

**REFLECTANCE  
TRANSFORMATION IMAGING**

CHELSEA GRAHAM

YALE DIGITAL COLLECTIONS CENTER

# CHELSEA GRAHAM

DIGITAL IMAGING SPECIALIST

YALE DIGITAL COLLECTIONS CENTER

DIGITAL IMAGING LAB

## Background:

**Archaeology BA, MA**

**Natural history museum collections & archives based work**

**Digital archaeology and 3D digitization as a Master's focus**

## Areas of Interest:

**Applications of digitization for museum collections management, conservation, research and dissemination**

**3D models as integrated data platforms**

# YALE DIGITAL COLLECTIONS CENTER (YDC2)

<b>CREATE</b>	<b>MANAGE</b>	<b>USE</b>
<p>The Imaging Lab is a shared digital and scientific imaging facility on West Campus (formerly known as Digital Core) to extend capacity in digital photography and introduce innovative methods of scientific imaging of collections for the museums, computing and the arts, and IPCH.</p>	<p>The Content Platform makes digital content available online and provides a managed environment for storing, retrieving, preserving and sharing digital media and data.</p>	<p>Research Support activities include the development of tools and methods for exploring and using digital cultural heritage in new and innovative ways</p>

<http://ydc2.yale.edu/>

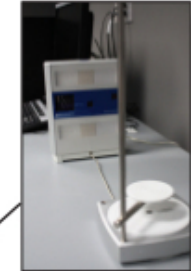
### Studio 1 Infinity Wall

The infinity wall, provides a background incorporating curved surfaces to create a back drop for a photographic image that has no perceptible beginning or end.



### Studio 2 Catwalk and Easel

The catwalk allows photographers to shoot objects from above. The easel was designed by Yale photographers and custom-built to accommodate a wide range of sizes up to 19' and up to 300lbs (135kg).



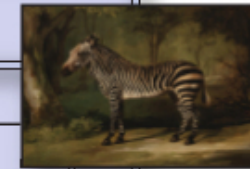
### Project Room 5 3D/Scientific Imaging

Both the NextEngine 2020i and the ShapeGrabber PRM330 are devices that are capable of generating three-dimensional (3D) digital scans as their output and rendering of precise numerical representations of the surface topography of objects.



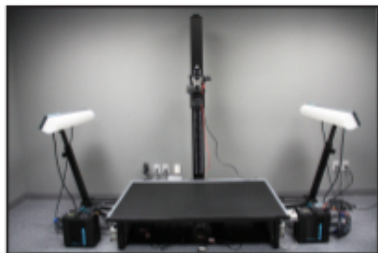
### Project Room 4 Large Object Color Proofing

Specialized viewing lights have been installed throughout the Imaging Lab to ensure consistent and correct color when assessing original artwork and material against its digital image.



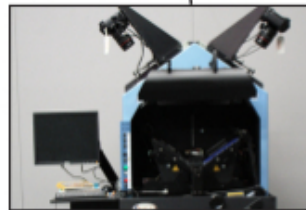
### Project Room 2 2D Photography

High quality, colorimetrically accurate images.



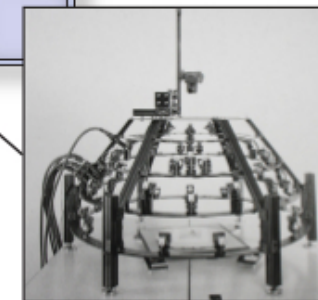
### Project Room 3 Camera and Vacuum Copy Stand

The copy-stand system consists of Broncolor strobe lights, the Hasselblad H4D-200MS camera, the Tarsia Technical Industries frame and column with a vacuum platform to gently flatten curled works.



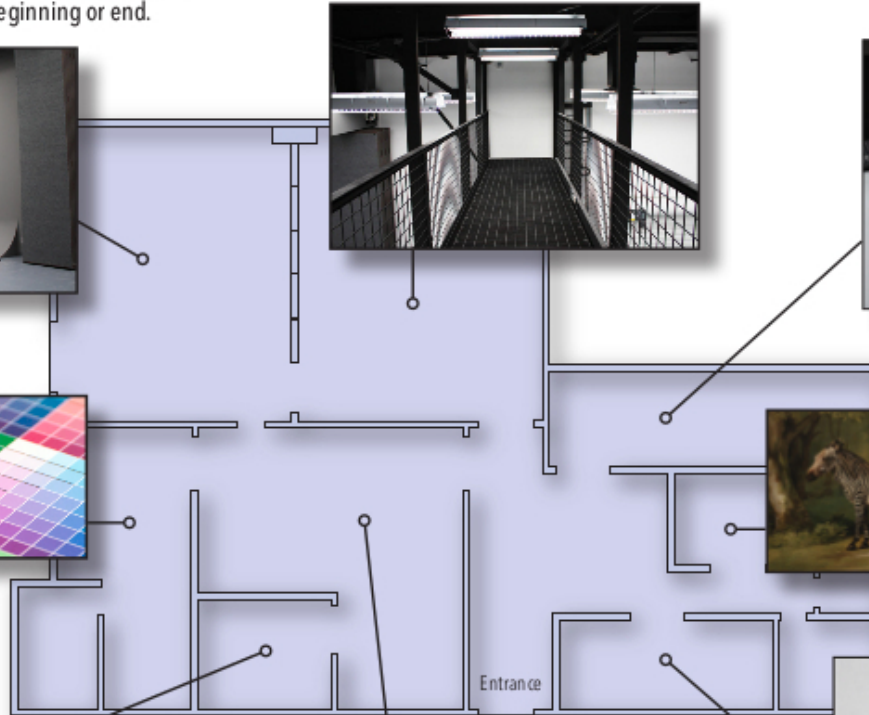
### Studio 3 Robotic Page Scanners

The APT BookScan 2400RA robotic book scanners developed by Kirtas Technologies are used to digitize books, ledgers, and other bound documents.



### Project Room 1 RTI/Scientific Imaging

Reflectance Transformation Imaging (RTI) is a computational photographic method that captures a subject's surface shape and color and enables the interactive re-lighting of the subject from any direction.



# YDC2 DIGITAL IMAGING LAB

**YDC<sub>2</sub>**  
Yale Digital Collections Center

Search YDC2  GO

PRINCIPLES | **IMAGING LAB** | CONTENT PLATFORM | RESEARCH SUPPORT | NEWS & PUBLICATIONS | ABOUT | FORMERLY ODAI

**The Digital Ecosystem**

- Arts Area
- Audio/Video
- Collaboration
- Community
- Conservation
- Content
- Content Management
- Cultural Heritage
- Data Curation
- Data Mining
- Datasets
- Digital Asset Management
- Digital Assets
- Digital Ecosystem
- Digital Humanities
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- Metadata
- Museums



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## YDC2 at West Campus Imaging Lab

[Conservation](#) [Collaboration](#) [Cultural Heritage](#) [Digitization](#) [Content Management](#) [Images](#)

Yale University is expanding access to its vast collections through digital technologies. As part of the effort to bring Yale's cultural heritage and natural science collections online, the University is developing the YDC2 Imaging Lab; a state-of-the-art shared digital and scientific imaging laboratory to extend capacity in digital photography and introduce innovative scientific imaging methods. In addition to the creation of a shared state-of-the-art facility, the YDC2 Imaging Lab is designed to bring together researchers, educators, curators, archivists and digital professionals to strengthen Yale's ability to process and understand its renowned collections and make them available worldwide.

<http://ydc2.yale.edu/imaging-lab/ydc2-west-campus-imaging-lab>

# WHAT IS REFLECTANCE TRANSFORMATION IMAGING?

Reflectance Transformation Imaging (RTI)...

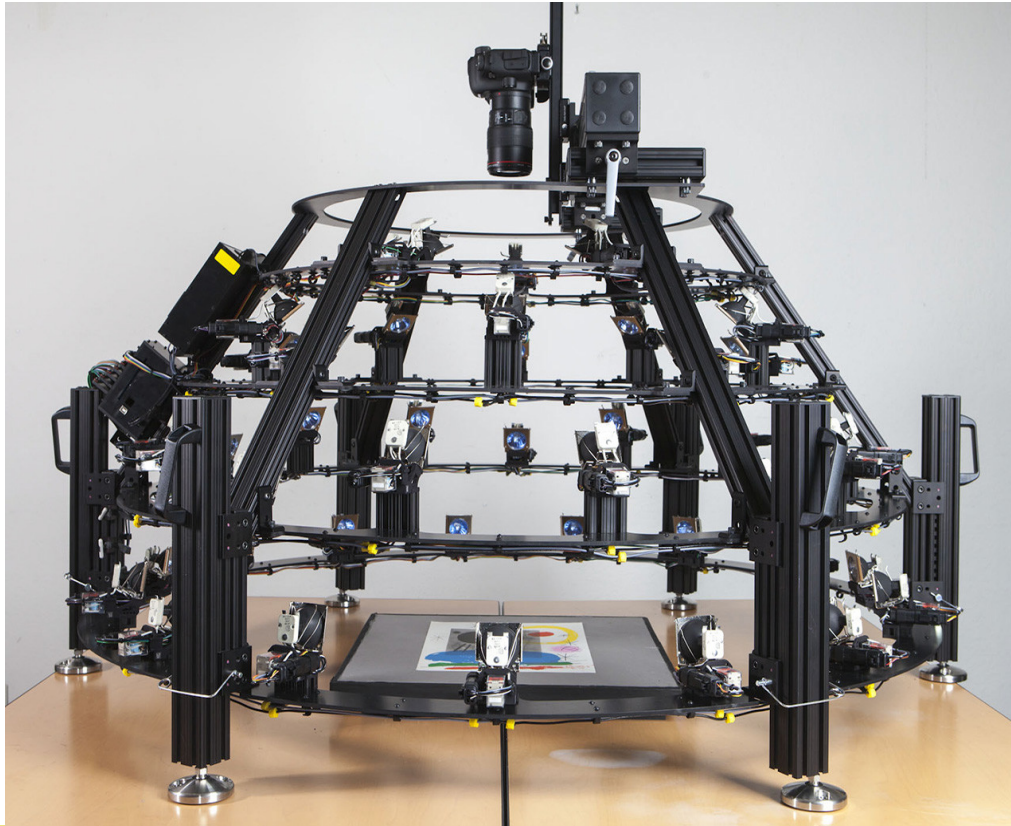
is a digital imaging method that captures how the surface of an object interacts with light

yields visualizations that allow users to interactively manipulate the direction of virtual light sources

has the ability to extend research and conservation methods for natural history, cultural heritage and art objects



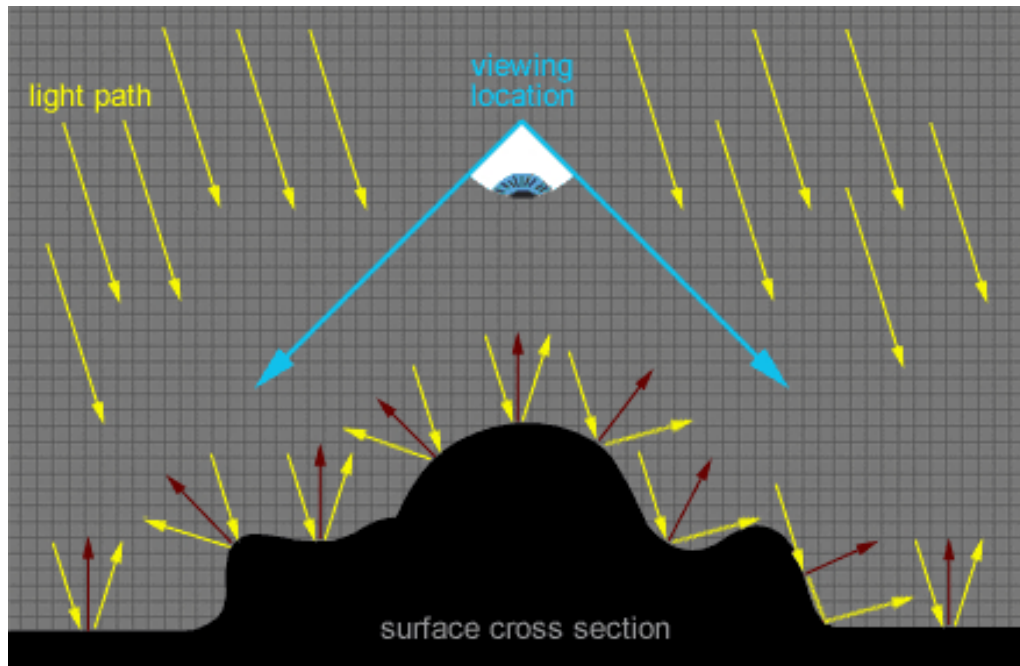
# HOW IS RTI ACQUIRED?



<http://culturalheritageimaging.org/>

# WHAT DOES RTI CAPTURE?

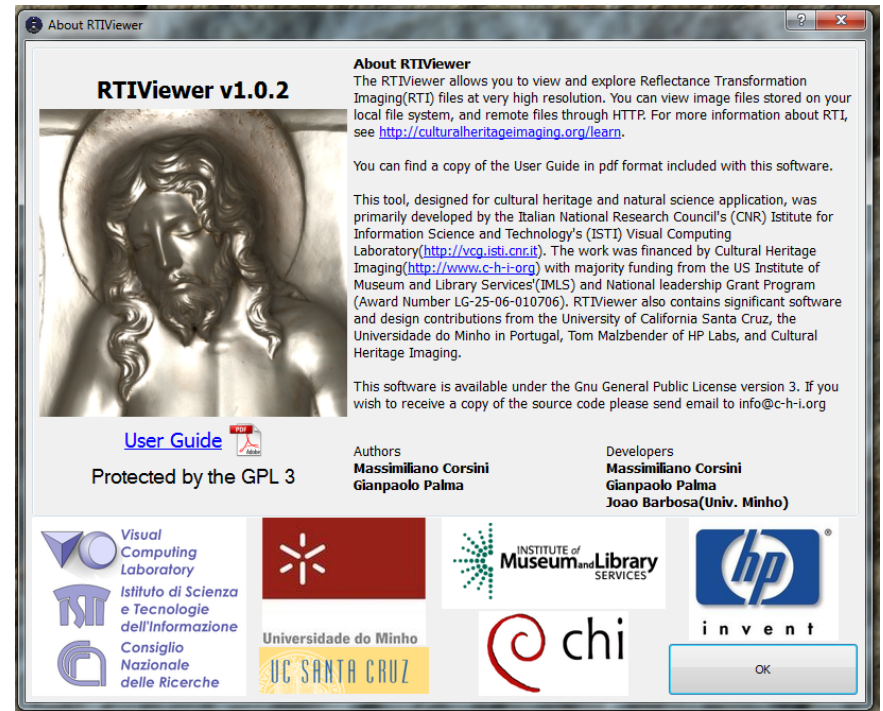
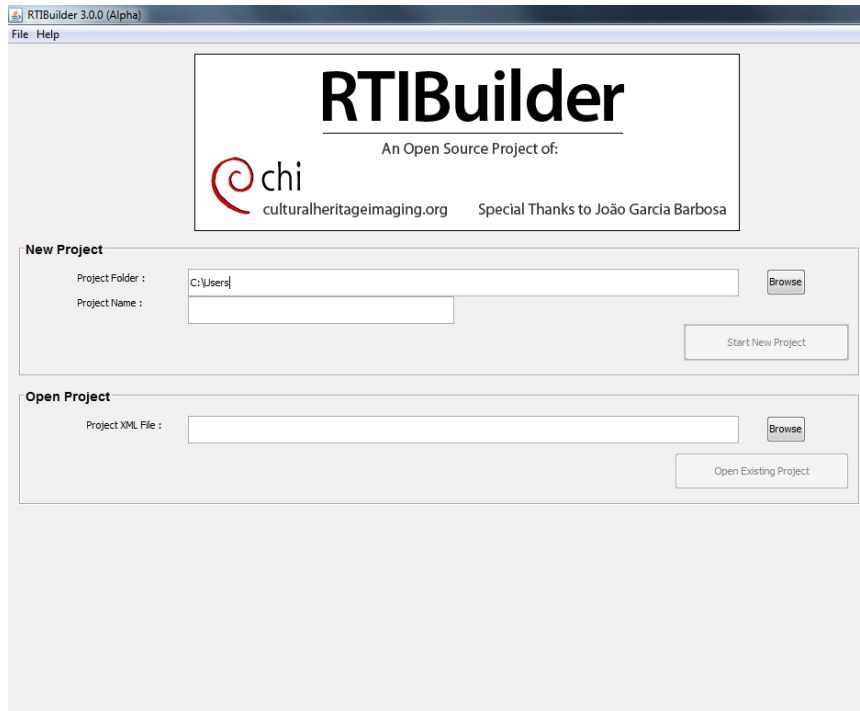
Reflectance values for each pixel in each image are recorded



<http://culturalheritageimaging.org/Technologies/RTI/>



# HOW IS RTI DATA POST PROCESSED?



[http://culturalheritageimaging.org/What\\_We\\_Offer/Downloads/Process/index.html](http://culturalheritageimaging.org/What_We_Offer/Downloads/Process/index.html)

# HOW IS RTI VISUALIZED?

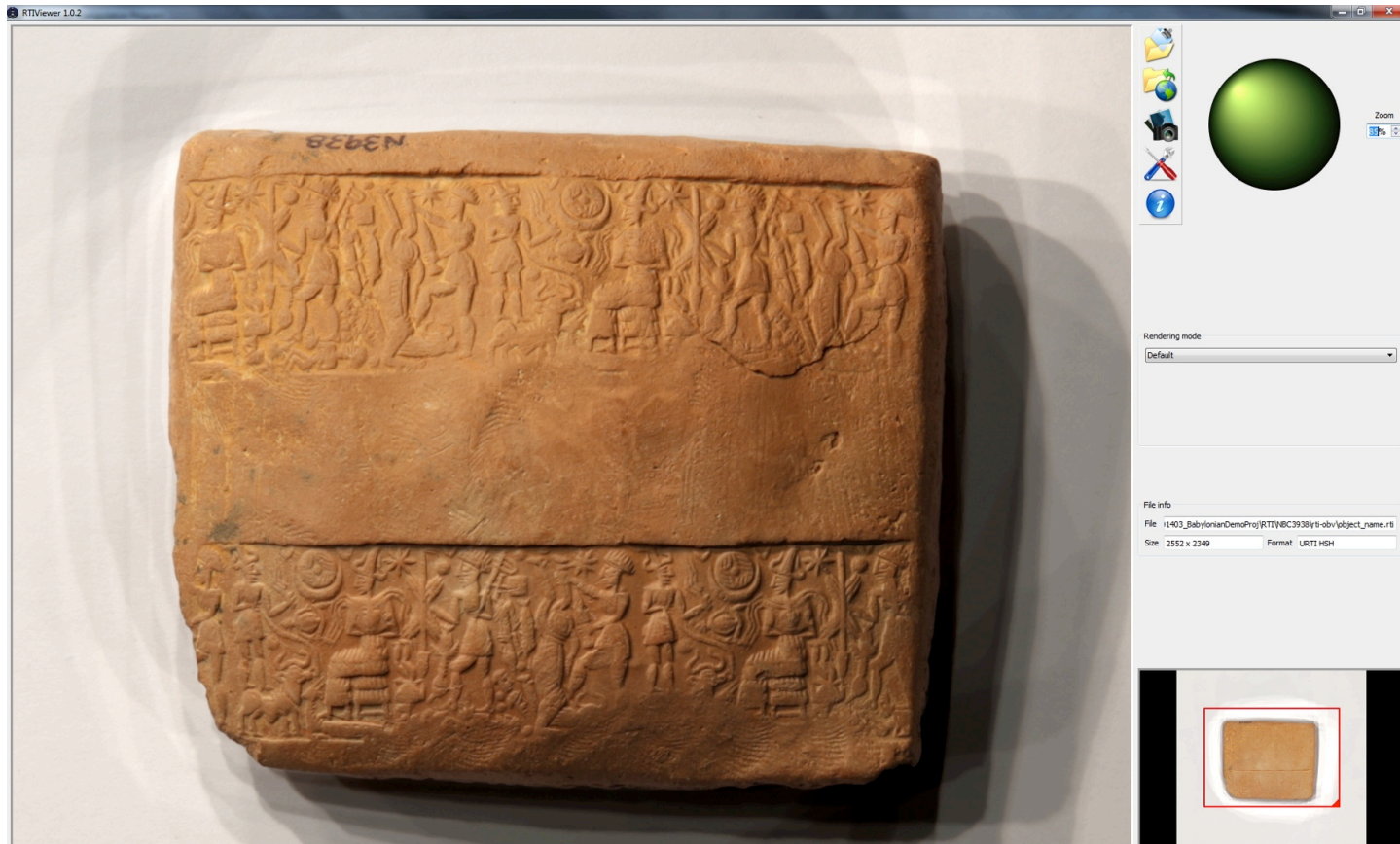


[http://culturalheritageimaging.org/What\\_We\\_Offer/Downloads/View/](http://culturalheritageimaging.org/What_We_Offer/Downloads/View/)

# HOW IS RTI VISUALIZED?



# HOW IS RTI VISUALIZED?



# HOW IS RTI VISUALIZED?



# RENDERING MODES: SPECULAR ENHANCEMENT

.rti



.ptm



# RENDERING MODES: NORMALS VISUALIZATION

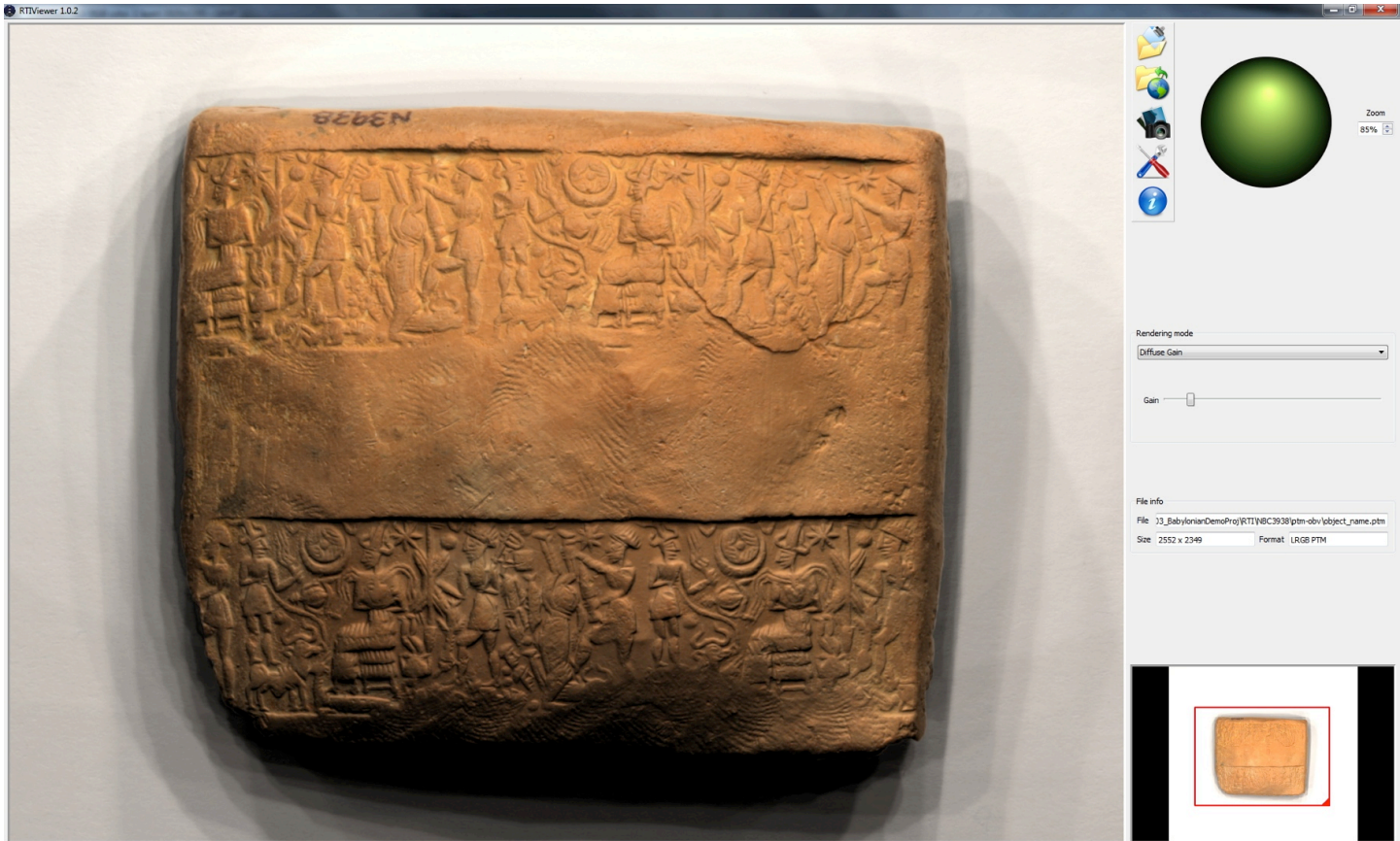
.rti



.ptm



# RENDERING MODES: DIFFUSE GAIN (.ptm)





# RENDERING MODES: UNSHARP MASKING (.ptm)

NORMAL UNSHARP  
MASKING



IMAGE UNSHARP  
MASKING



# RENDERING MODES: MULTILIGHT (.ptm)

STATIC MULTILIGHT



DYNAMIC MULTILIGHT



# HOW CAN RTI BE APPLIED?

Research and virtual inspection of morphological features:

- Natural History
  - ex. Paleontology: feather, wing and leaf venation, coils, scales, vertebrae, appendages, trace fossils...
- Cultural Heritage
  - ex. Archaeology: inscriptions, impressions, carvings...
- Art
  - Ex. Paintings: paint placement, artistic technique...

# HOW CAN RTI BE APPLIED?

## Conservation and conditions monitoring:

- A benchmark of the current state of an object
- Compare future conditions via deviation analysis
- Gain insight into small scale structures for conservation practices

## 3D extraction:

- Detailed information about surface normals can be used to create fine grained 3D information for surface geometry

# HOW CAN RTI BE DISSEMINATED?

Gianpaolo Palma

Visual Computing Laboratory - ISTI CNR

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## Web RTI Viewer

The WebRTIViewer is a HTML5-WebGL viewer for high resolution RTI images (PTM and HSH) and standard images (JPEG, PNG and TIF). The download link contains all the necessary tools to preprocess the image (the webGLRTIMaker tool - only Windows) and to view the image in the web browser (WebRTIViewer). All the information about the tools are contained in the readme file. The viewer has been used in the kiosk for the visualization and navigation of the coin collection of the Museum Palazzo Blu in Pisa ([Video](#))([Link](#)). ([Archeomatica news](#))

### Download

[Link](#) (code, binary and examples)

### Examples

- [Sarcophagus](#) (PTM, resolution 2930 x 2224 pixels)
- [Tomb](#) (PTM, resolution 3492 x 2280 pixels)
- [Coin](#) (HSH, resolution 3750 x 3750 pixels)
- [Space](#) (TIF image, resolution 10666 x 6000 pixels) Image courtesy of NASA/JPL

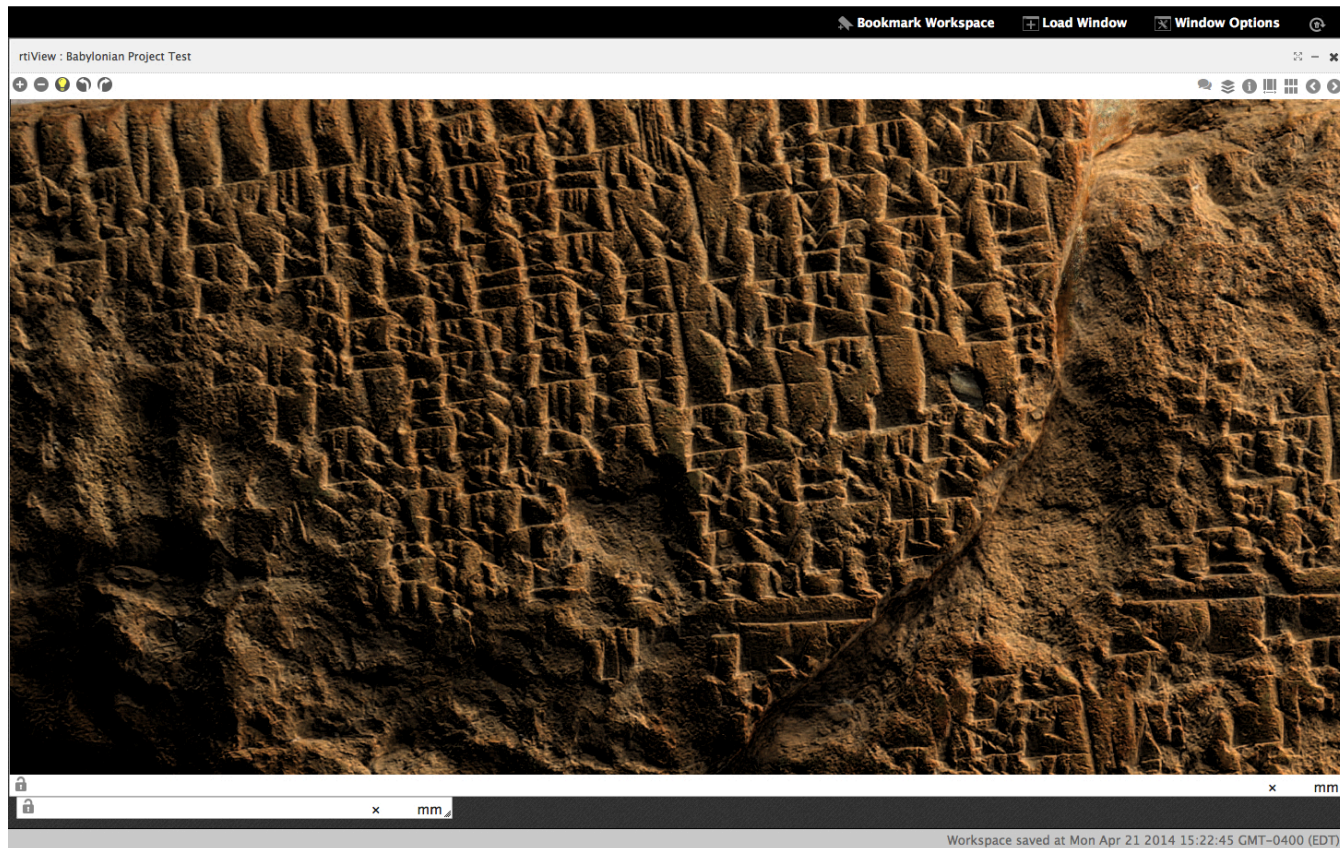
### The coin collection of Palazzo Blu

[Link](#)



<http://vcg.isti.cnr.it/~palma/dokuwiki/doku.php?id=research>

# HOW CAN RTI BE DISSEMINATED?



<http://iiif.io/mirador/>

# LINKS

YDC2:

<http://ydc2.yale.edu/>

<http://ydc2.yale.edu/imaging-lab/ydc2-west-campus-imaging-lab>

Cultural Heritage Imaging:

<http://culturalheritageimaging.org/>

[http://culturalheritageimaging.org/What We Offer/Downloads/Process/index.html](http://culturalheritageimaging.org/What_We_Offer/Downloads/Process/index.html)

[http://culturalheritageimaging.org/What We Offer/Downloads/View/](http://culturalheritageimaging.org/What_We_Offer/Downloads/View/)

HP:

<http://www.hpl.hp.com/research/ptm/downloads/download.html>

ISTI-CNR Visual Computing Lab:

<http://vcg.isti.cnr.it/~palma/dokuwiki/doku.php?id=research>

Mirador Viewer:

<http://iiif.io/mirador/>