IESL FORTH
Institute of Electronic Structure and Laser

SERVICES & PRODUCTS in
•DIAGNOSTICS
•ANALYSIS and
•LASER CLEANING

DHSPI diagnosis for artwork applications

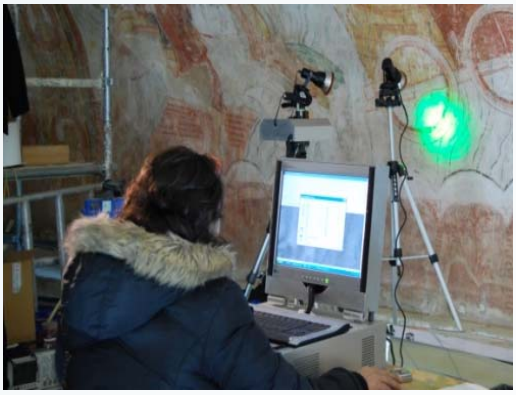
The holographic speckle interferometry technique permits through real-time surface illumination the non-contact detection of invisible micro-deformations. The method registers deformations by whole-field differential displacement of surface field. Surface deformations are resolved in steps of 10.4 microns and the deformation value is measured by multiples of half wavelength. DHSPI-I & DHSPI-II are custom-made systems for sensitive interferometric imaging to capture alterations of surface topography. Hidden defects are revealed by inhomogeneous intensity distribution witnessing the deformation fields. Can be used on various artworks from *panel paintings*, *canvas paintings, furniture, icons, to statues and wall paintings*. Additionally can be used to monitor environmental change impact, transportation effects, restoration and interventive actions impact and originality verification on both movable/immovable artworks.

DHSPI systems features:

- Portable system with Tripod mountable head
  a) Head, b) control unit, c) peripherals
- Easy interconnecting automated system
- Dedicated, user friendly software
- Parameters adjustment via software
- Recording of environmental RH / T and surface temperature changes on the samples
- Real-time acquisition
- Post-processing analysis
- Multi-methodology custom developed procedures
- Non-destructive, non-contact technique
- No sample preparation and No sample removal
- Independent of surface texture, size, complexity

DHSPI applications:

- Detection of defects in real-time
- On-field application
- Structural documentation
- Transportation impact assessment
- Preventive Deterioration control
- Originality verification
- Interventions and environmnetal effects monitoring



DHSPI systems are portable laser-interferometry instruments that allow real time full-field acquisition of structural condition on-site. It is specially developed for universal use of application. Suitable to operate indoor and outdoor (museum, conservation lab, on-site).

Selected publications: 1. E. Bernikola, et al, Applied Physics A **95**, pp. 387-399 (2009) - 2. V. Tornari et al., Sensors 2008, 8, DOI 10.3390/sensors
3. V. Tornari, *Analytical Bioanalytical Chemistry*; **387,** 761-80 (2007) – 4. V. Tornari, *chapter 5*, Ed. R. G. W. Brown, E. R. Pike.Taylor and Francis, NY2006

DHSPI applications in Cultural Heritage

SELECTED EXAMPLES

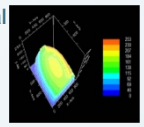
Artworks Structural Analysis

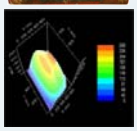
DHSPI stands for Digital Holographic Speckle Pattern Interferometry, an hybrid geometry to provide high resolution defect detection with digital capturing ease. It detects in micrometer resolution all typical defects located either on the surface, subsurface or in the bulk. Cracks and detachments hidden to advanced imaging tools are traced. Data offers multi-tasking usage from conservation research to documentation while provides coded "signature" conducing to the verification of originality.

Icon 1 *Before travel*

Icon 2 *After travel*

original





fraud

Risk-Priority Map

Defect topography map and risk priority map are direct qualitative and quantitative results from non contact surface examination. The structural condition and monitoring to carry out necessary remedial interventions are performed remotely. DHSPI visualises the defect micro-structure in 2D, 3D deterioration map. The defected areas are located, sized and calculated for deformation to be marked with a pseudo-color related to the severity of defect and the risk of permanent damage in μm/sq unit.

Risk topography in painting

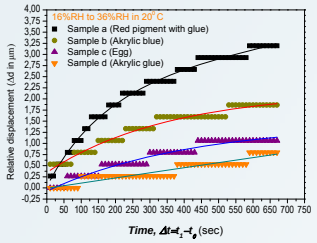
In situ applications

Decorative artifacts, furniture, frescoes and wall paintings in historical buildings and monuments deteriorate constantly in interaction with the environment. DHSPI suits to on-field measurement requirements and can operate in moderate harsh conditions.

Environmental monitoring

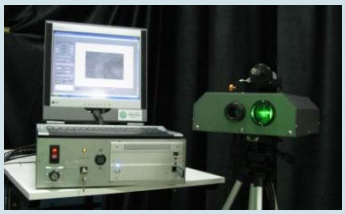
Direct monitoring of materials, interior/exterior surfaces, in respond to natural climate conditions can be performed.

Lab Simulation of indoor RH/T change vs material first reactions



DHSPI – I

DHSPI-I is a compact transportable system with dedicated user-friendly software and built-in processor, display and controls for visualisation of structural discontinuities. It provides in real time qualitative insight of structural condition including post-processing tools for enhanced quantitative structural diagnosis.



Technical data

- **Laser power:** 250mW
- **Coherence length:** >30m
- **CCD resolution:** 1.4MP
- **Pixel size**: 6.45 μm
- **Spatial resolution:** 89 lines/mm:@standard FOV
- **Displacement resolution**: 266nm
- **Sensor lens:** C-Mount type
- **Typical FOV:** ≥30 cm, lens depended
- **Beam Divergence:** >40cm@1m (Gaussian Profile)
- **Dimensions (LXWXH)**
  Control Unit: 42X26X13cm , *Head*: 18X16X8 cm (without lens),
- **Peripherals**
  Tripods, IR Excitation sources
- **Weight**: ≈35Kg

DHSPI – II

DHSPI-II is a compact fully-portable system with dedicated user-friendly software and built-in processor, display and controls for real time qualitative and post-processed quantitative structural diagnosis. DHSPI-II allows control (via cable) from a remote pc (eg laptop) which provides extra flexibility for in-situ measurements.

Technical data

- **Laser power:** 300mW
- **Coherence length:** >30m
- **CCD resolution:** 2MP
- **Pixel size:** 4.40 μm
- **Spatial resolution**: 114lines/mm
- **Displacement resolution**: 266nm
- **Sensor lens:** C-Mount type exchangeable
- **Typical FOV:** ≥30 cm, lens depended
- **Beam Divergence:** >40cm@1m (Gaussian Profile)
- **Dimensions (LXWXH)**
  Control Unit: 42X26X13 cm. *Head*: 18X16X8 cm
- **Peripherals**
  Tripods, IR Excitation sources, PC
- **Weight**: ≈20 Kg

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