazard that may have caused (and may still cause) damage to the archaeological remains

---

Free Software

MULTISPECTRAL IMAGE DATA ANALYSIS

◆ MultiSpec©

A Freeware Multispectral Image Data Analysis System
(Latest Release: 11-11-2005)

Description
What's New for 11.11.05
Download
- Macintosh
- Windows
Documentation
Links
- LARS
- IndianaView
- Purdue Terrestrial Observatory
- Other Sites

MultiSpec is being developed at Purdue University, West Lafayette, IN, by David Landgrebe and Larry Biehl from the School of Electrical and Computer Engineering, ITaP and LARS. It results from an on-going multiyear research effort which is intended to define robust and fundamentally based technology for analyzing multispectral and hyperspectral image data, and to transfer this technology to the user community in as rapid a manner as possible. The results of the research are implemented into MultiSpec and made available to the user community via the download pages. MultiSpec© with its documentation© is distributed without charge.

Updated: November 11, 2005. Please send questions or comments to Larry Biehl, webwriter.

Copyright (c) 1994-2005 Purdue Research Foundation.
Macintosh is a registered trademark of Apple Computer.
Windows is a registered trademark of Microsoft Corporation.

http://dynamo.ecn.purdue.edu/~biehl/MultiSpec/

17

Free Software

GRASS

Geographic Resources Analysis Support System

Commonly referred to as GRASS, this is a Geographic Information System (GIS) used for geospatial data management and analysis, image processing, graphics/maps production, spatial modeling, and visualization. GRASS is currently used in academic and commercial settings around the world, as well as by many governmental agencies and environmental consulting companies.

Latest News!

- 22 August 2005: GRASS GIS 6.0.1 released - bugfix release: download - Announcement - Screenshots
- June 2005: GRASS News vol.3 released: download pdf (1 MB)
- 10 March 2005: GRASS 6.0.0 released: download - Announcement - Screenshots

http://grass.baylor.edu/

Free Software
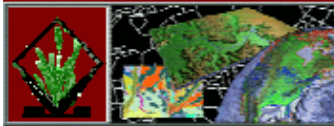
GRASS

GRASS: Download

Software download section

Please use the GRASS mirror site next to you.

GRASS 6.0.1 (advanced vectors, more...)

Binaries	Source code	Manuals
Debian GNU/Linux	grass-6.0.1.tar.gz (grass-6.0.1 md5sum)	Tutorial (HTML)
Fedora Core 3	Source code directory	User manual pages (HTML)
SuSE RPMs		Programmer's Manual
Mandrake	weekly 6.0.x release branch source code snapshot	
Slackware		
MacOSX		
MS Windows / Cygwin		

http://grass.baylor.edu/download/index.php

Cheap Software

IDRISI - **http://www.clarklabs.org/Home.asp**

Cheap Software

IDRISI - **http://www.clarklabs.org/Home.asp**

19

FRANCO NICCOLUCCI – ANDREA D'ANDREA

niccolucci@unifi.it – dandrea@unior.it

PIN Servizi Didattici e Scientifici per l'Università di Firenze

Piazza Ciardi, 25

PRATO 59100

ITALIA