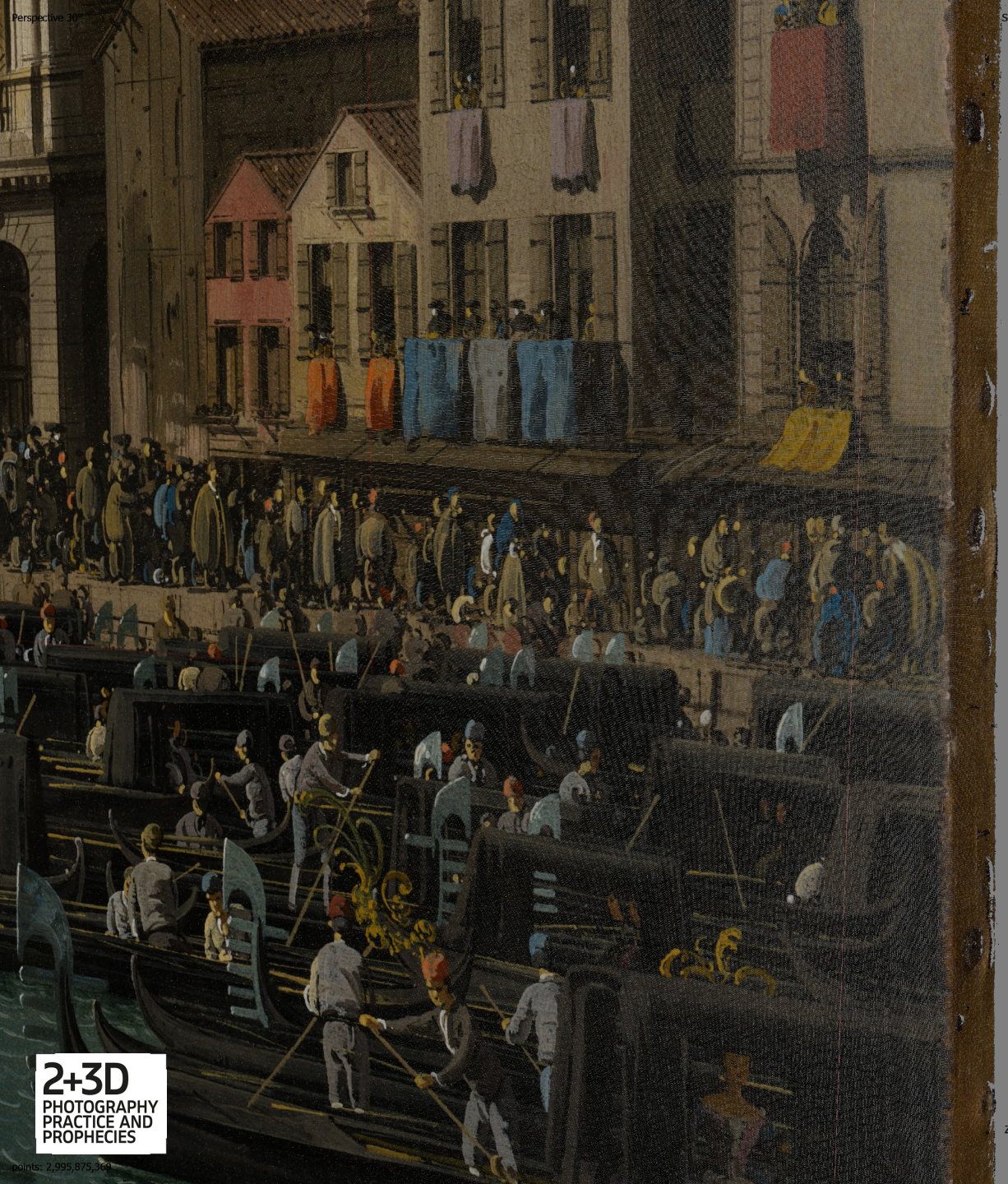

RTI-Photogrammetry Integration for Planar Surfaces Capture

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Chatrapati Akula
Nathan Churchill

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C F P R
Centre for Fine Print Research

UKRI Research England

Introduction

Scanner system overview

Software interface

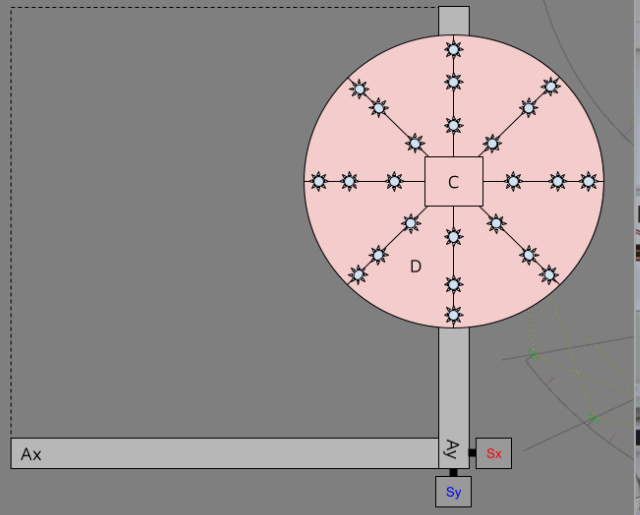
Capture set-up

Processing workflow

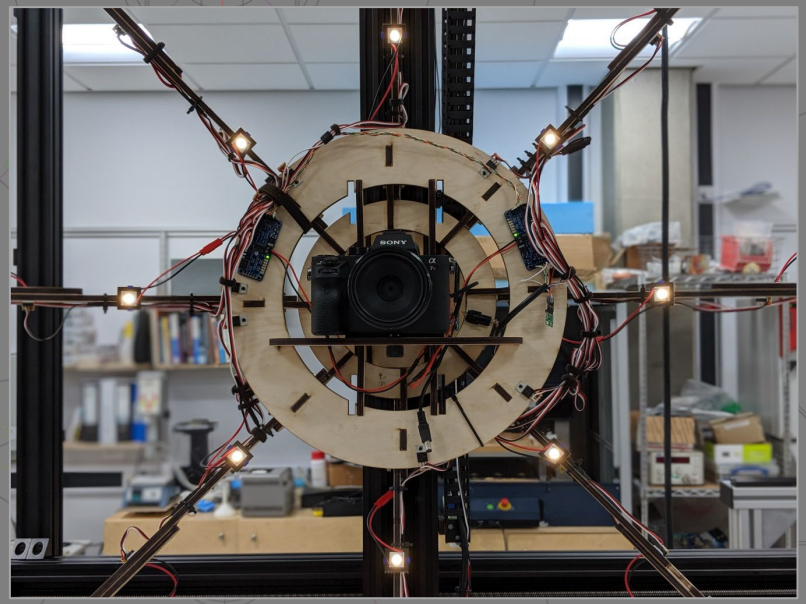
Case studies

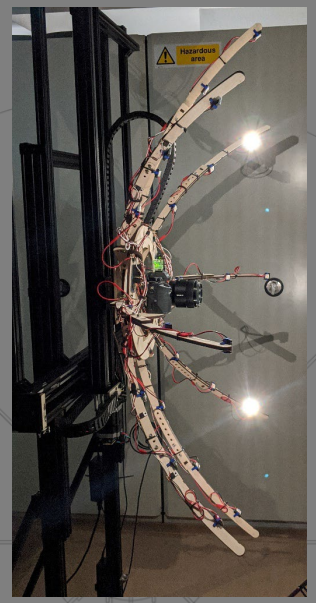
- The Grand Canal, Ascension Day
- The New Forest Embroidery
- The Revenge of Queen Tomyris over Cyrus
- Gilt leather panel

Scanner system overview

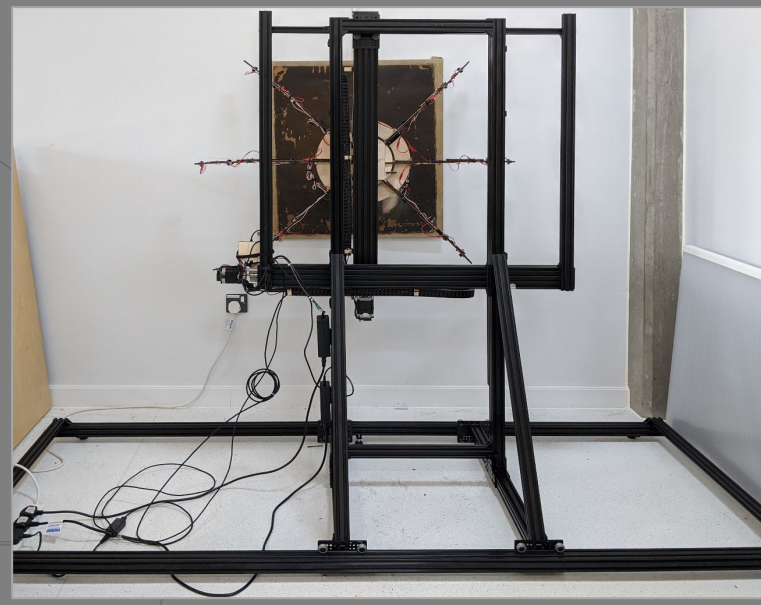


Schematics of scanner system





Front and side view with camera positioned in centre



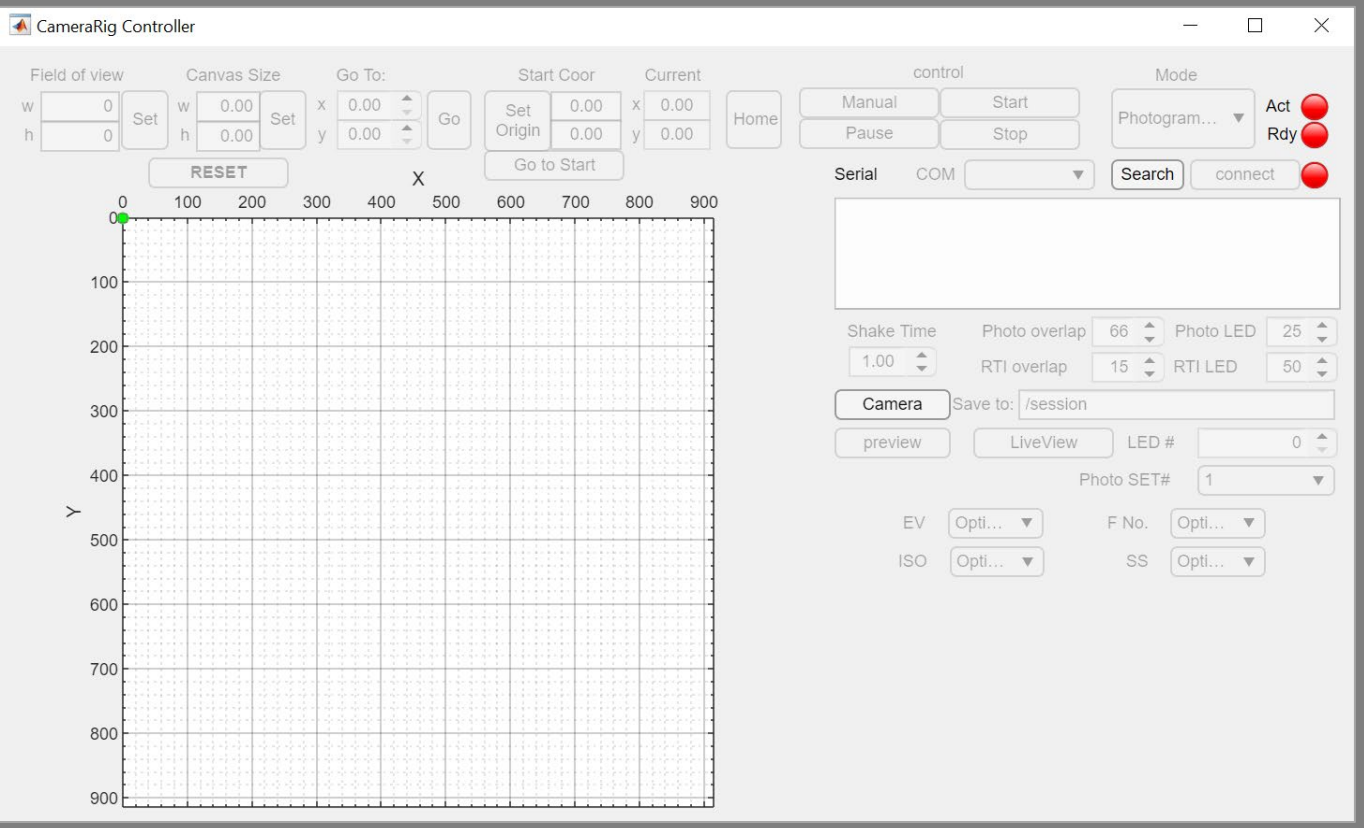
Scanner on rails for lateral movement

The scanner features a 1m x 1m frame, linear actuators, a dome with LEDs, and a Sony Alpha A7RII camera.

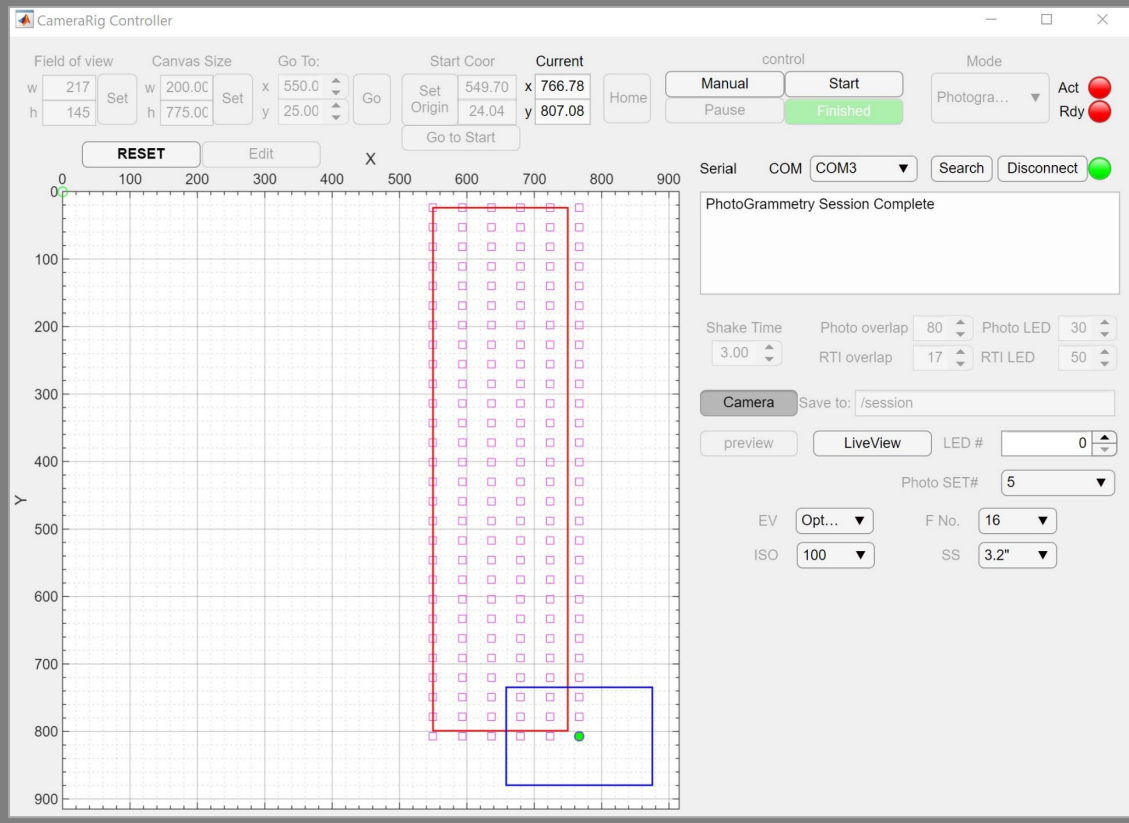
Adjustable spokes with 24 LEDs for varied illumination angles.

The system can be tilted to align with the artwork for optimal capture.

Software interface



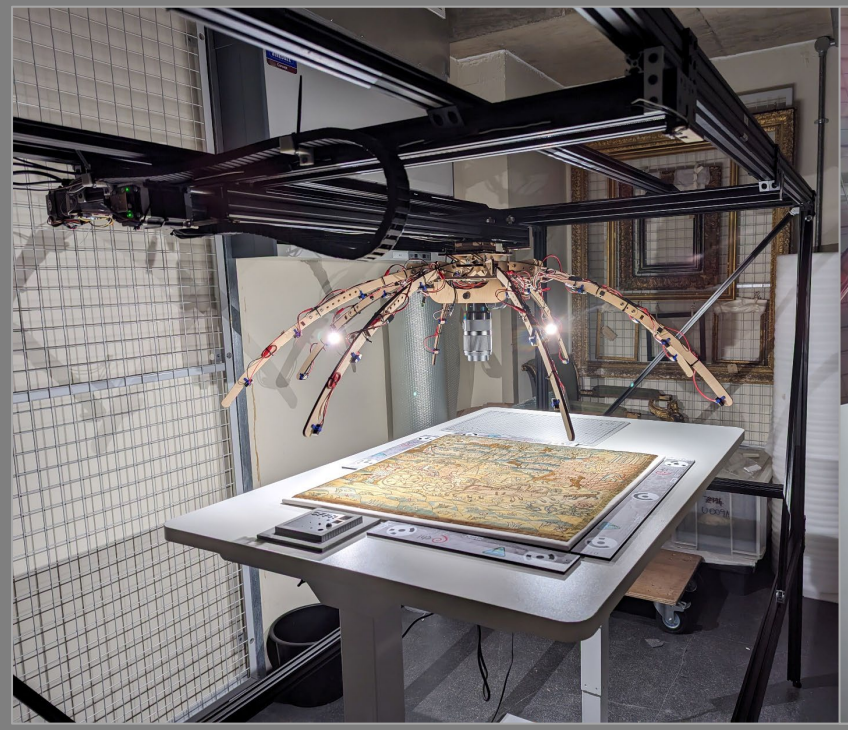
Software application to control the scanner

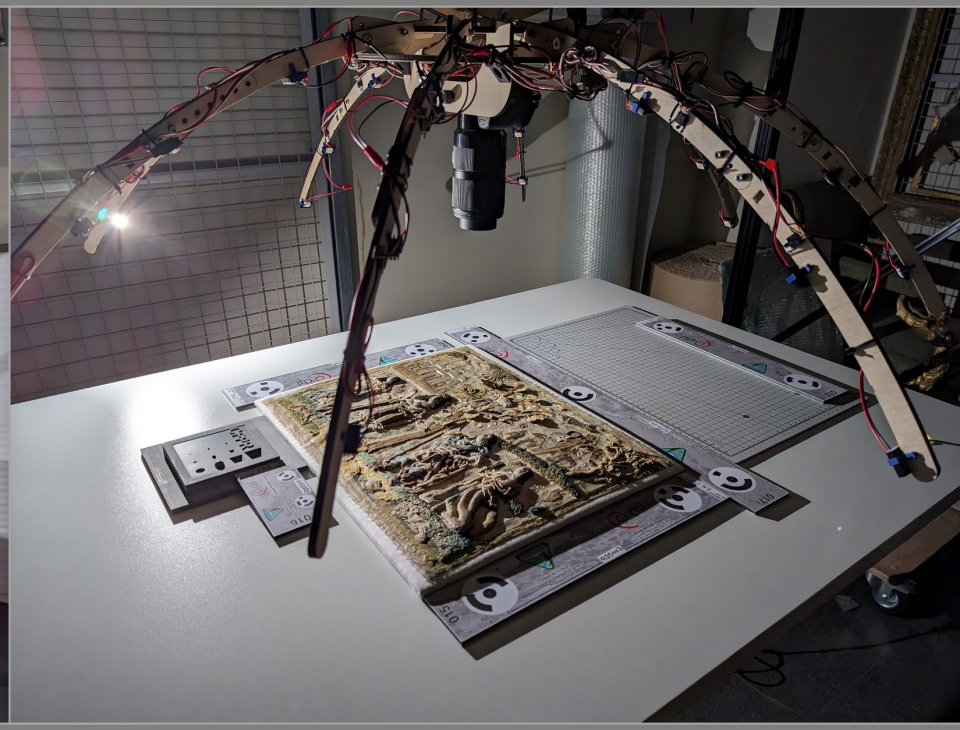


Camera positions calculated with specified overlap

Capture set-up

Vertical scanning





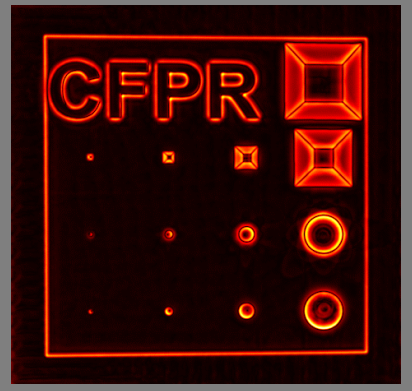
Horizontal scanning

Capture set-up

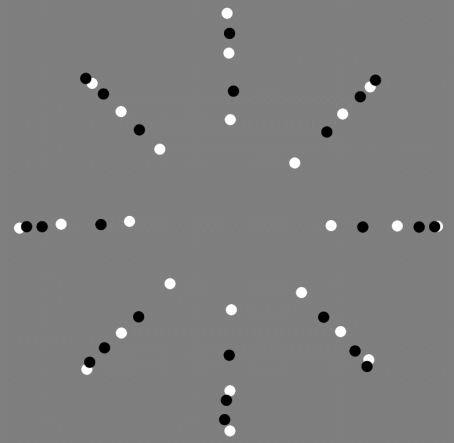
PG

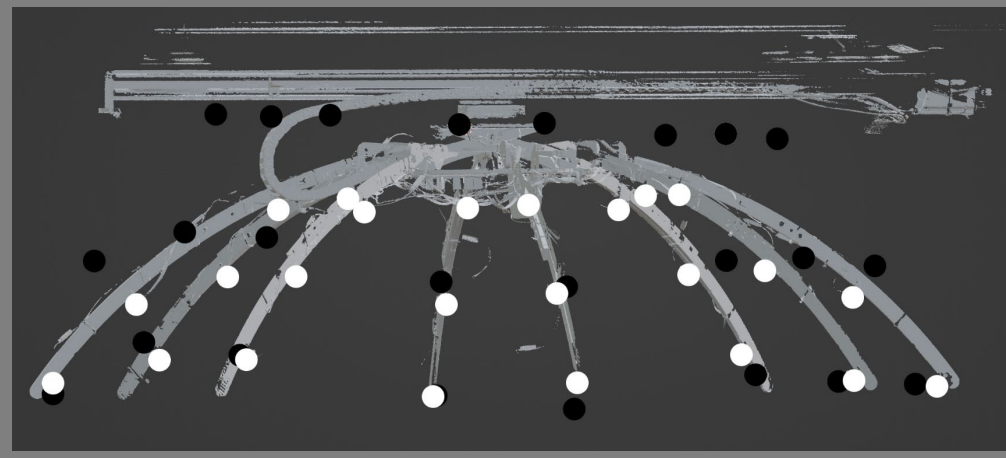
RTI

corrected



Angular differences

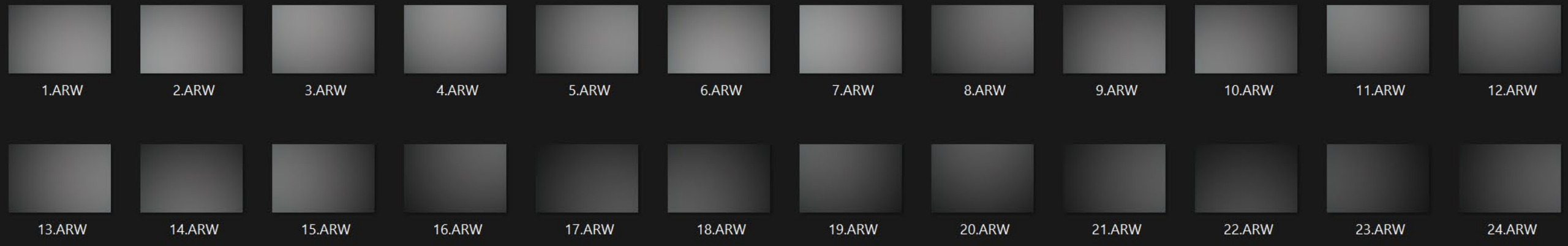




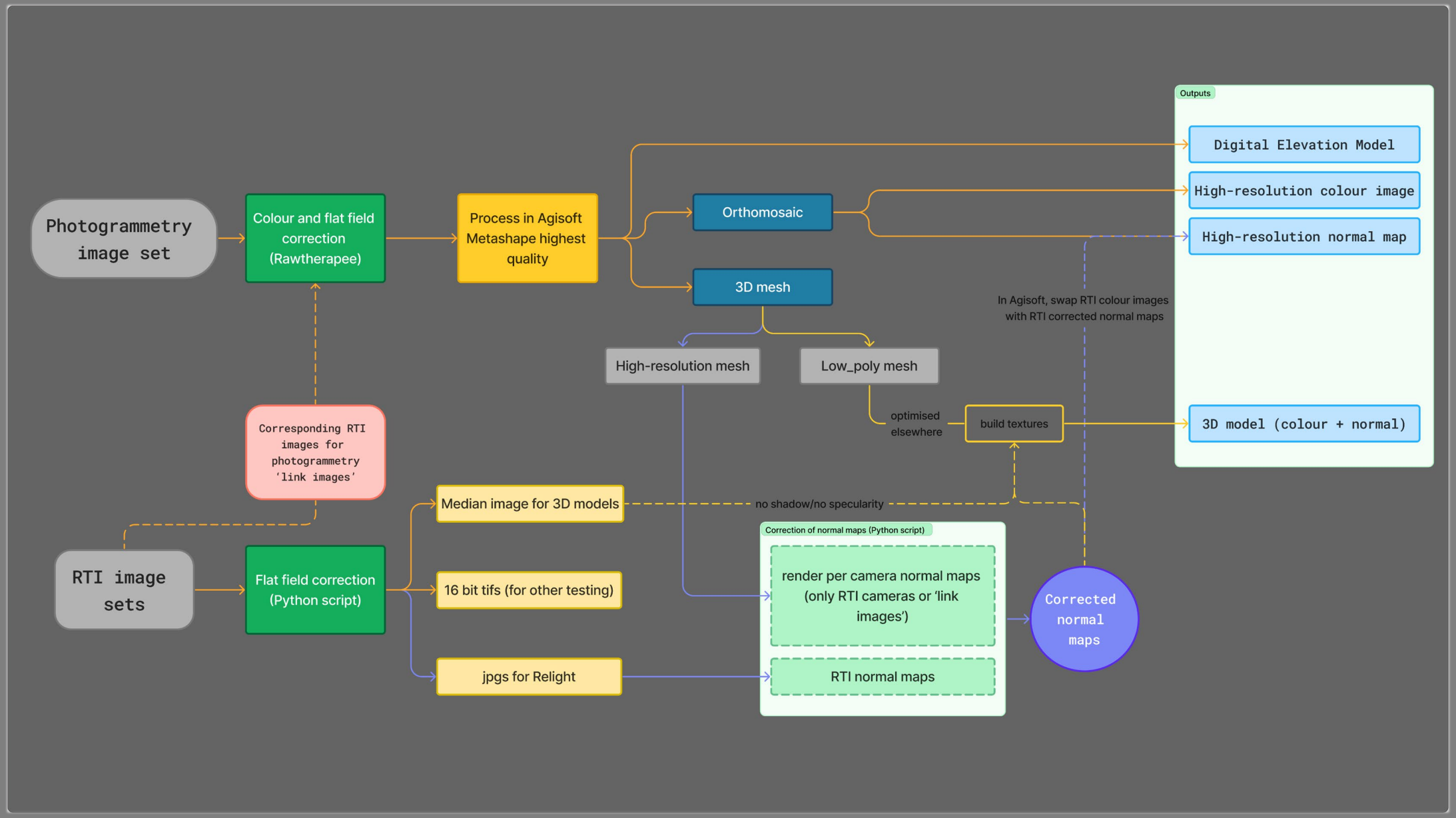
Light positions calculated from ball against scan/3D model positions, top and side view.
Black dots = ball method
White dots = scan/3D model

CHI scale bars

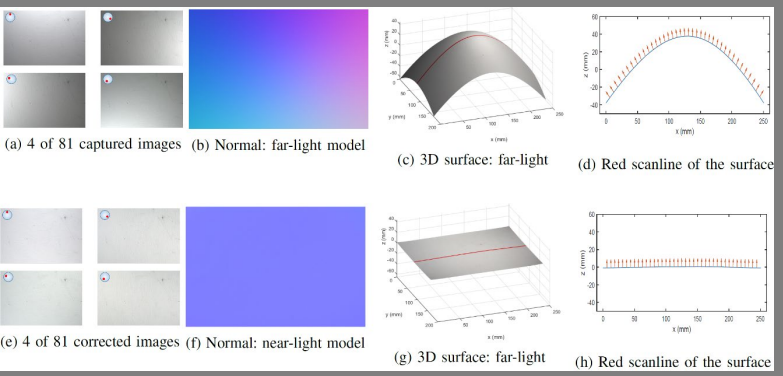
Flatfield images



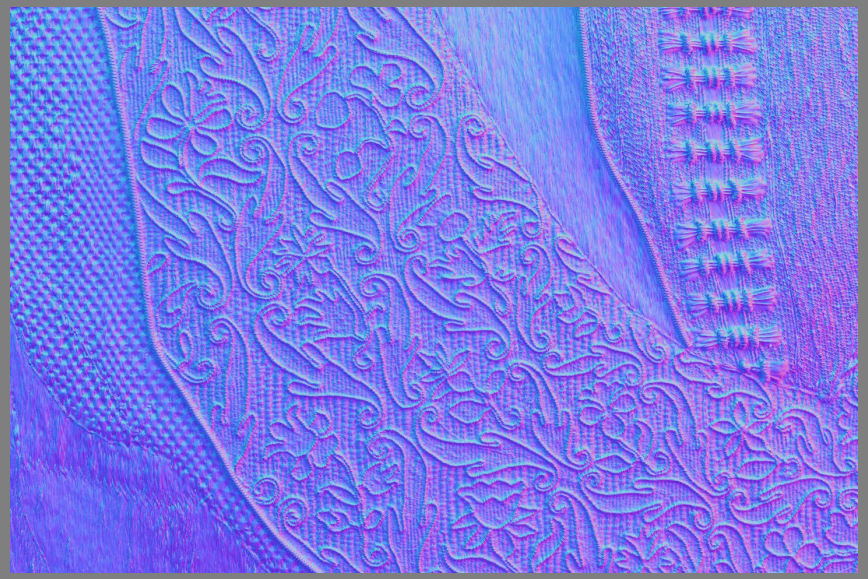
Processing workflow



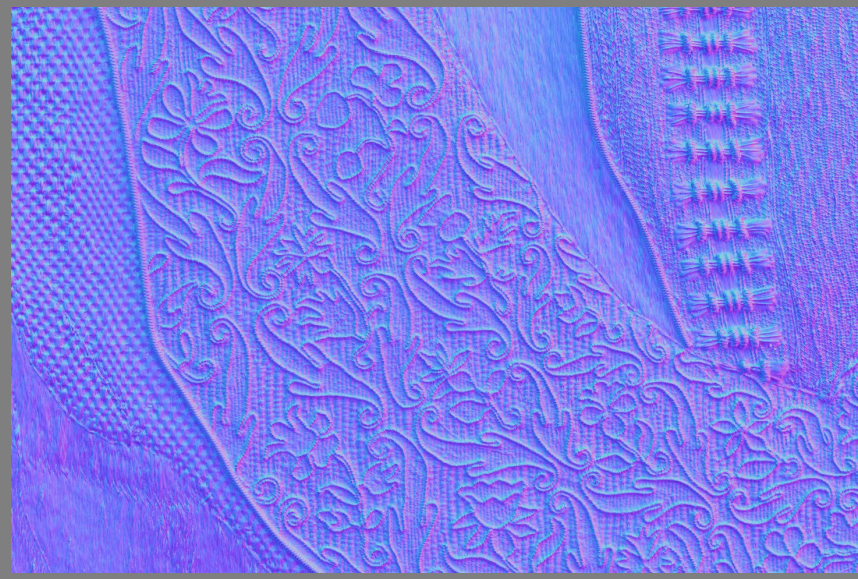
Processing workflow | Flatfield correction



Huang, X., Walton, M., Bearman, G. and Cossairt, O., 2015, September. Near light correction for image relighting and 3D shape recovery. In 2015 Digital Heritage (Vol. 1, pp. 215-222). IEEE.

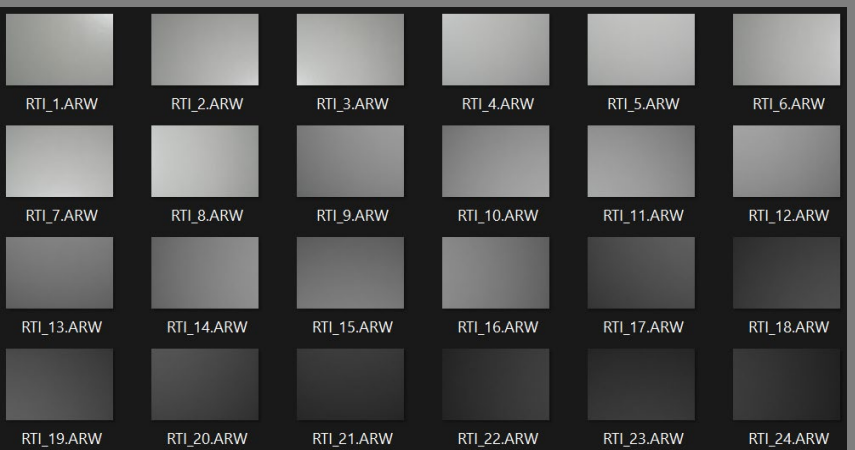


before



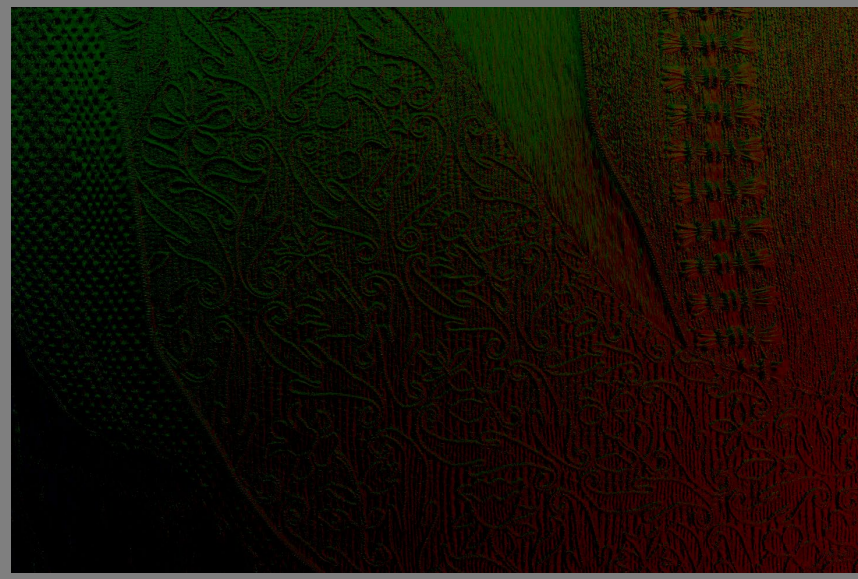
after

For PG images



We correct for shading effects by fitting and saving polynomial model coefficients for each flatfield image that can be used later to correct images capture with the same set-up.

For RTI images

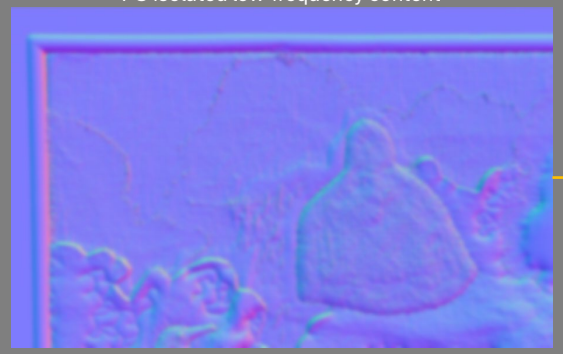


difference

Processing workflow | **Normal maps correction**

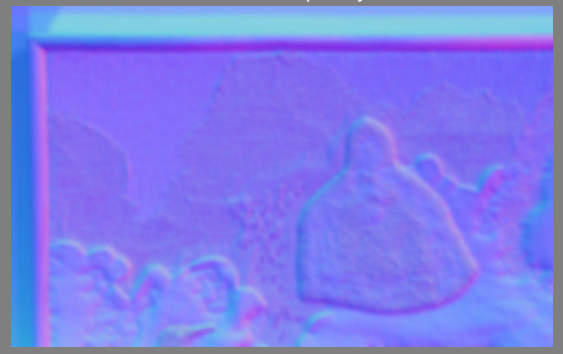
Photogrammetry normal map from hi-res mesh

PG isolated low-frequency content

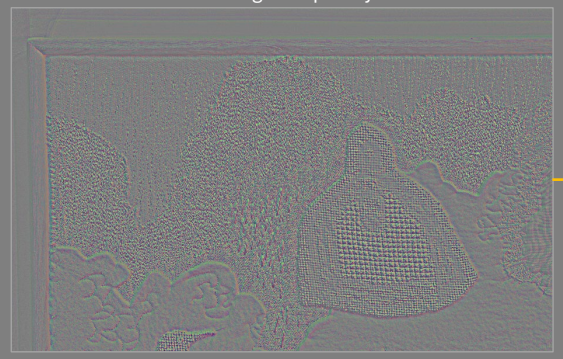


RTI normal map

RTI isolated low-frequency content



RTI isolated high-frequency content

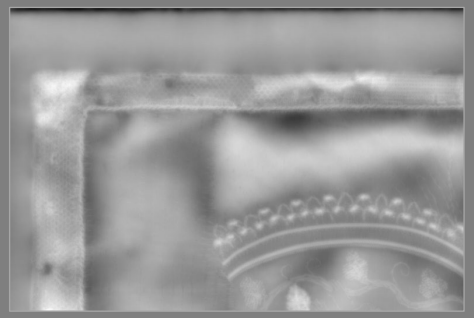


Corrected normal map

We correct the low-frequency distortions from the RTI normal maps using the corresponding photogrammetry normal maps. We use Gaussian blur to isolate the low-frequency content of both maps, these are blended to desired ratio, and used to replace the low-frequency content in the RTI normal map.

Processing workflow | **Depth maps correction**

Corrected RTI normal map

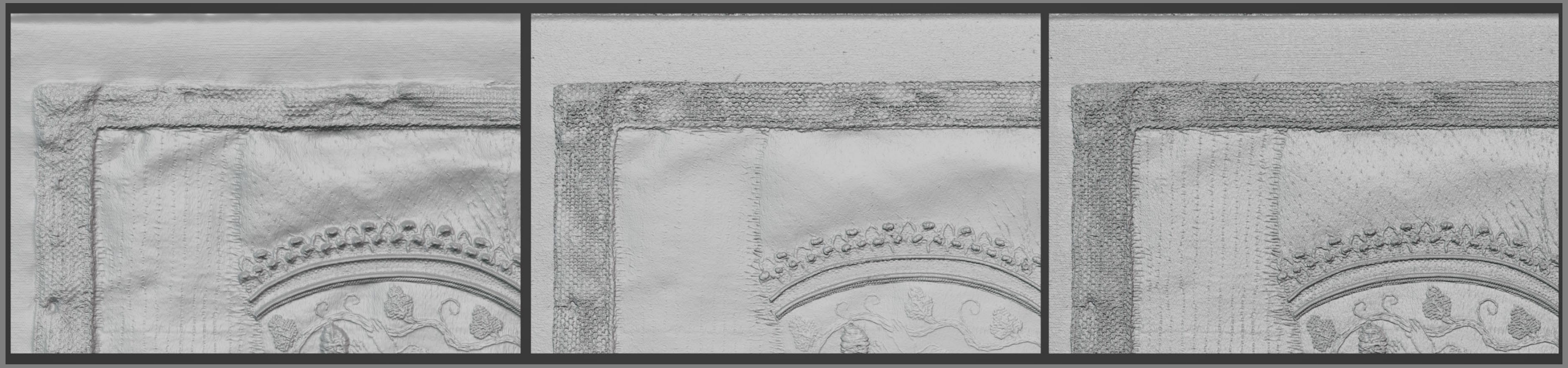


Integrated RTI depth map

Isolated high-frequency

High-freq added to PG depth map

Blending all depth maps in Agisoft



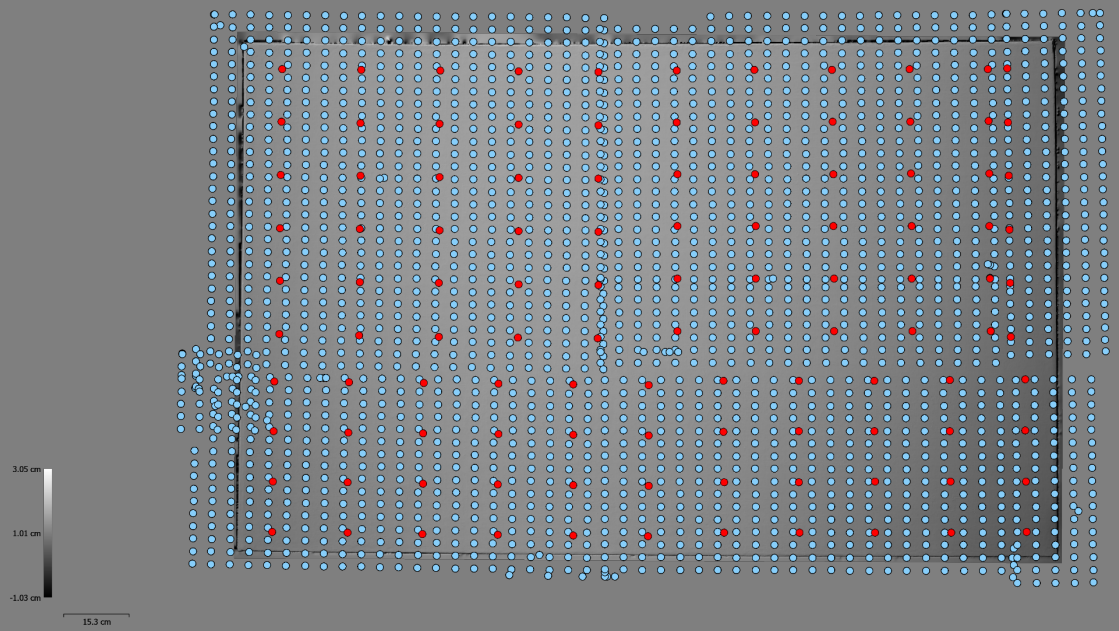
The depth map correction improves the photogrammetry depth maps by adding high-frequency details from integrated RTI normal maps while preserving the original low frequencies of the photogrammetry depth maps.

Blender visualisation of integrated RTI mesh, PG depth map mesh and corrected depth map mesh.

Case studies | The Grand Canal, Ascension Day

Canaletto, *The Grand Canal, Ascension Day* (1731–1740). 190cm x 120cm
The Woburn Abbey Collection, Milton Keynes, UK

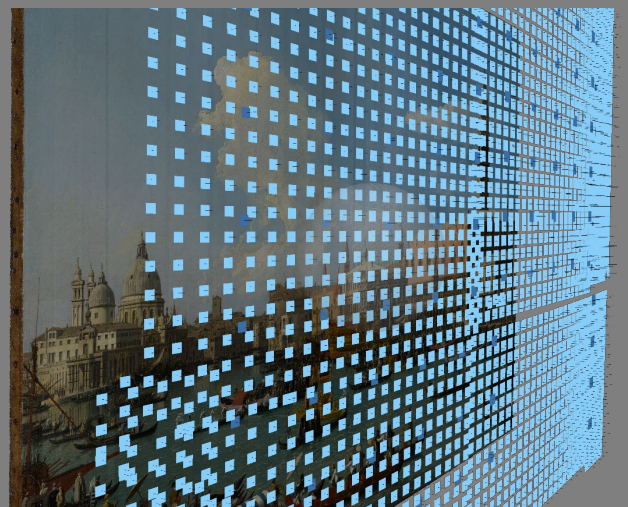
Case studies | The Grand Canal, Ascension Day

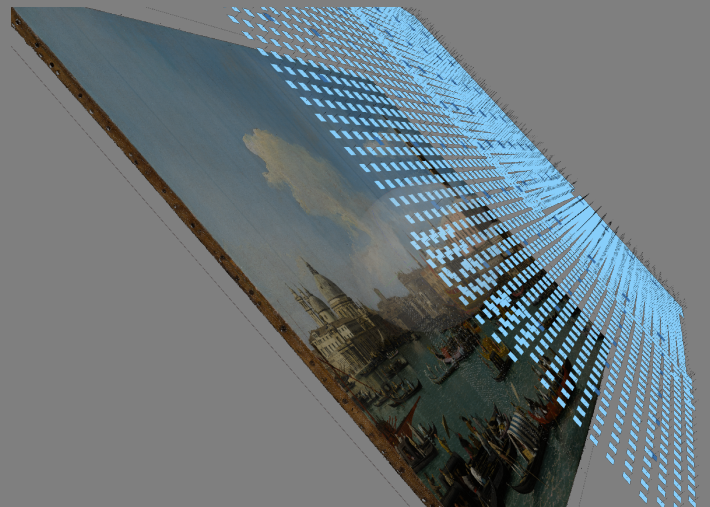


Lens: Sony FE 50mm f/2.8 Macro Lens Full Frame
Images: 2200 images (blue dots) + 110 RTI ‘link’ images (red dots).

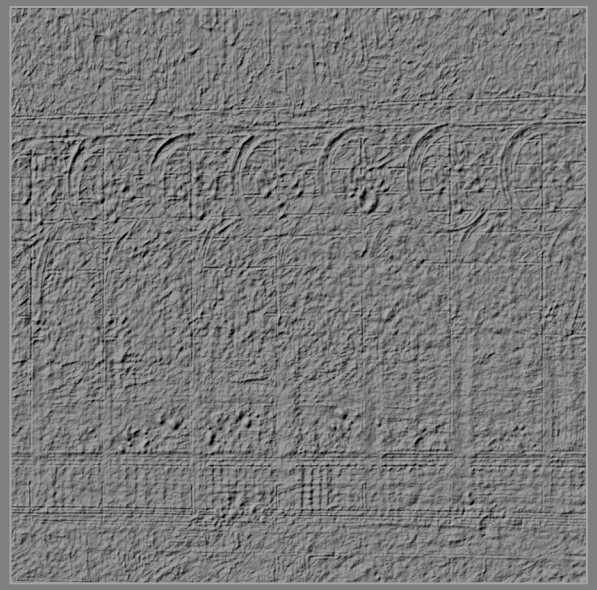
110 RTI image sets (2640 images)

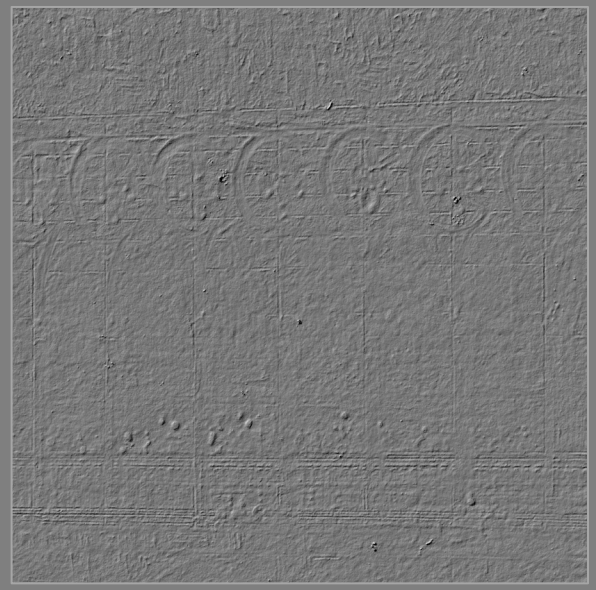
Ultra-high quality point cloud: 2,995,875,369 points
Orthomosaic: 68,533 x 43,098 pixels
Resolution: 0.0277 mm/pixel
36 pixels/mm
917 DPI

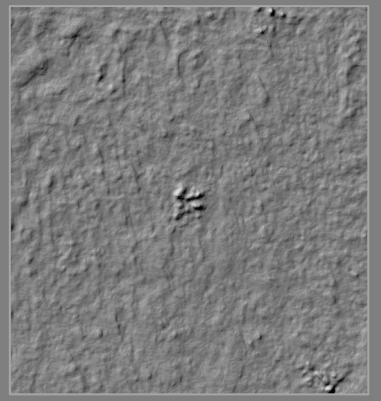




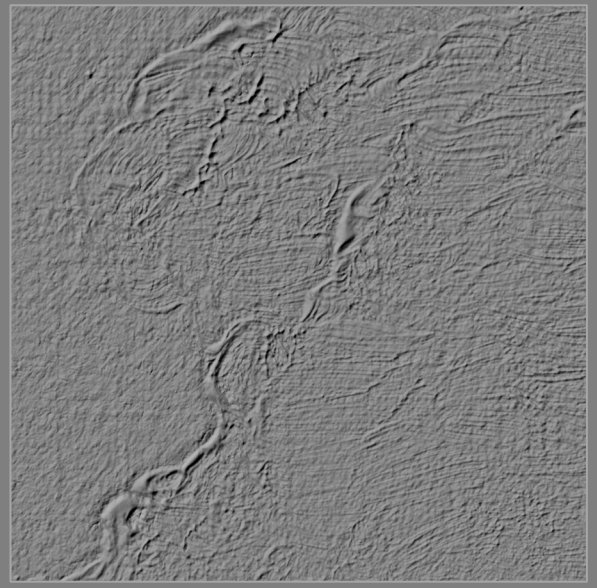
Case studies | The Grand Canal, Ascension Day



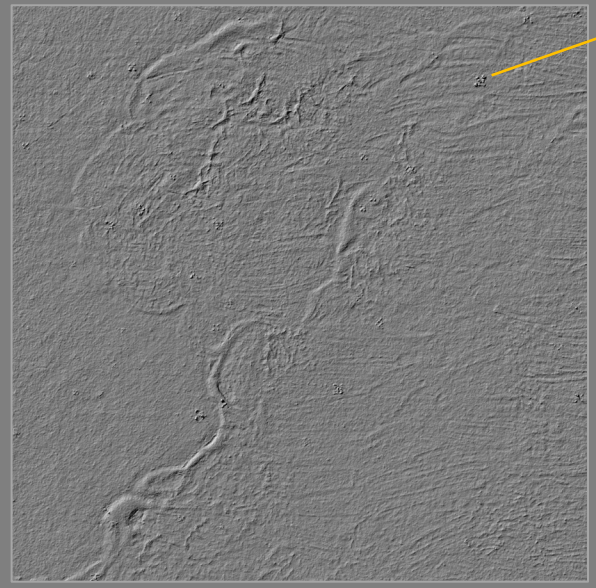




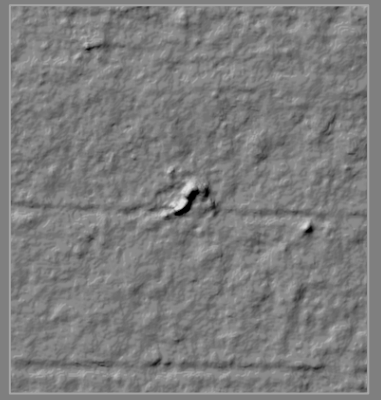
Colour detail



Shaded render of RTI normals.
Rendered in Blender with two raking lights.

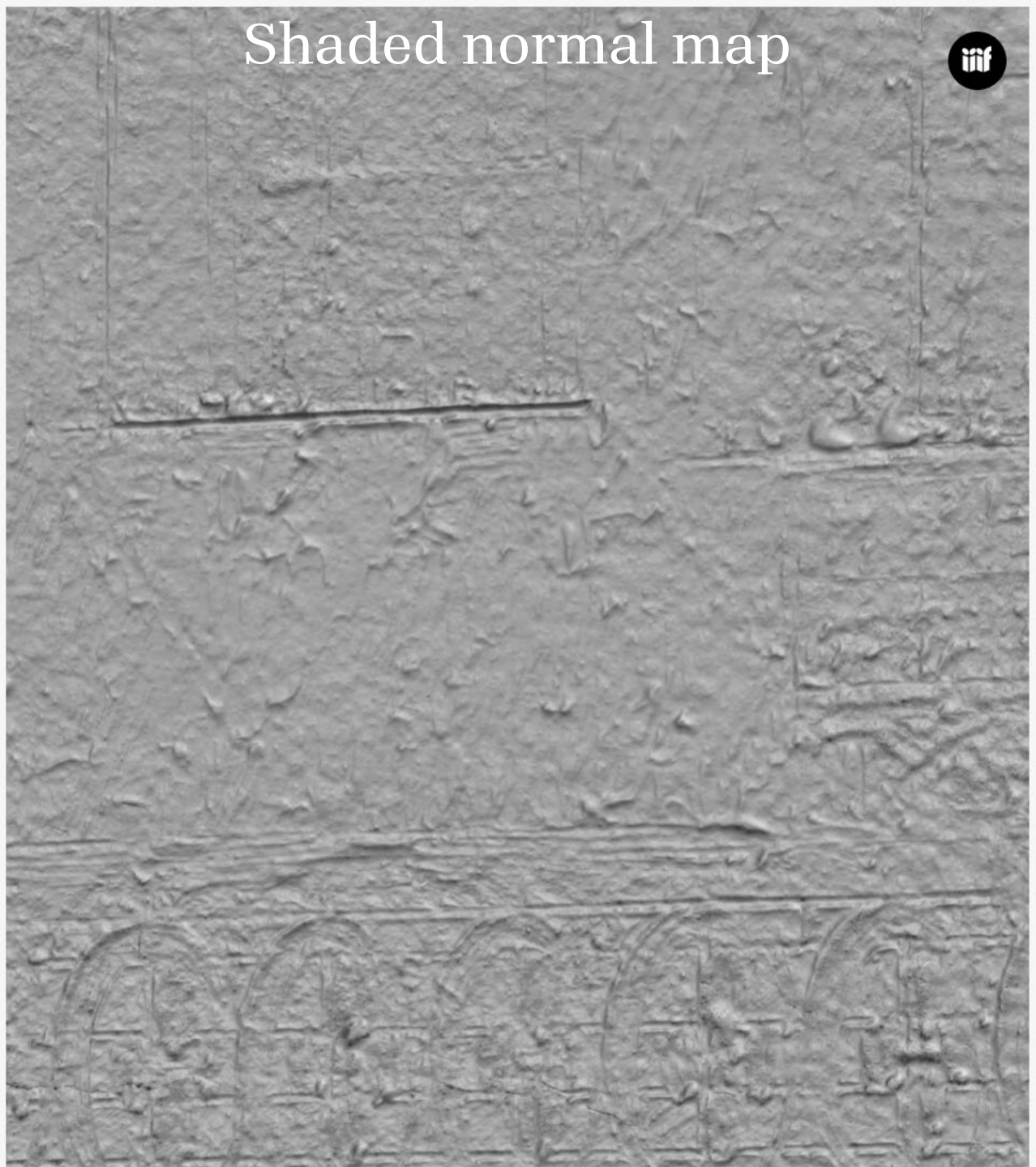


Greyscale render of Agisoft DEM



Dust particles in PG

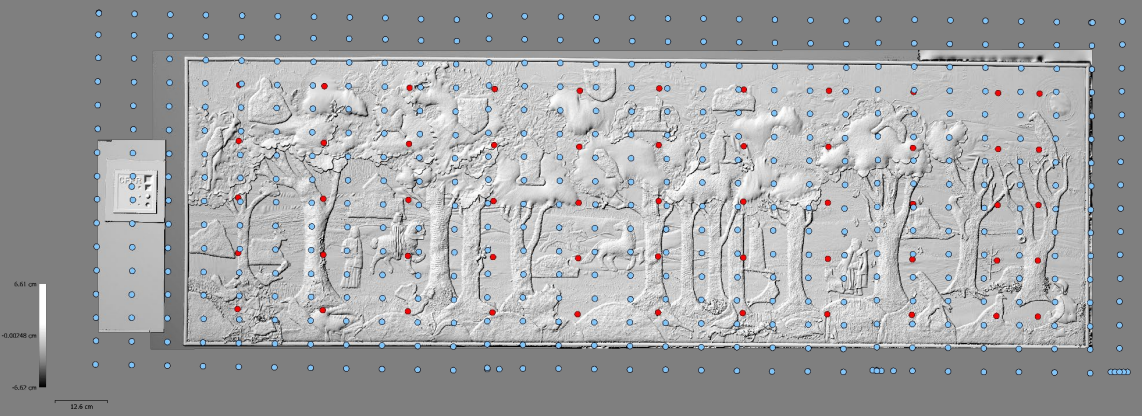

Colour


Shaded normal map

Case studies | The New Forest Embroidery

The New Forest Embroidery (7.6 x 0.66 m) highlights the most important events in the Forest's history together with a wide range of local flora and fauna. It was commissioned in 1979 by the New Forest Association to commemorate the 900th anniversary of the creation of the New Forest.
The New Forest Heritage Centre, Lyndhurst, UK.

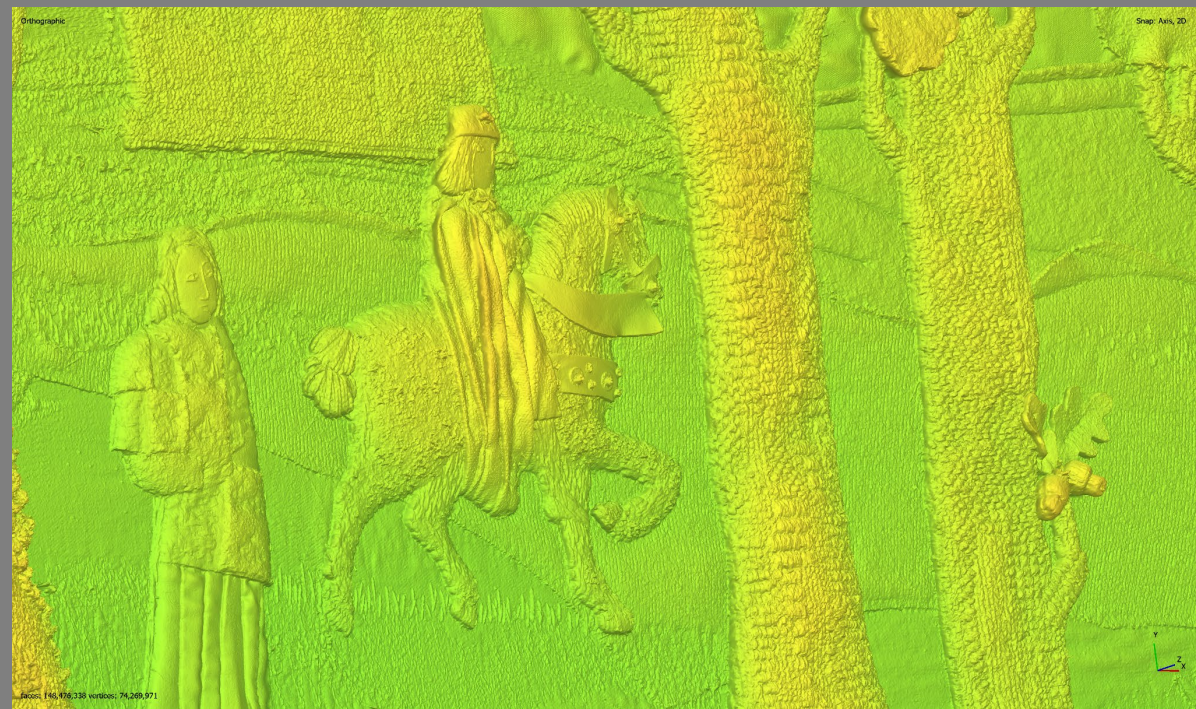
Case studies | The New Forest Embroidery



Lens: Sony FE 50mm f/2.8 Macro Lens Full Frame
Images: 497 images (blue dots) + 55 RTI ‘link’ images (red dots).

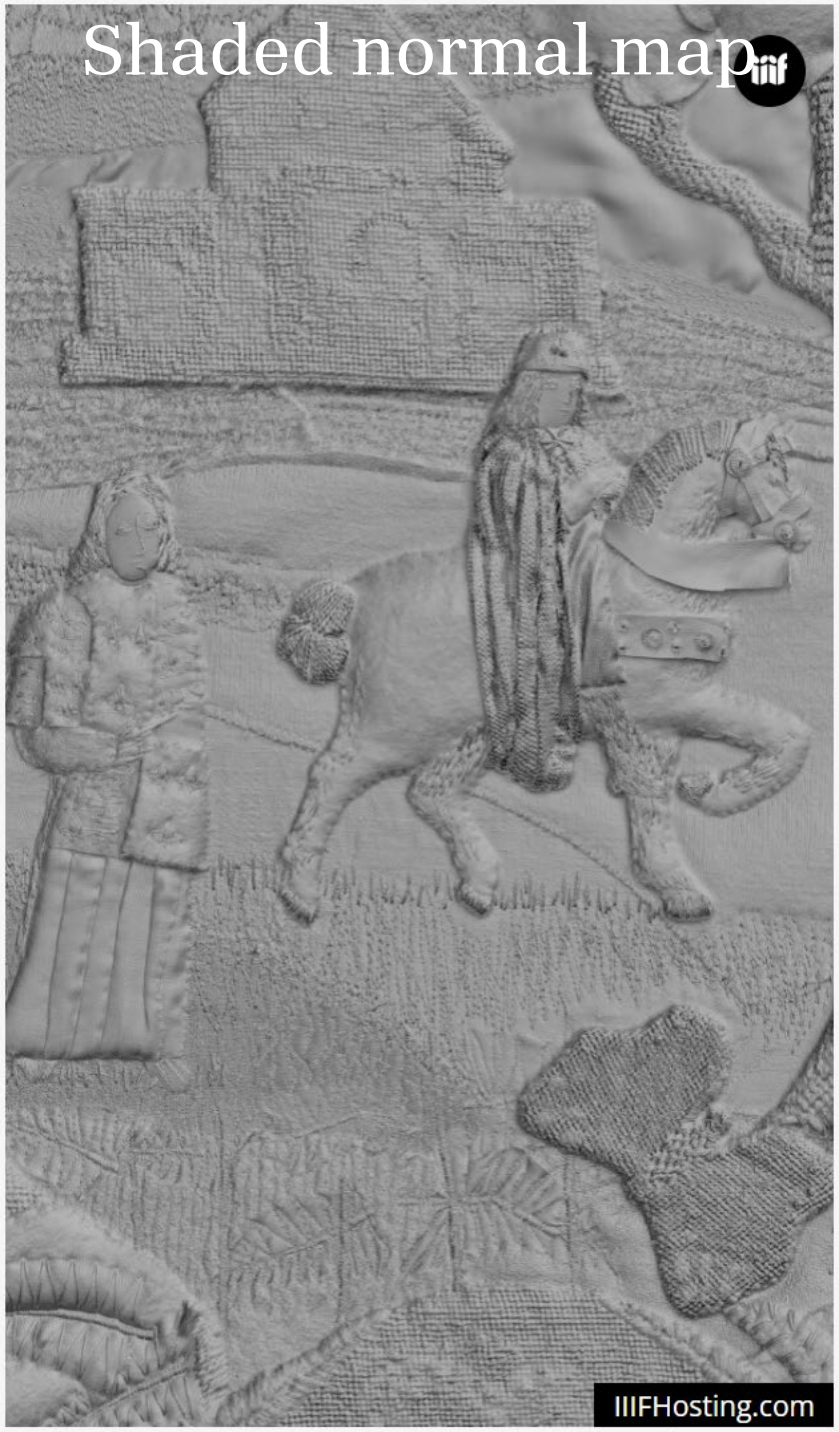
55 RTI image sets (1320 images)

Ultra-high quality point cloud:	1,464,766,889 points
Orthomosaic:	68,533 x 43,098 pixels
Resolution:	0.0384 mm/pixel
	26 pixels/mm
	661 DPI




Colour
IIIFHosting.com

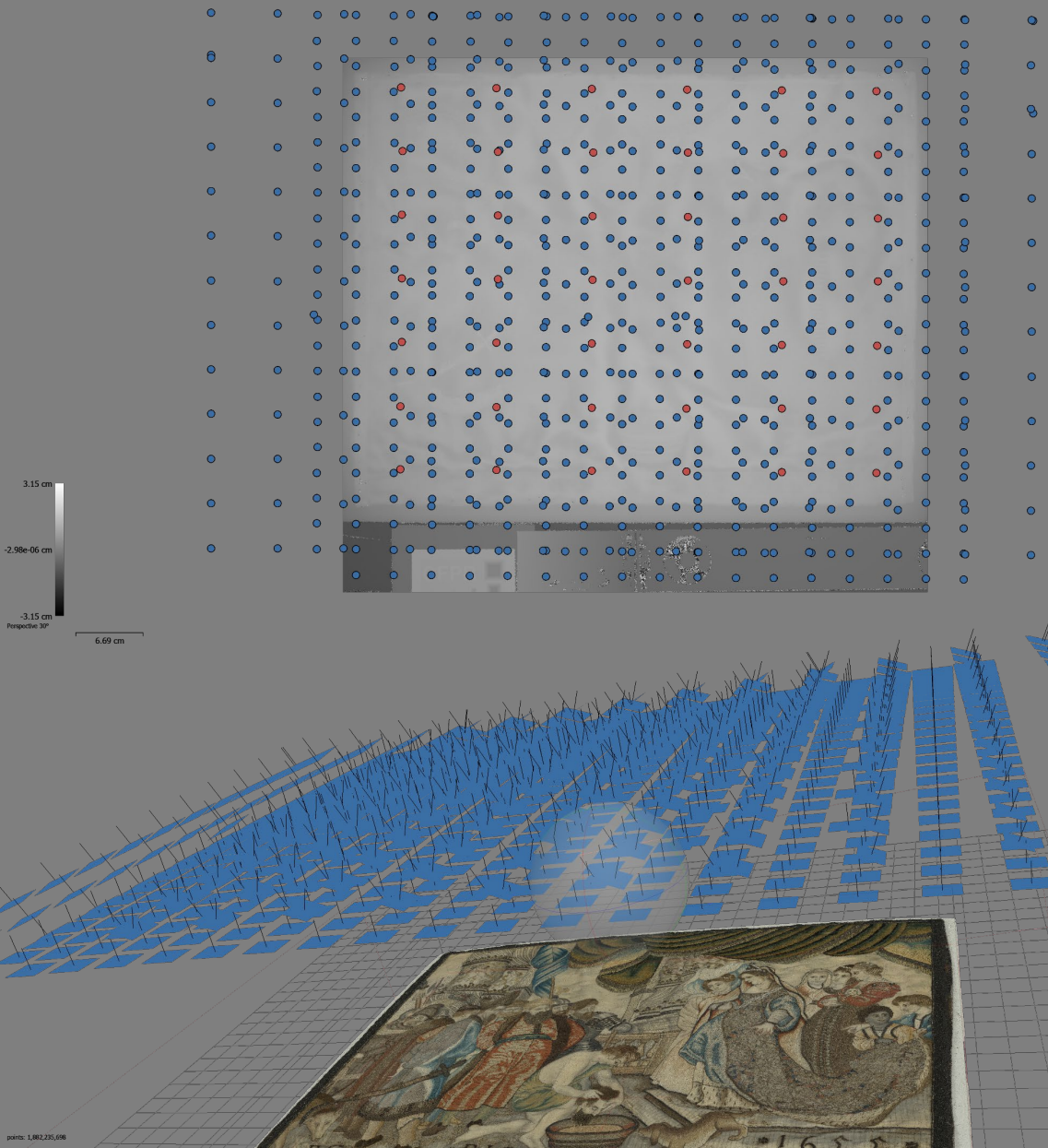

Normal map
IIIFHosting.com


Shaded normal map
IIIFHosting.com

Case studies | The Revenge of Queen Tomyris over Cyrus

The Revenge of Queen Tomyris over Cyrus, c.1655.
Silk embroidery by English School (55 x 43 cm).
The Holburne Museum, Bath, UK

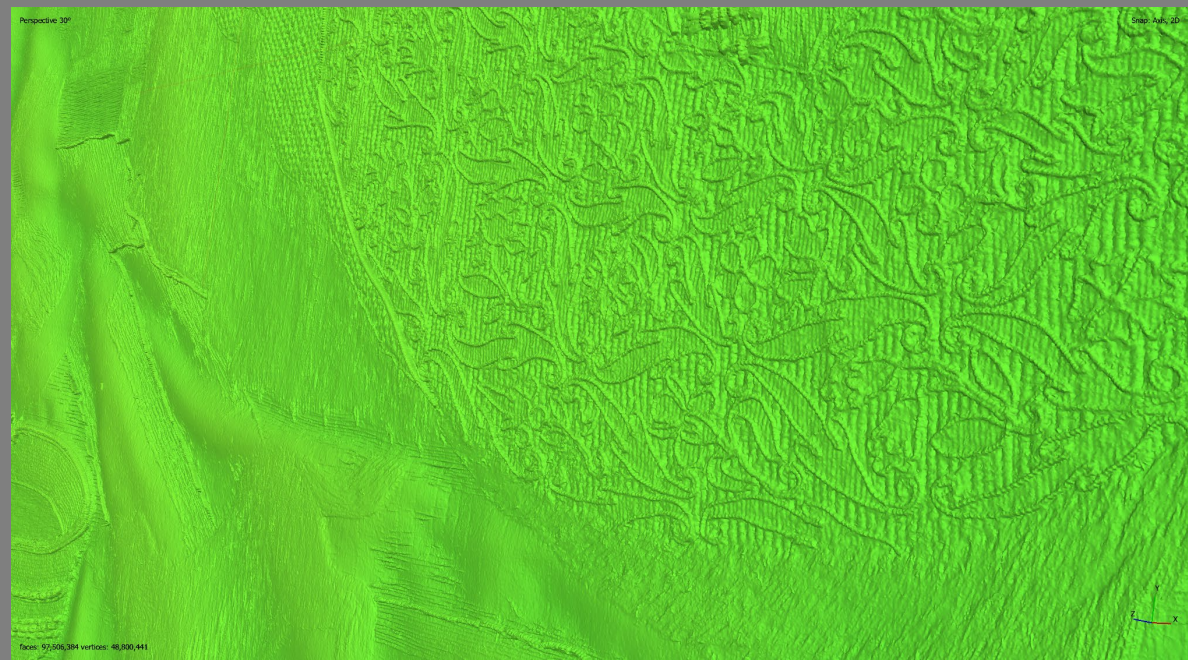
Case studies | The Revenge of Queen Tomyris over Cyrus



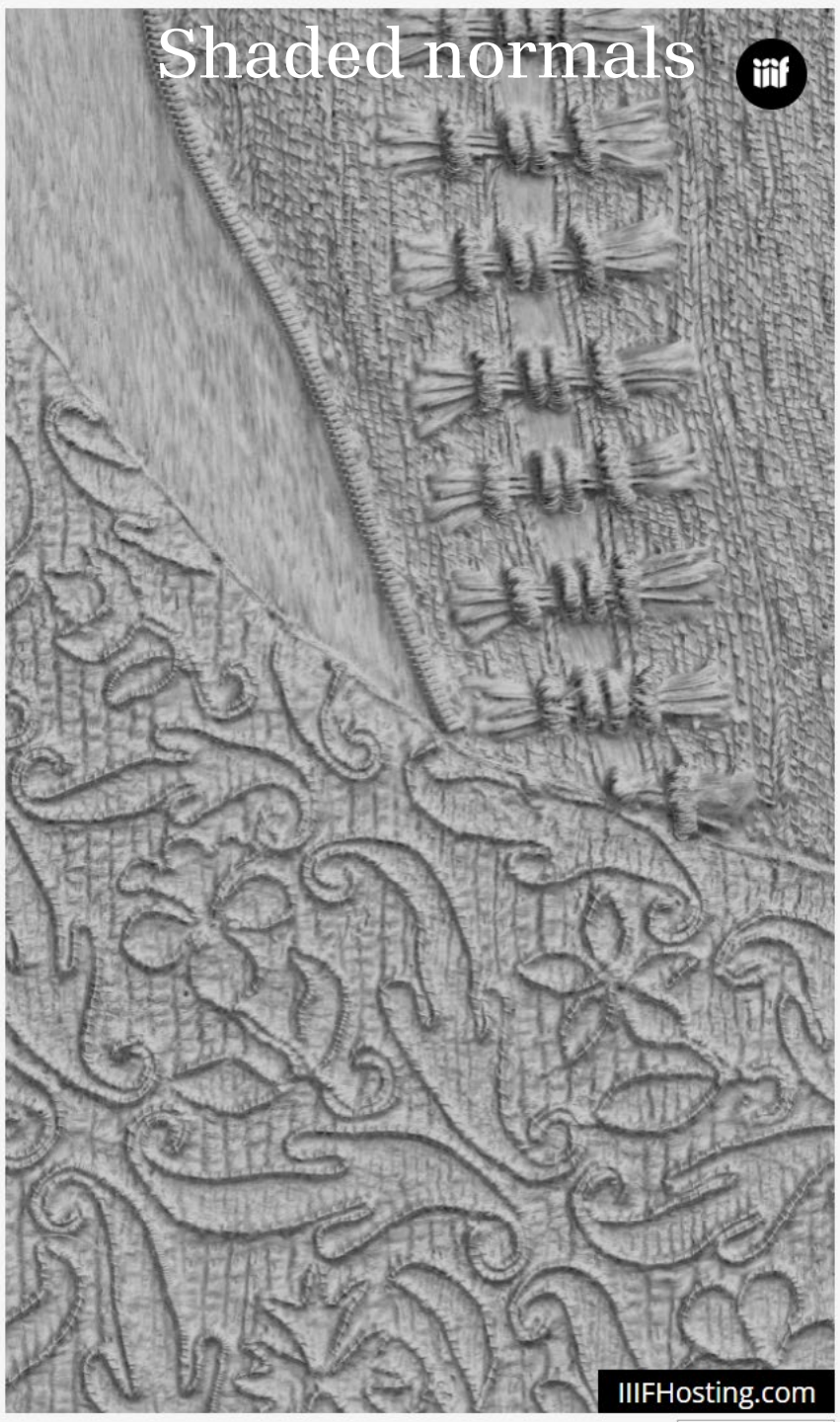
Lens: Sigma 70mm f/2.8 DG Macro Lens
Images: 684 images (blue dots) + 42 RTI ‘link’ images (red dots).

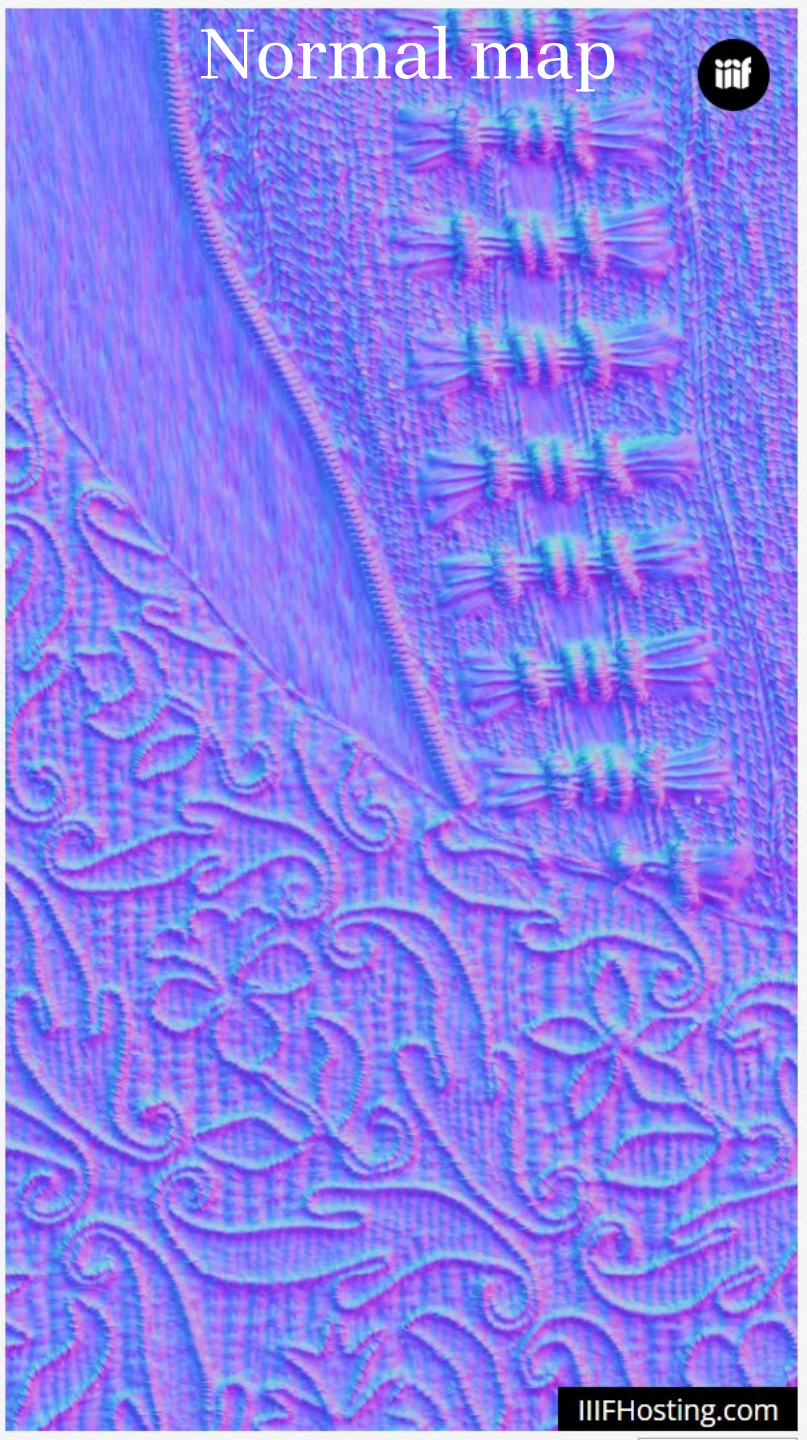
42 RTI image sets (1008 images)

Ultra-high quality point cloud:	1,887,474,698 points
Orthomosaic:	41,033 x 37,511 pixels
Resolution:	0.014 mm/pixel
	71 pixels/mm
	1814 DPI




Colour
IIIFHosting.com

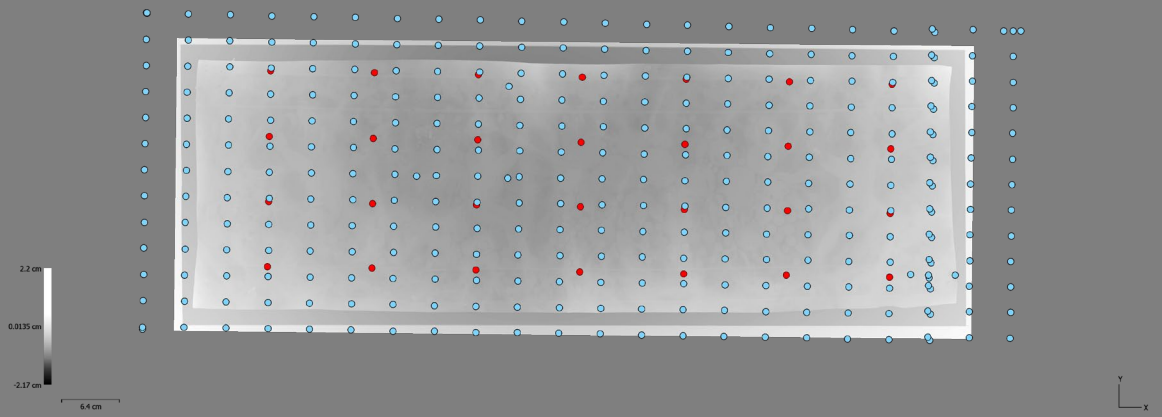

Shaded normals
IIIFHosting.com


Normal map
IIIFHosting.com

Case studies | Gilt leather panel

Section of a frieze or border, silvered and embossed using a metal plate.
16th century, sheepskin leather panel (83 x 27 cm).
The design includes Amorini, grapes, pomegranates and foliage. Partly coloured with gold, red glaze and green paint.
Museum of Leathercraft, Northampton, UK

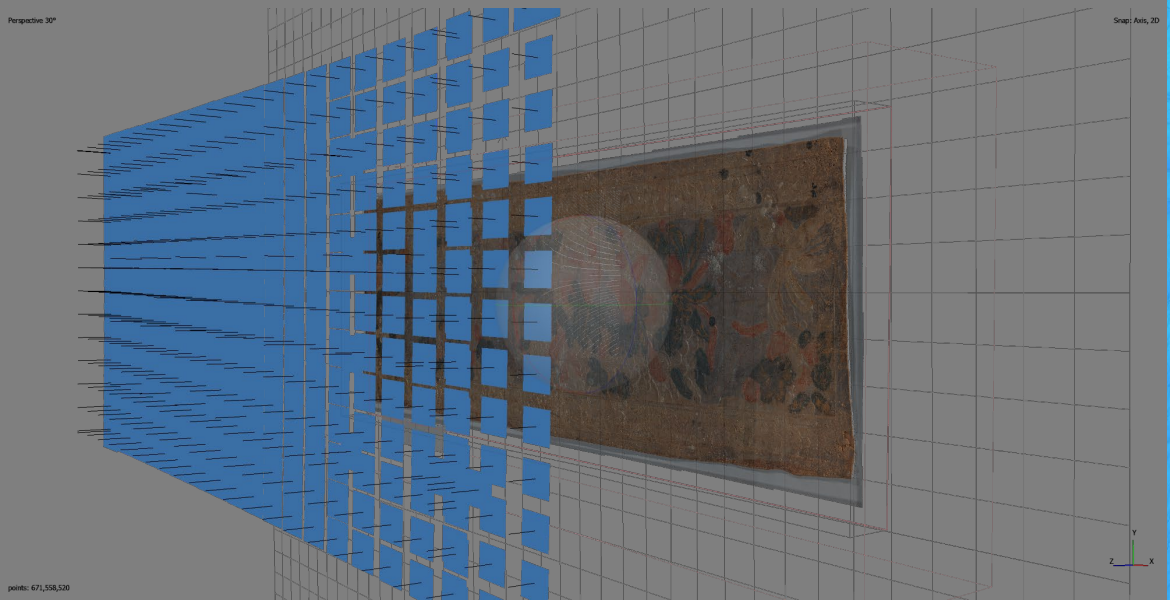
Case studies | Gilt leather panel

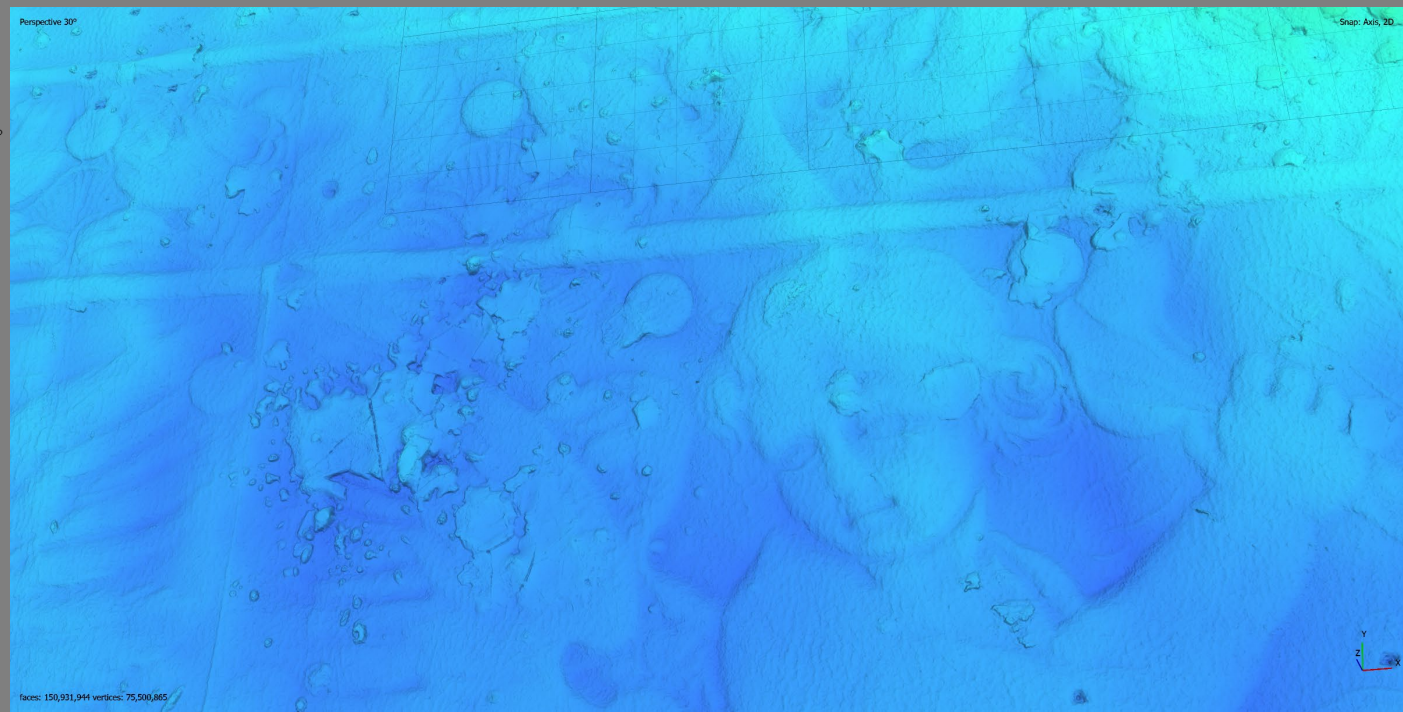


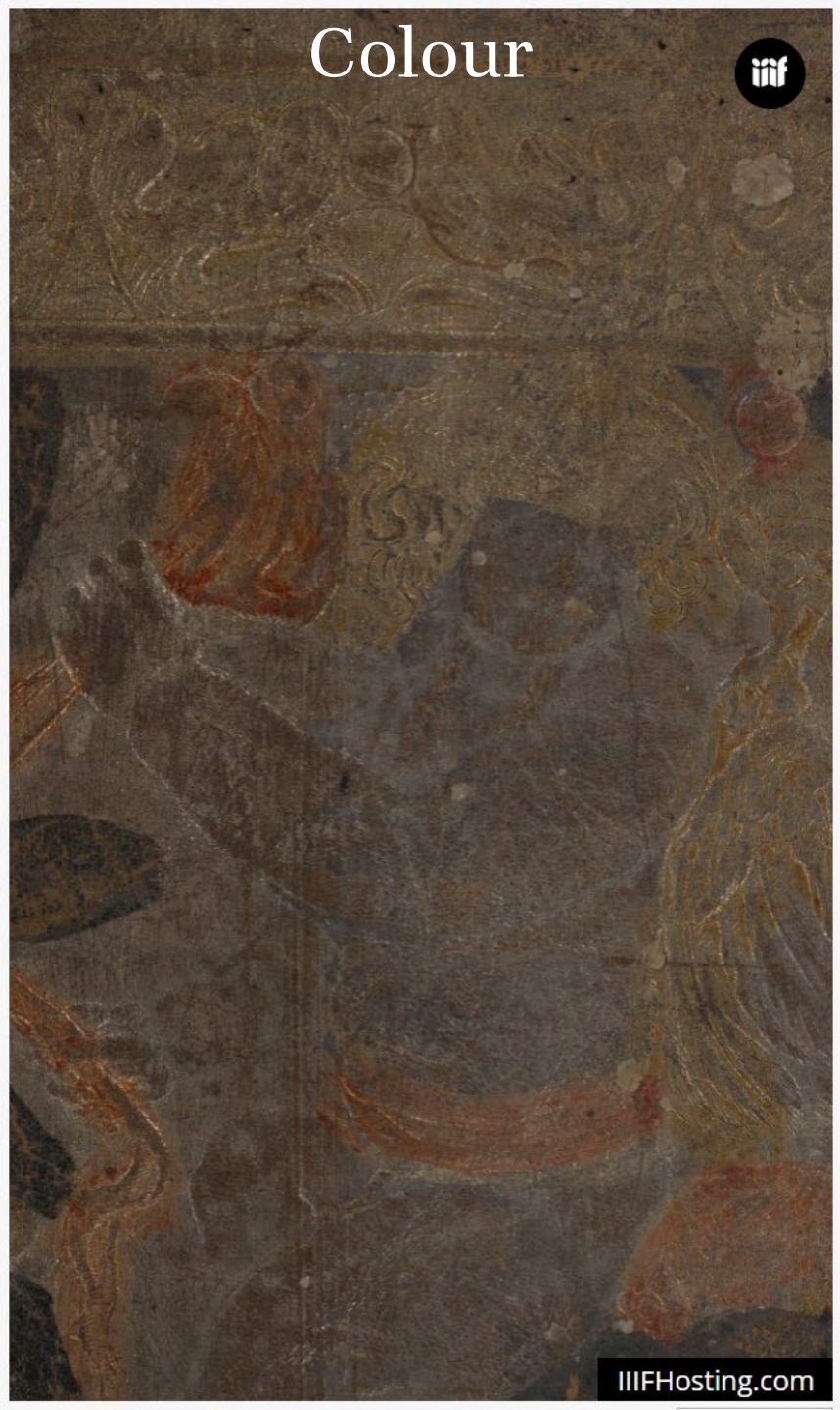
Lens: Sigma 70mm f/2.8 DG Macro Lens
Images: 318 images (blue dots) + 28 RTI ‘link’ images (red dots).

28 RTI image sets (672 images)

Ultra-high quality point cloud:	671,558,520 points
Orthomosaic:	42,974 x 16,039 pixels
Resolution:	0.0198 mm/pixel
	50 pixels/mm
	1282 DPI






Colour
IIIFHosting.com


Shaded normals
IIIFHosting.com


Normal map
IIIFHosting.com

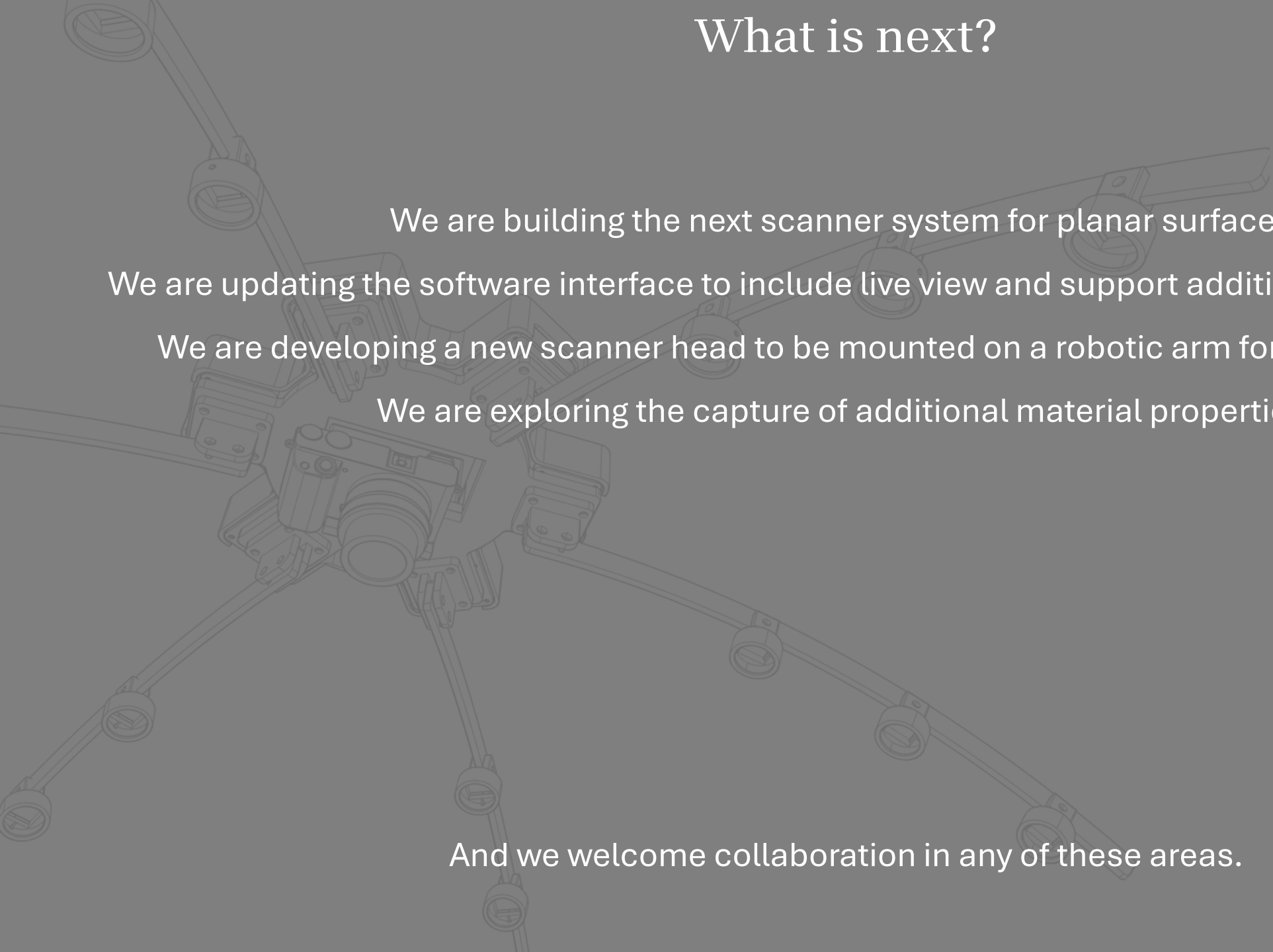
What is next?

We are building the next scanner system for planar surfaces.

We are updating the software interface to include live view and support additional camera brands.

We are developing a new scanner head to be mounted on a robotic arm for turntable scans.

We are exploring the capture of additional material properties.



And we welcome collaboration in any of these areas.

Acknowledgements

INTERNATIONAL
FINE ART
CONSERVATION
STUDIOS

Get in touch

xavi.aurecalvet@uwe.ac.uk | https://cfpr.uwe.ac.uk/