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Lasers and Holography
in the preservation of Cultural Heritage

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9th INTERNATIONAL CONFERENCE HOLOEXPO -2012
Holography, Science and Practice
Sep 2012
Suzdal, Russia
2009: HoloCultura
Applied Holography in Cultural Heritage

Why Greece?
HEL_LAS: ‘the land of light’

primary surplus in art and culture
The ancient Greek city is often called a "city of images". Few ancient civilisations depicted their gods and heroes, their myths, their daily life and even death, so systematically and passionately as the Greek one. While in other societies pictorial art was usually reserved for the decoration of public buildings and luxury items, in ancient Greece it was applied even to simple objects of practical or personal use (e.g. vases, coins, private grave markers), thus becoming gradually available to broader social strata.

Why did the Greeks need so many images? No doubt, giving visual form to things – in an era when the image was still a relatively new medium of communication and artistic expression – helped them to understand their world and reality. But this is only part of the truth, for ancient Greek art was not always realistic and very often blended real with imaginary elements.
The most distinctive sign or symbol of Eastern Orthodoxy is the icon. **Icon** is a Greek word meaning *image*, and in Christianity, icons are sacred images. Eastern Orthodoxy does not tend to use statues. The icons are created in mosaics, frescoes, engravings, paintings, or prints. The technique is not representational, that is, the style of drawing does not imitate real life. **Icons are so important to Eastern Orthodox Christianity that it can be difficult to fully understand the tradition without an understanding of icons.** In Eastern Orthodox belief, icons are windows that open into eternity.
HoloCultura: our brief in 2009

Applied Holography in Cultural Heritage

- ‘Digital’ Holography:
  - Filming Studio equipment
  - Transportable setup for image capturing
  - PC cluster and software for image processing

- Analog Holography:
  - Transportable laser camera
  - Portable film development studio
  - Support equipment and accessories

- LED illumination:
  - HoLoFoS - intelligent LED illumination
‘Digital’ Holograms
for documentation of cultural artifacts
2011: Z-Studio

- **Target:** perspective capture system for stereoscopic 3D modelling, anaglyphs, lenticulars, holographic printing
2011: Z-Studio

Z System
MULTI MODE PERSPECTIVE CAPTURE SYSTEM

Z.linear
Z.radial
Z.axial
2011: Z-Studio

- Digital holographic print (GEOLA) of ortho-photographic map Kos island (Dodecanese), size 115x50 cm. Permanent exhibit at the Museum of Greek Army Geographical Services (Athens)
2012: Z-Studio

- Digital holographic print (ZEBRA) in full parallax of map of Antiparos (Cyclades). Developed for the Greek Army Geo Services in cooperation with Photogrammetry Section of the National Polytechnic School (Athens)
Analog Holograms
for documentation of cultural artifacts
Denisyuk-type holograms
2011: Z3-Camera

- **Holophos**
  - b,g,r maximum relative luminance
  - Wavelengths:
    - 450-465
    - 520-535
    - 620-630
    - 638 at 70% of red led max relative luminance

- **Pan Plates**
  - [nm]: 350, 400, 450, 500, 550, 600, 650, 700, 750

- **Cobolt Samba™** 532nm
  - 100 mW

- **Cobolt Twist™** 457 nm
  - 50 mW

- **CrystaLaser** 638 nm
  - 70 mW
2012: Z3-Camera
Preliminary Results (Sep 2011)

- Alabaster Wrestlers
Wood is wood,
Silver is silver,
White is white
but ROLEX is ...
Bolex !

Preliminary Results (Oct 2011)
Preliminary Results (Oct 2011)

- Venetian Mask (cloth/fabric)
Preliminary Results (Oct 2011)

- Venetian Mask (cloth/fabric)
- St. Nicholas (silver/wood icon)
Preliminary Results (Nov 2011)
Preliminary Results (Nov 2011)

- Chios Epitaph
Results (Jun 2012)

Hand-made wooden model 100x100 cm

Industrial design
(awarded model-maker, ATHENS 2004 Olympics torch)

Z3 RGB Camera

Hand-made wooden model 100x100 cm
Results  (22-June-2012)

Polyester fiberglass cast body
Results (30-July-2012)

Operational Test version
Results (14-Sep-2012)

Final version

Z3 RGB Camera

HiH
Results (Jun 2012)

Schematic setup

- **TE**: temperature
- **F/P**: beams monitoring
- **HU**: humidity
- **SP**: spatial filter
- **RGB**: RGB combiner
- **RG**: RG combiner
- **SH**: shutter
- **PR**: λ/2 plates
- **VD**: variable density

HELLENIC INSTITUTE OF HOLOGRAPHY
Results (Jun2012)

PC-driven operations, custom-built control software

LASER beam purity real-time monitoring by scanning interferometer
Results (Jun 2012)

Z3 Lab

Mobile self-contained dark-room tent
Results (Jun 2012)

iLumogram printed by GEOLA size 3040cm
Results (Jun 2012)

9th ISDH2012 at MIT

The Hologram
Results (Feb 2012)

The Object

'warm' white light  
'cold' white light
Results (Apr 2012)

LED
Results (Jun 2012)
Results (Jun 2012)

The Box

Object side

Hologram side
An intelligent illuminant

(WIFI communication,
DMX protocol (IP-address)

Early announcement – Rapid communication

Paper in preparation to be published
**COMMON RGB**

**MIXING PROFILE**
3 angularly displaced beams
considerable angular separation

**CHARACTERISTICS**
Narrow bandwidth
High level of blur
Must be placed far from a hologram
May support intensity mixing
RGB-W version
(2010-11)
HoLoFoS V.1

MIXING PROFILE
3 angularly displaced beams
small angular separation

CHARACTERISTICS
Narrow bandwidth
Lower level of blur
Must be placed far
from a hologram
Smart control with intensity mixing

RGB-W version
Trichroic Prism
(Dec2011)
HoLoFoS V.2

MIXING PROFILE
3 coaxial beams mixed with a dichroic cube

R G B

CHARACTERISTICS
Narrow bandwidth
Minimal level of blur
Can be placed close to a hologram
Smart control with intensity mixing

Trichroic Prism
Dichroic Filters
(Mar 2012)
HoLoFoS V.3

MIXING PROFILE
3 coaxial beams mixed with 2 dichroic combiners

CHARACTERISTICS
Narrow bandwidth
Minimal level of blur
Can be placed close to a hologram
Smart control with intensity mixing

Dichroic Filters
The ‘Chios Epitaph’
an Optically Cloned Artifact
True-colour display holograms with full parallax are the most accurate method of capturing and reproducing parts of the world around us. Add animation and they should be world-beating. And display holograms are a great medium for artists.
But...

Color Holographics

“Display holograms don’t sell on their own merits, however good the quality. If a 100% suitable reason or application is found you can then sell a lot more than one.”  Mike Medora, Founder & Chief Holographer

Geola

“We would never have survived if we only printed holograms.”  
Stas Zacharavas

Holographics North

“Maximum employment was 5 full-time plus 3 part-time in 1989 to 1993. We now employ 1 full-time (me) plus 1 part-time.”  John Perry

Bordeaux Holographie

“My activity for display holography does not work on a commercial base, but on pleasure of scientific work and artwork.”  Yves Gentet
A Holistic Approach to (Display) Holography
Optically Cloned Artifacts

Hyper-Documentation™
of cultural heritage artworks

Institute of Electronic Structure & Laser
Foundation for Research & Technology - Hellas

leading center worldwide for research and development of
innovative laser and optical technologies for the diagnostics
and conservation of works of arts and antiquities
The ‘MobArtLab’
a Mobile Art Laboratory

Proposal for funding under
PHOTONICS CLUSTER (EU)
MORPHOLOGICAL PROFILING

OptoClone® of ‘Masks on Red’
June 2012

Step 0 Holographic Recording

OptoClone® of Minoan Goddesses
June 2012
SPECTRAL IMAGING
(IRIS-ii)

Step 1
Multi-Spectral Imaging
(IR-VIS-UV)

FORTH
Foundation for Research & Technology - Hellas
Step 2
Laser-Induced Breakdown Spectral Analysis
STRUCTURAL DIAGNOSTICS (DHSPI-ii)

Step 3
Digital Speckle Interferometric Structural Diagnosis

Saint Sebastian, (attr. to Rafaelo)
Step 1
Spectral Imaging

Step 4
Laser Cleaning
Laser Restoration

‘The AXA Reinhardt Project’
Guggenheim / MOMA
‘Live’ UV/IR laser cleaning at the Acropolis Museum
Epilogue
Evzonas (1912)

OptoClone® of ‘Evzonas 1912’
Sep2012
• War Museum of Thessaloniki (7-30 Sep 2012)