Use of space technologies for cultural heritage: the challenges and benefits for archaeology

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Abstract

We used here the term ‘space technologies’ as a user friendly term better understood by the non-specialists. In reality we are referring to the scientific and technological theme known by specialists as ‘geomatics’. Reason to use the term ‘space technologies’ is to facilitate the contact with archaeologists, who do not necessarily have a strong background in science, technology, engineering’s and mathematics.

Archaeological features can only be studied and documented in great detail working closely on these objects in the ground. However, the understanding of the cultural landscape on which the archaeological site was constructed, and the different natural and human made elements that constitute the archeological site, are better understood with a global view from above. This is one of the contributions of earth observation from space. Under certain conditions, radar satellite images, allow the identification of new archaeological features not clearly visible in the terrain by the human eye. Airborne LIDAR sensors that can, under optimal conditions, penetrate certain type of forests, are being used to detect archaeological features that are not possible to identify otherwise.

A complete documentation, interpretation and visualization of an archaeological site require an interdisciplinary group of experts working jointly. Earth observation from space (e.g. satellite images), in particular the recent high-resolution images, has
become a valuable support tool in archaeology. Satellite data, when combined with aerial data as well as with local data acquisition of the archaeological structures (e.g. laser scanning) constitute today the optimal set of data (digital data) for the documentation of archaeological sites and its associated cultural landscape. However, the technical and scientific skills to manage all this digital data are not within the archaeologist community.

The management of all the digital data produced by satellite images, airborne, remote control helicopters and/or laser scanners is complex to manipulate. It requires heavy computing processing and large human effort involvement. Although there is commercial software available that allows certain operations to be done automatically, there is still the need to develop large amount of in-house software in order to improve the registration of all data, the overall accuracy, the associated modeling and visualization. Worldwide recognized institutions with expertise in remote sensing and photogrammetry are obtaining excellent results in the documentation and visualization of archaeological structures and sites.

In developing countries site managers responsible for archaeological sites have reduced resources for the management of these sites. Most frequently their specialization is in archaeology and as a consequence they are not familiar with science and technology mainly on techniques dealing with digital data acquisition and associated processing, manipulation and visualization. The challenge is therefore is to ‘bridge the gap’ between high-level scientists in remote sensing and photogrammetry, and those local site managers.

The author has large experience developing and implementing a network of space partners working on the provision of technical assistance to World Heritage sites authorities in developing countries. He will share in this paper the benefits and challenges of bringing together archaeologists, remote sensing experts and photogrammeters jointly with local site managers. These interdisciplinary group works then with the common objective of improving the documentation, visualization and understanding of archaeological sites. The ultimate goal is for local site managers to have additional tools and information for the improvement of their daily conservation activities.
Use of space technologies for cultural heritage: 
Advantages and Challenges 
For archaeology

Carlos Hermosilla

International Association for Remote Sensing of Environment (ISPRS), Chilean Representative, Chile

European Association of Remote Sensing Laboratories (EARSel), European Representative

International course, November 2012, Chile

International Society Photogrammetry and Remote Sensing

Each two years: Int’l symposium on remote sensing for cultural and natural heritage

European Association of Remote Sensing Laboratories
Open Initiative on the use of space technologies for heritage

(Space 4 Heritage)

Over 80 space partners located in 33 countries

Motivating the young generation

Two young women archeologists

Nicole Dore and Jolanda Patruno

eesa
UNESCO sites in danger since 2007
80% of the city is still unexcavated
Big structures for satellites detection

Semi desert area characterized by fluvial terraces, never flooded

SAR DATA SET

**ALOS**
**PALSAR**
INCIDENCE ANGLE

- **RADARSAT - 2**
INCIDENCE ANGLE

- **15th November 2008** 23.10°
- **16th April 2012** 43.43°
- **67th May 2012** 26.63°

**ARCHAEOLOGICAL PLATE**
High quantity of UNESCO archaeological documentation for results validation
STARTING POINT

al-Mubarak (Hun al-Qadiqya)
Octagonal city
abandoned unfinished
in 796 A.D.

ALOS PALSAR
23.10° incidence angle
Remote sensing assistance
to Egypt

Decision - World Heritage Committee of June 2007

Abu Mena - Egypt (Decision of the World Heritage Committee)

Main issues:

- Raising ground water level
- Affecting the heritage site
- Abu Mena authorities to solve the hydrological problem
Identification and Nomination for World Heritage Site
Andean Main Road
(Camino del Inca/Qhapac Ñan)

UNESCO, IBA, CONAIE, Argentina, Bolivia, Cile, Colombia, Ecuador, Peru

Locations of Interest in Argentina
- Provincial de Jujuy, Santa Fe
- Provincial de Salta, Provincia del Tucumán - Salinas de Chachalaca
- Provincia de Salta, Provincia de Catamarca - Mallcu<br>- Provincia de Salta, Provincia de Jujuy - Quilmes Antiguos<br>- Provincia de Salta, Provincia de Tucumán - Tilcara<br>- Provincia de Tucumán, Departamento Uspallata - Cerro del Ace<br>- Provincia de Tucumán, Departamento Uspallata - Uspallata<br>- Provincia de Tucumán, Departamento Uspallata - Uspallata<br>- Provincia de Tucumán, Departamento Uspallata - Uspallata<br>- Provincia de Tucumán, Departamento Uspallata - Uspallata

GENERAL OBJECTIVE
CONAIE assists the Argentinean Government:
- Identification, promotion, documentation
- To bring an additional benefit to the local communities
From Space to Place

An image atlas of world heritage sites on the ‘in danger’ list
The Atlas

Visual and Narrative Tour of 31 World Heritage Sites

A new era: Digital Archaeology

Preserving our ‘Digital Heritage’
At the Museum entrance

A big heavy stone with the instructions of the Governor ordering to construct the Temple of Bells.