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3D Scanning of Highly Reflective Surfaces: Issues in Scanning the Museums Sheffield Metalwork Collection

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3D SCANNING OF HIGHLY REFLECTIVE SURFACES: ISSUES ON SCANNING THE MUSEUMS SHEFFIELD METALWORK COLLECTION

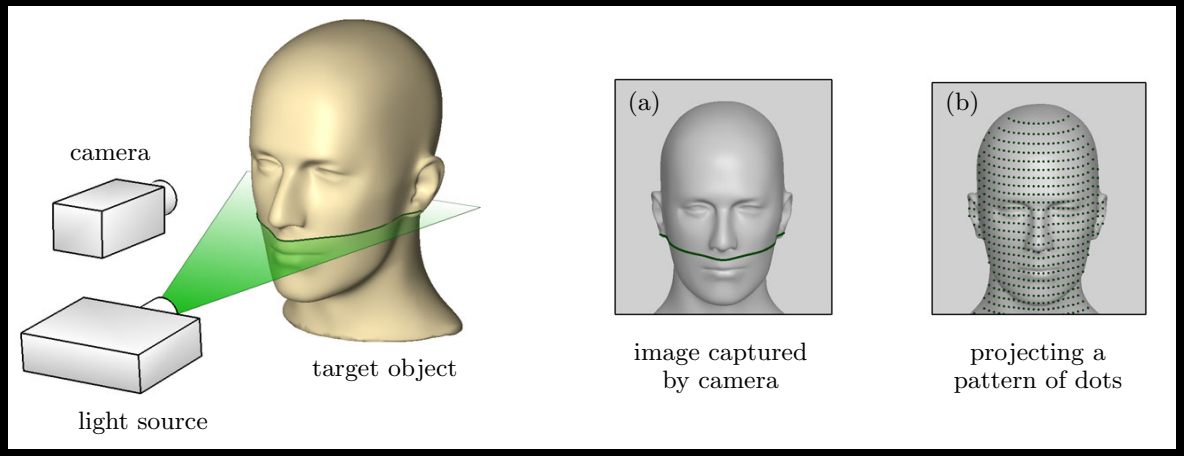
Rationale

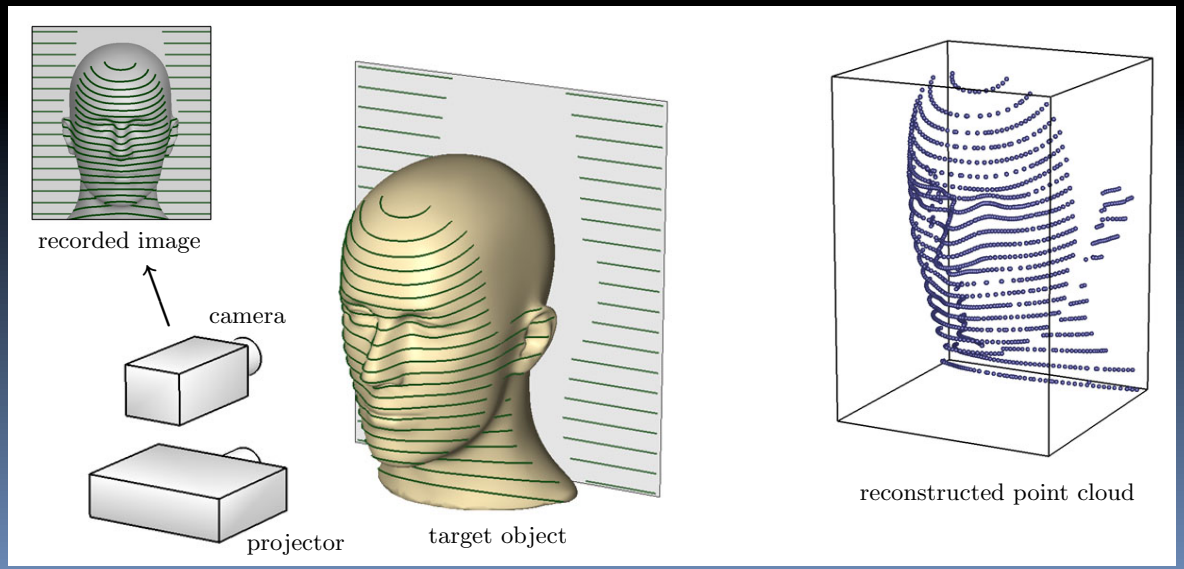
- Work funded by JISC Rapid Digitization Programme 2011
- Aims: scan representative items from metalwork collection and make them available on the web
- Universal accessibility on the web is key: options include WebGL and Flash



Techniques for 3D Scanning

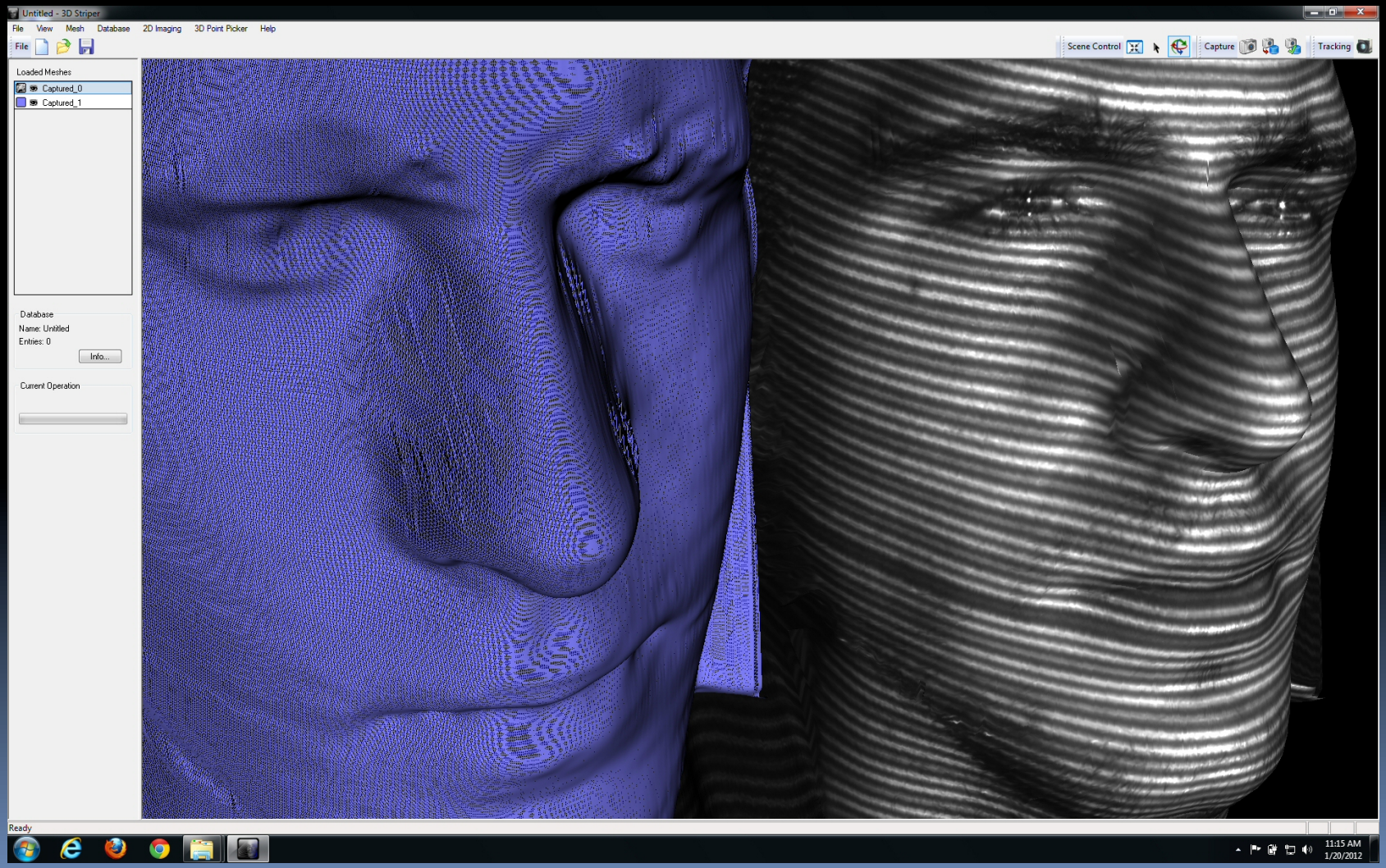
Structured light: SHU patented method of 3D reconstruction from line projection for both visible and near infrared spectra



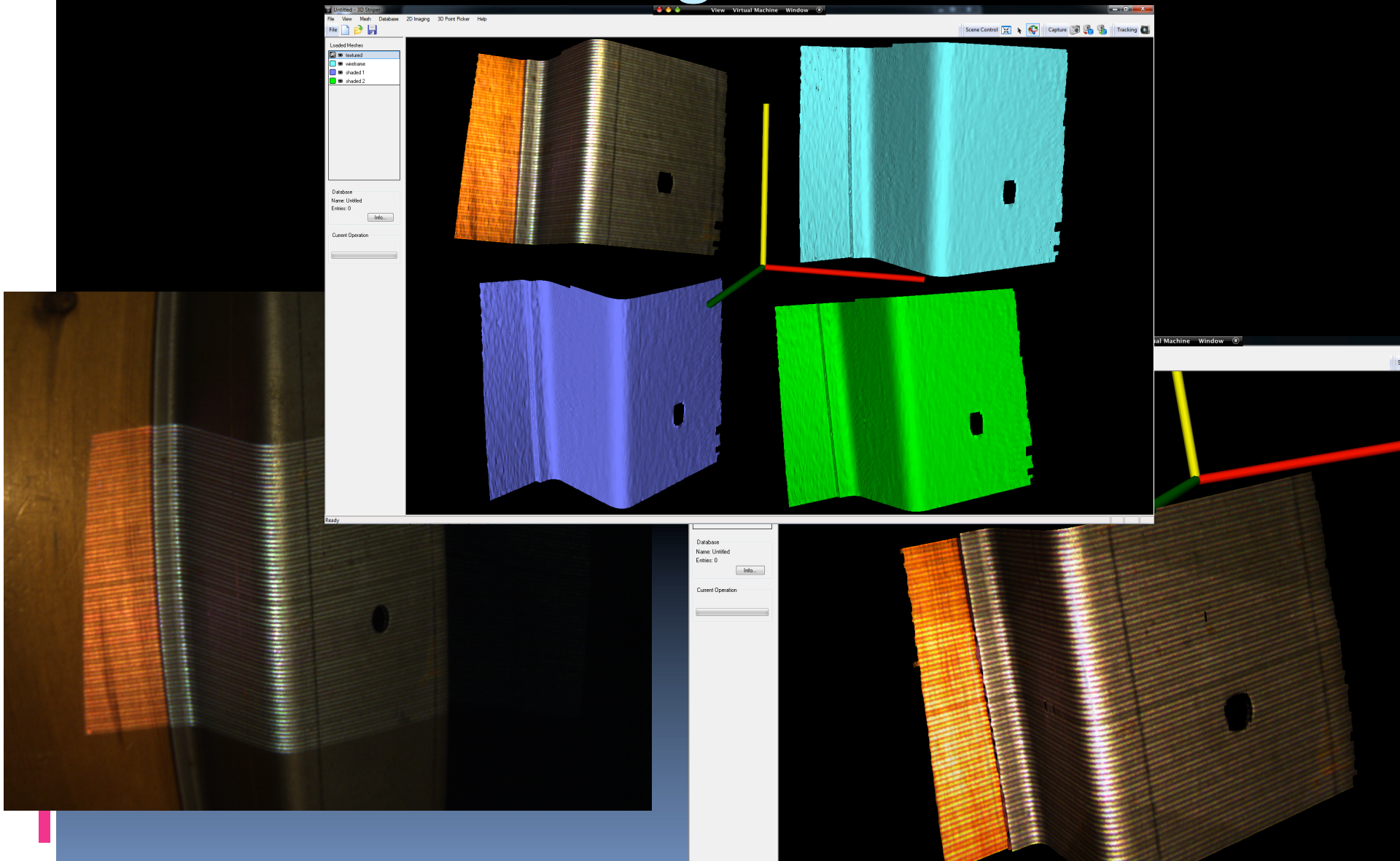


The GMPR Scanner

The GMPR Scanner: fast with automatic texture mapping

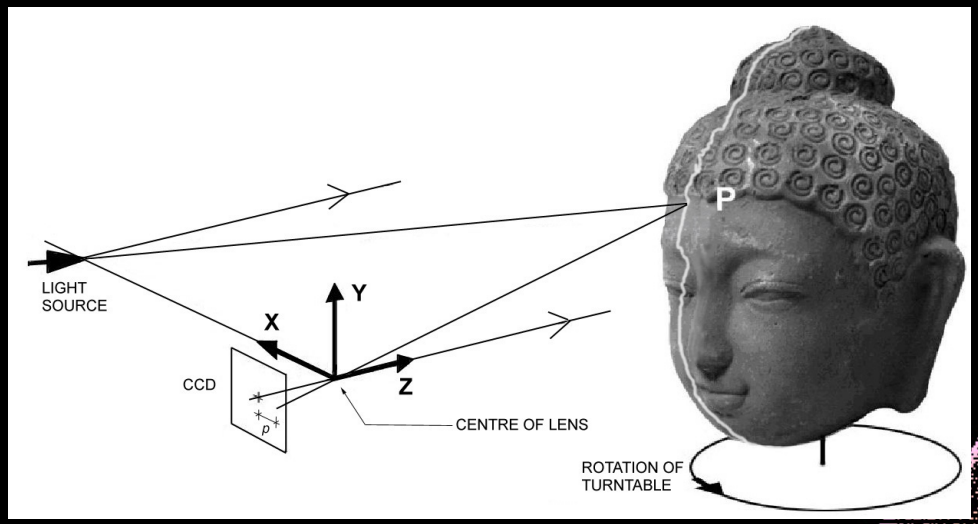


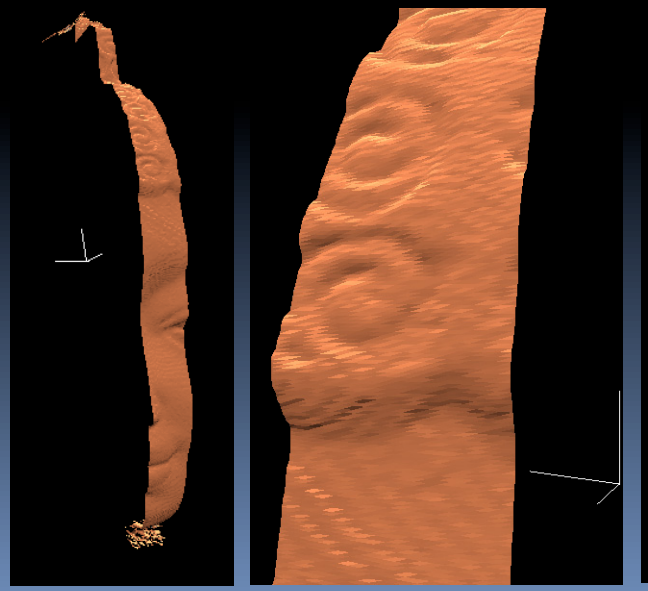
The GMPR Scanner on other surfaces: e.g. wood and metal

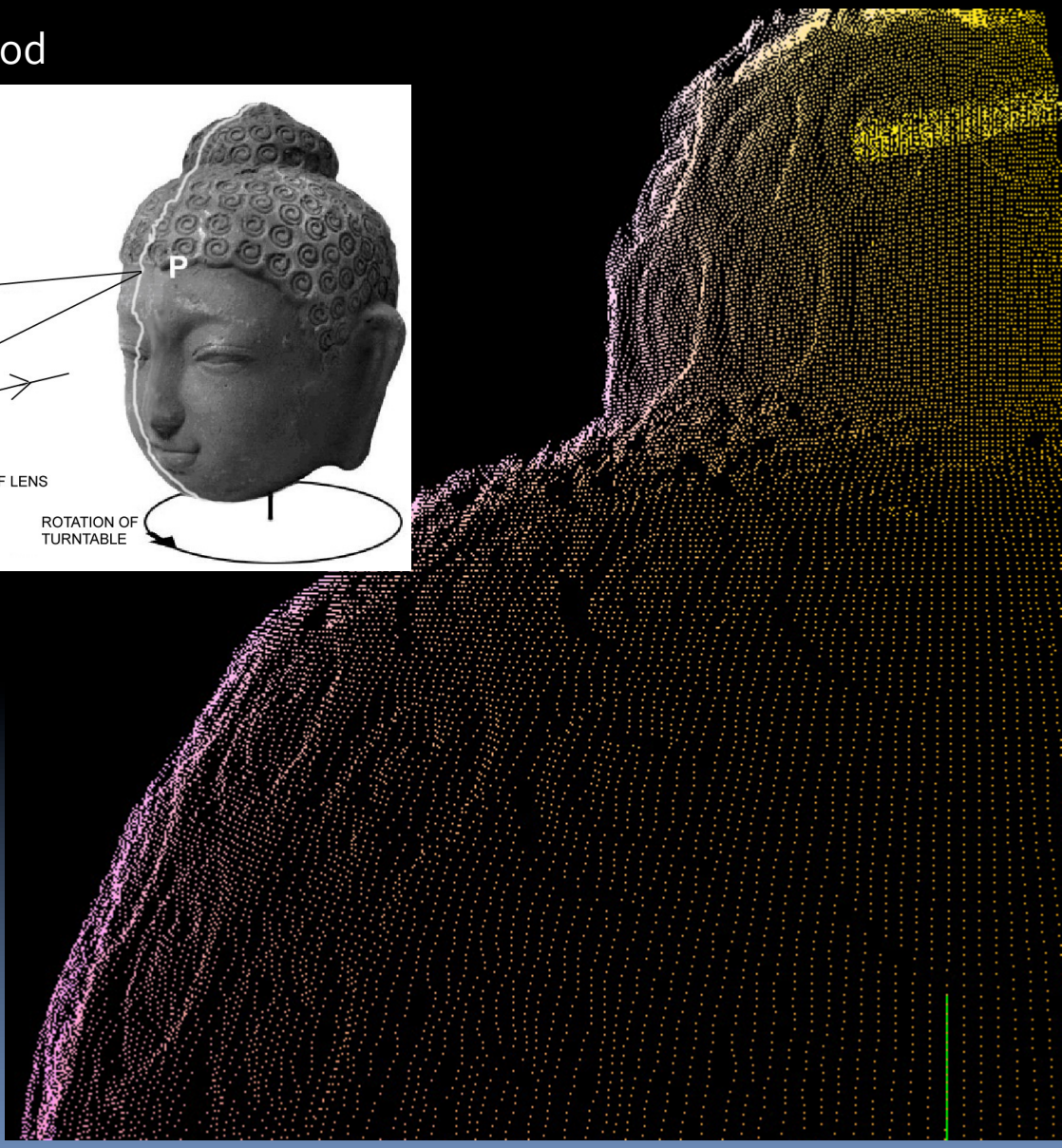


Techniques for 3D Scanning (2)

SHU Laser scanning method







Some samples

















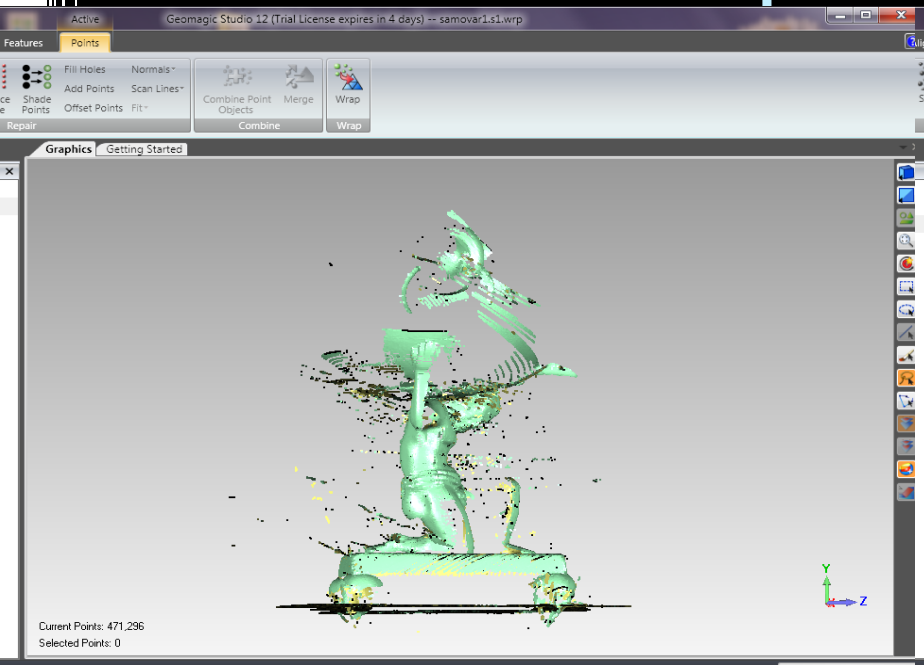
Choice of Scanning Technique

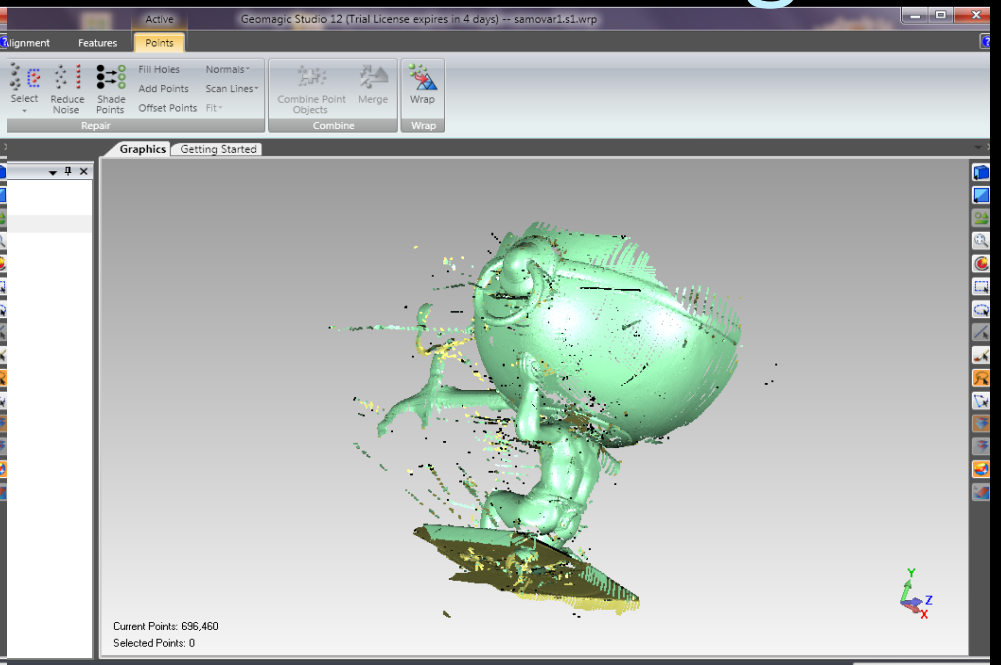
- Trials with structured light (multiple line pattern) visible and near-infrared spectra
- Single line laser allows controlling the angle of incident light thus reducing noise levels
- Single line laser scanner in connection with a robotic arm (replacing the turntable) was the technique that worked best

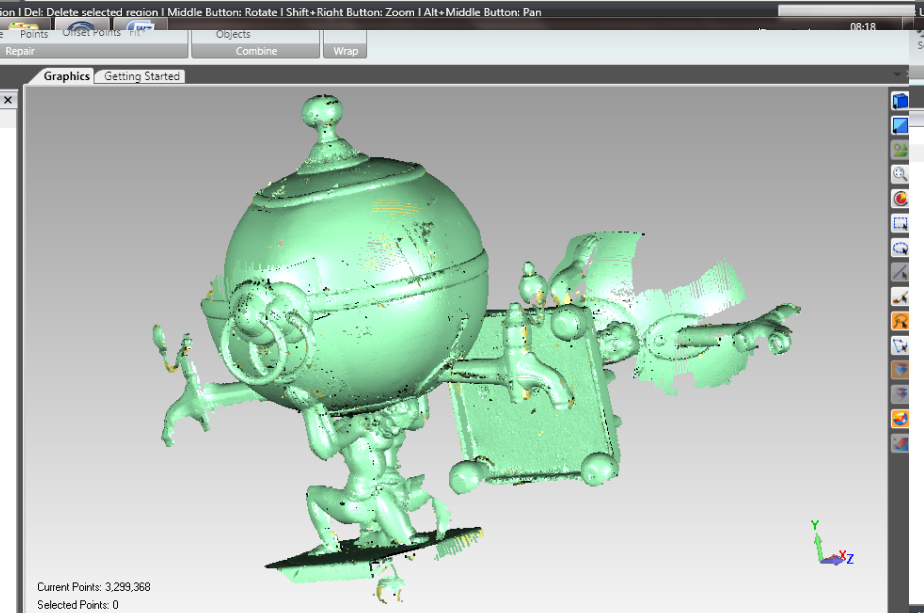
Controlling the light’s incident angle

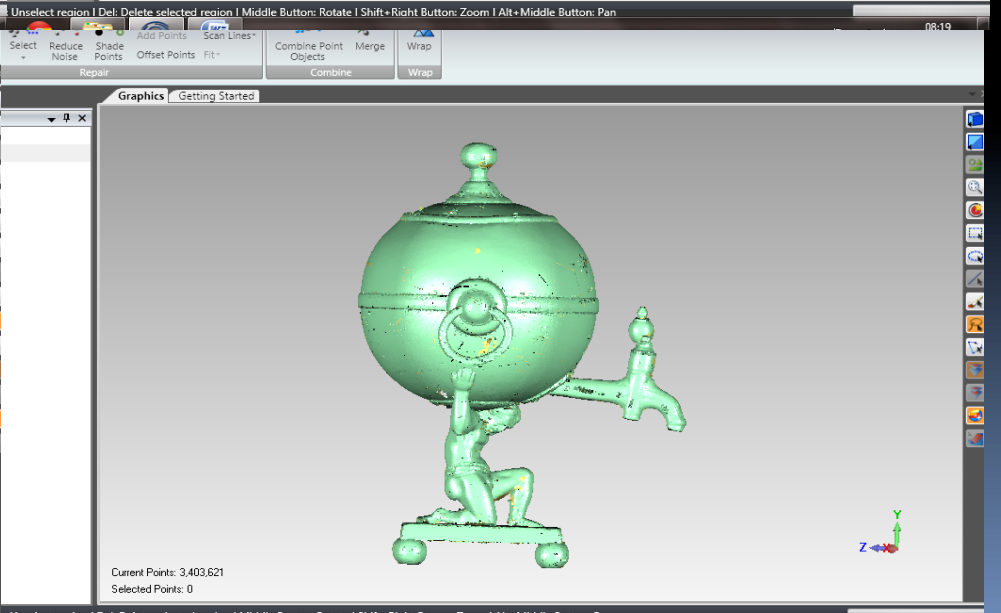


Some Steps in 3D Scanning

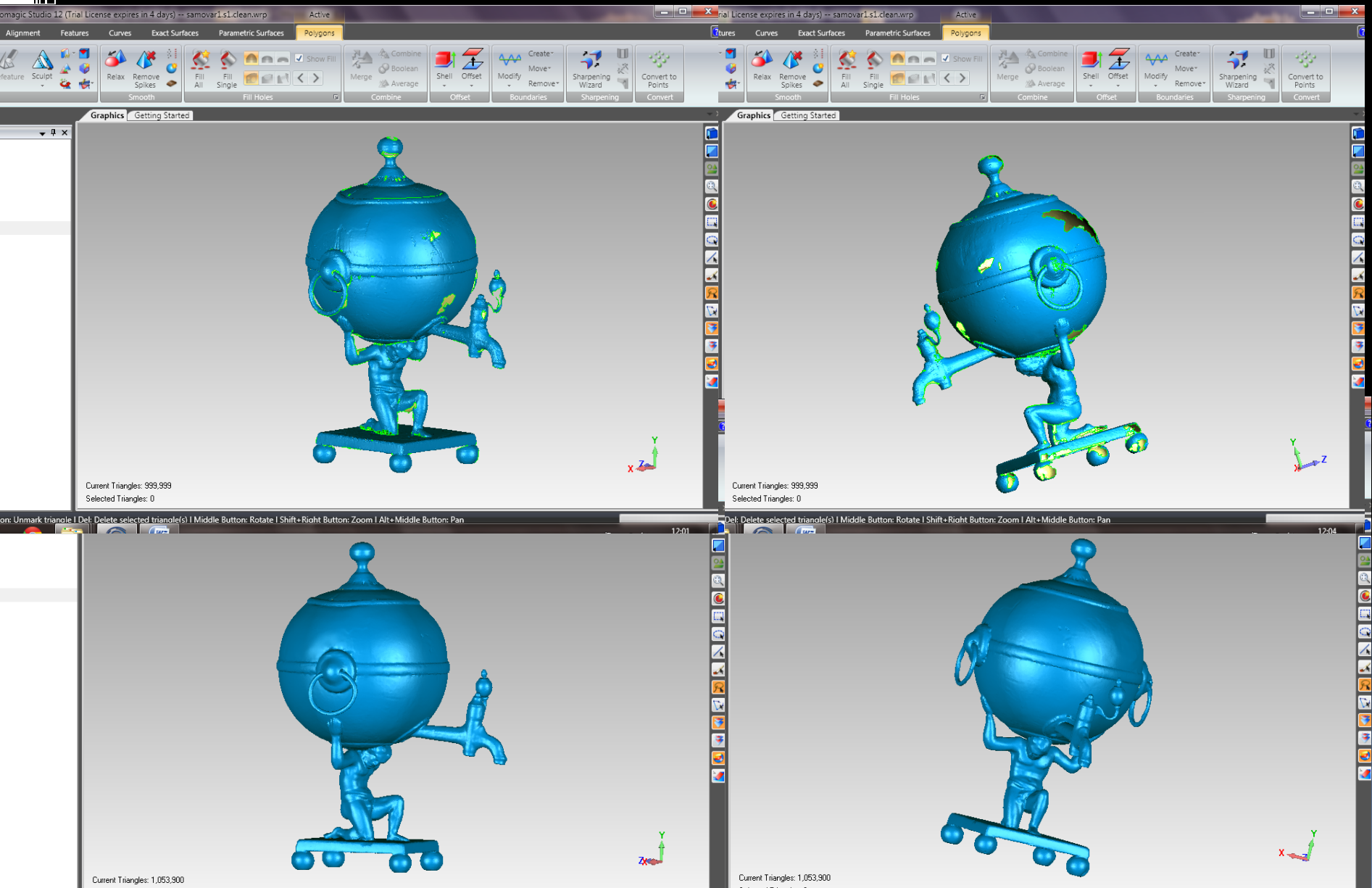




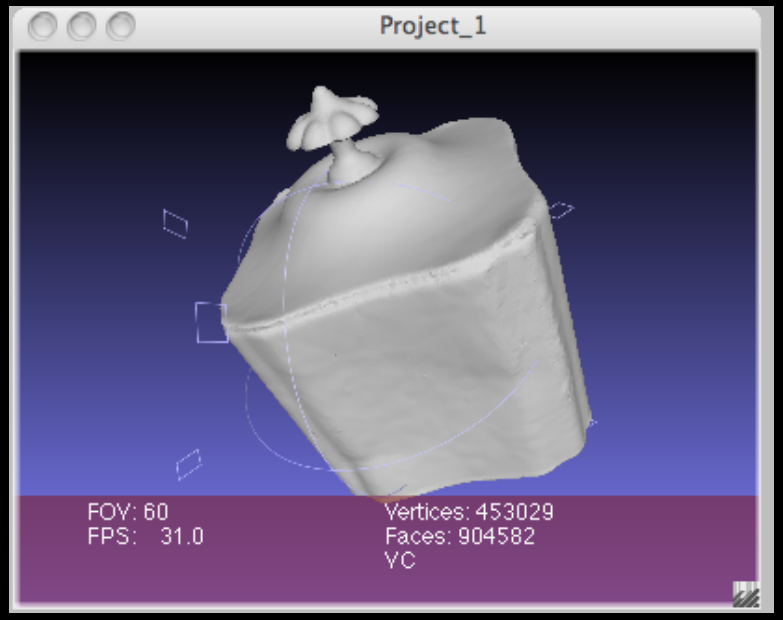


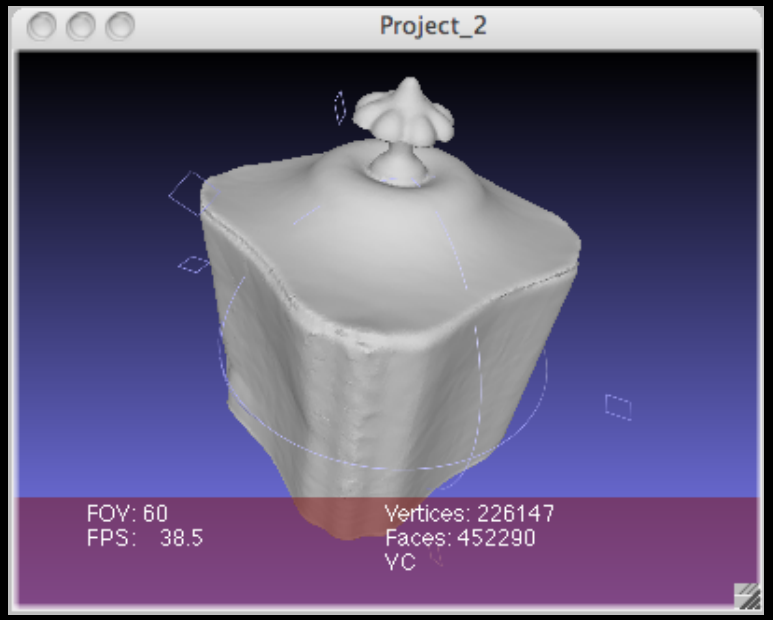


3D Post-Processing

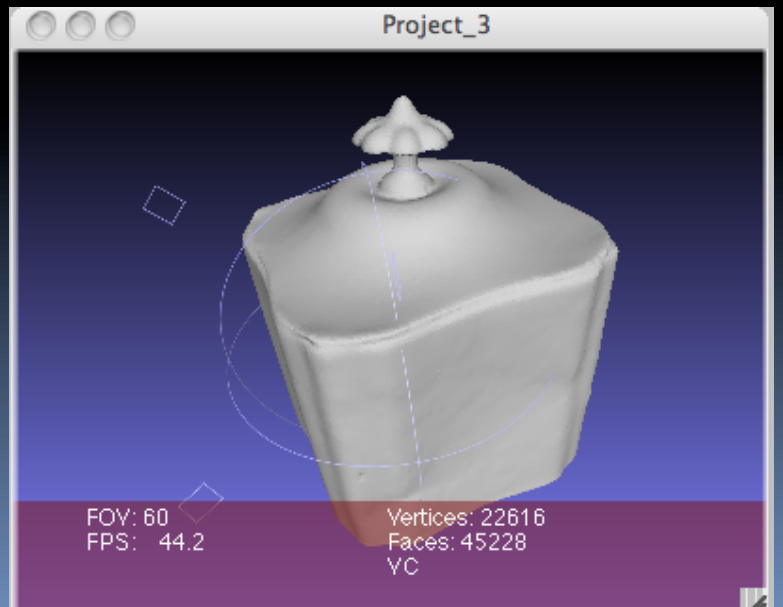


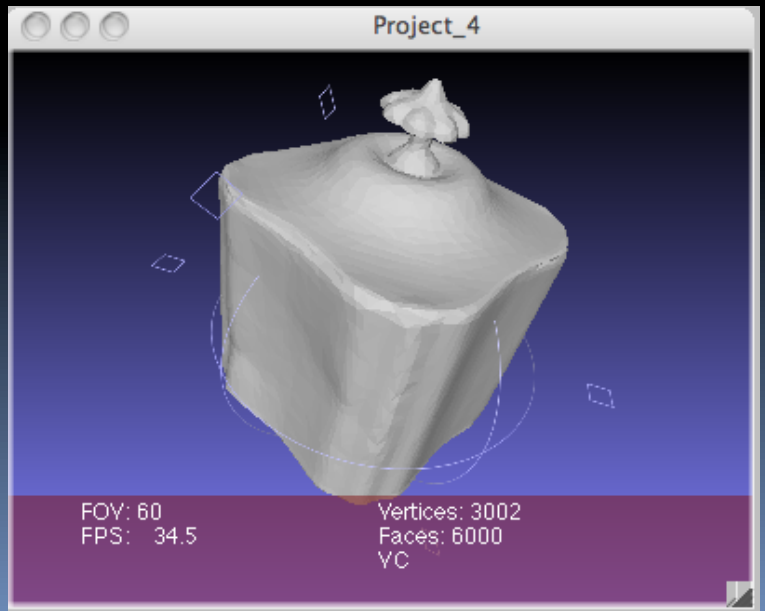
Mesh Decimation





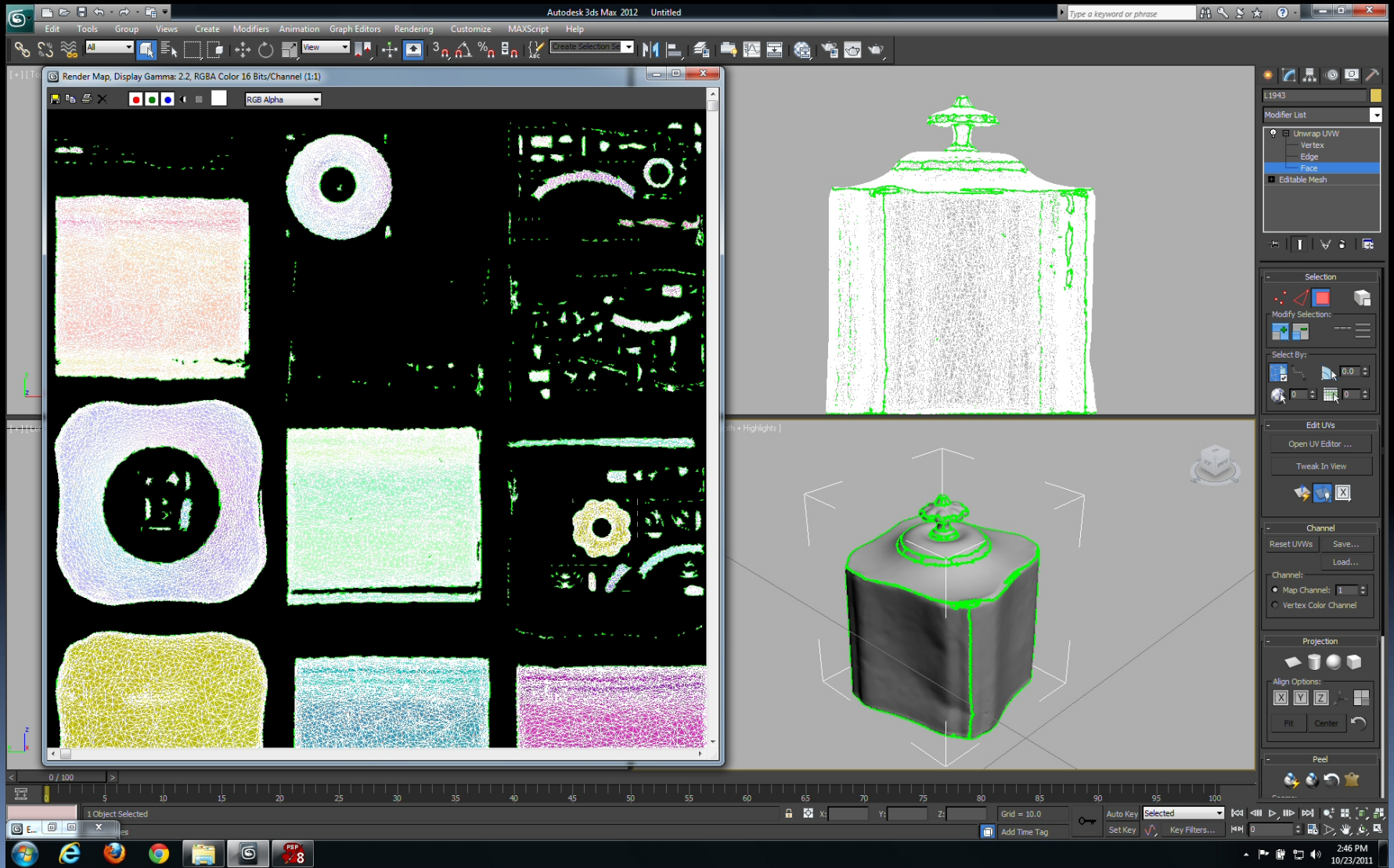
Up to 99.7% data compression



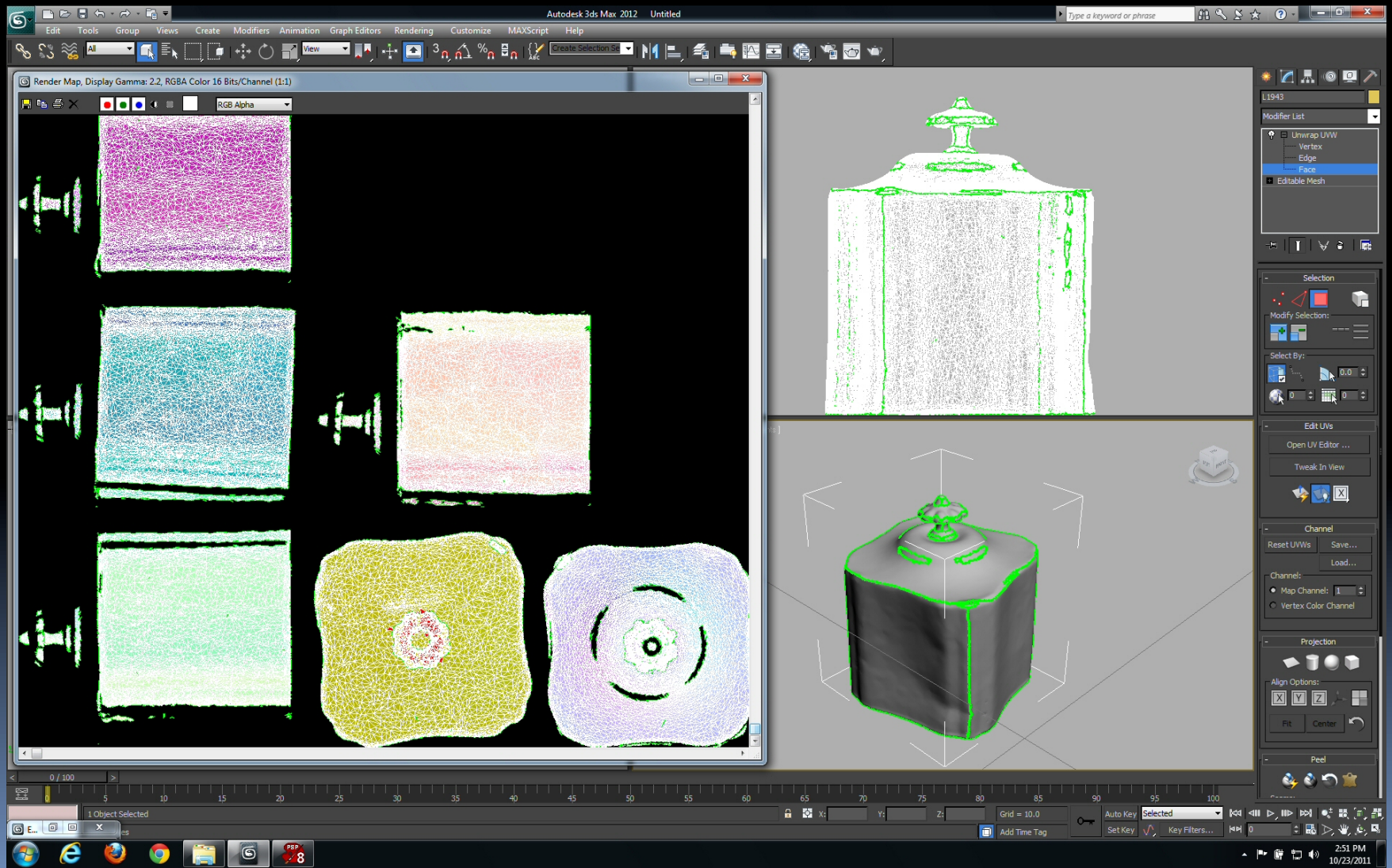


Texture Mapping

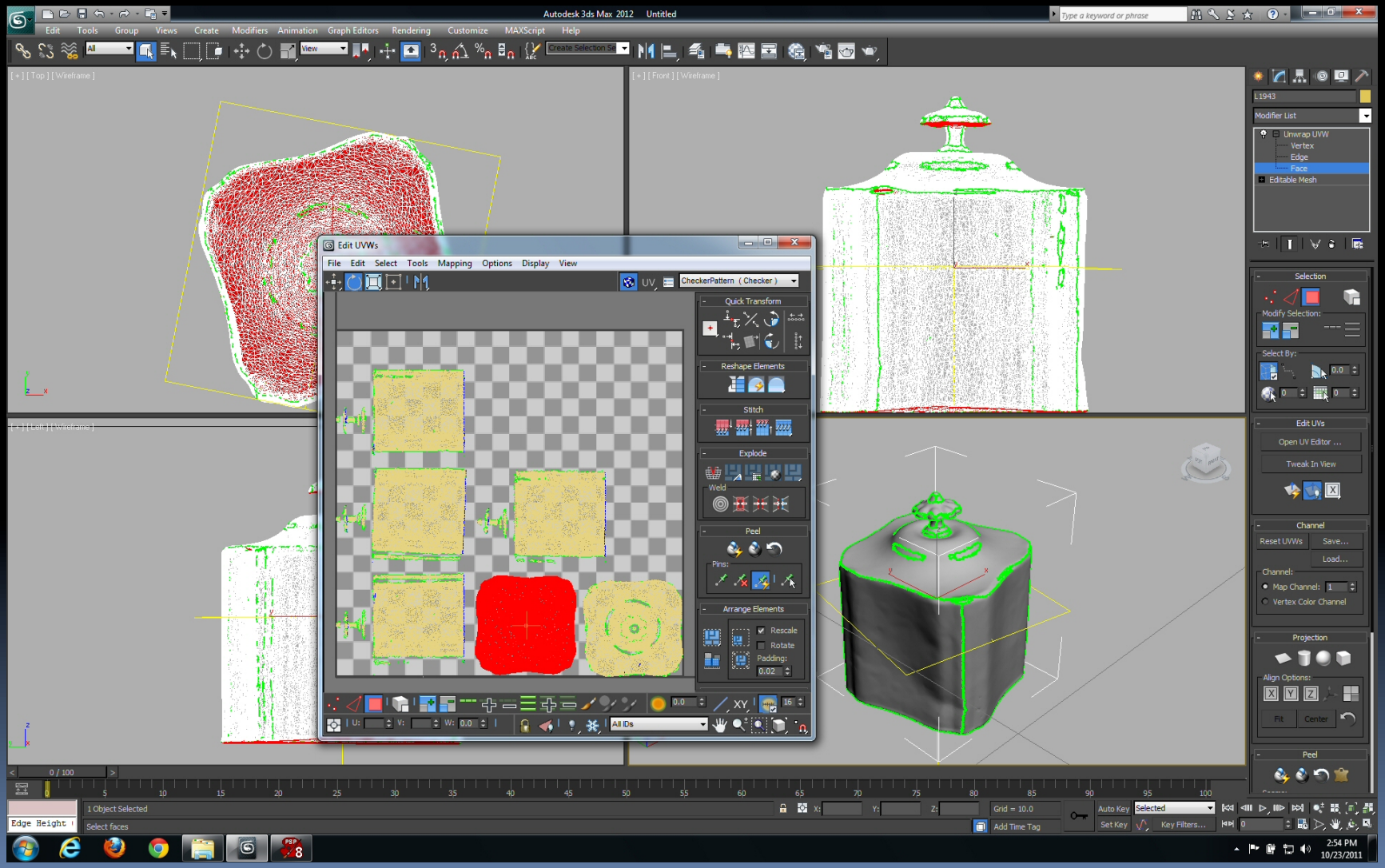
- First need to cut the model open then flatten to plane



A more efficient way of flattening out a model



The uvw map can be edited



Fitting images to uvw maps

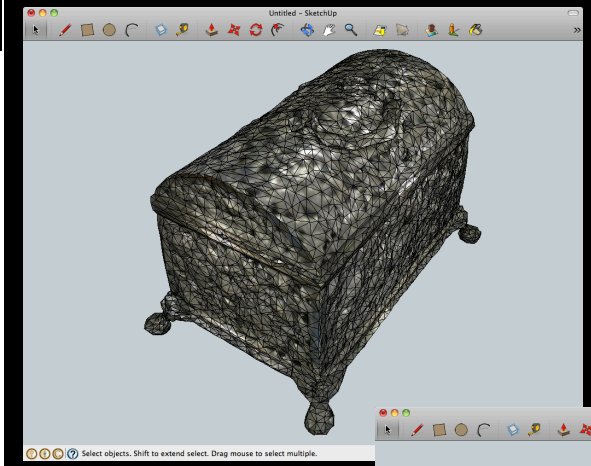
Requires cropping, scaling and rotation of original photographs.
Requires editing at the borders of uvw map and photos

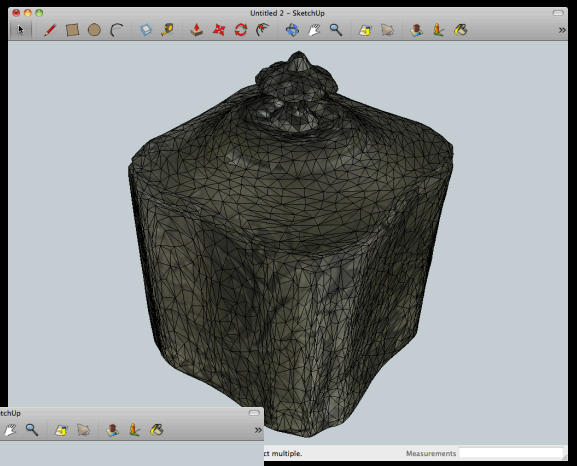


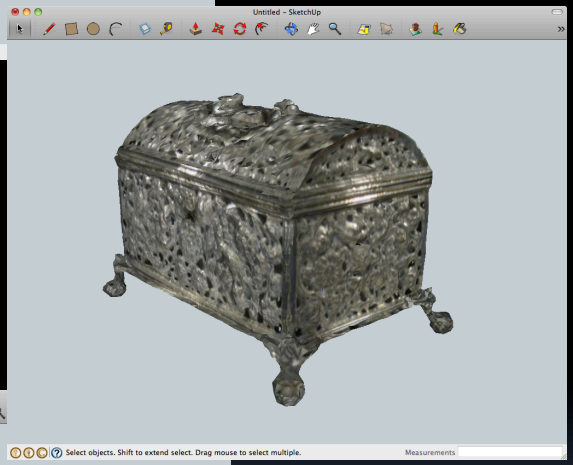


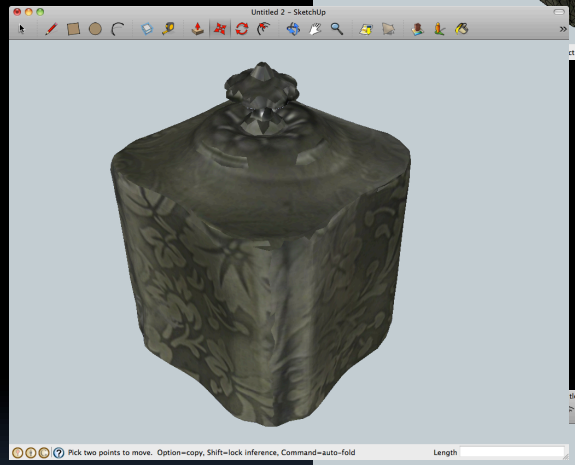


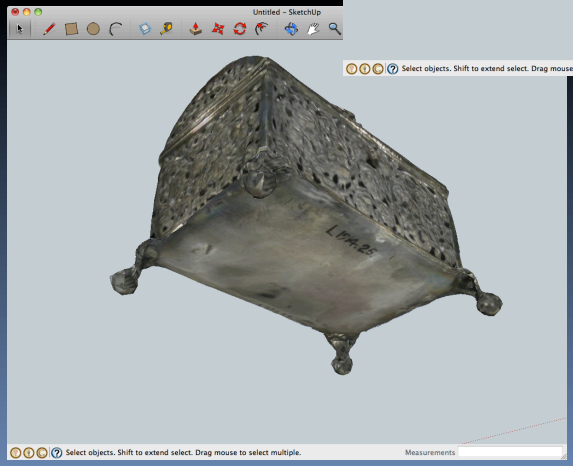
3D textured model results

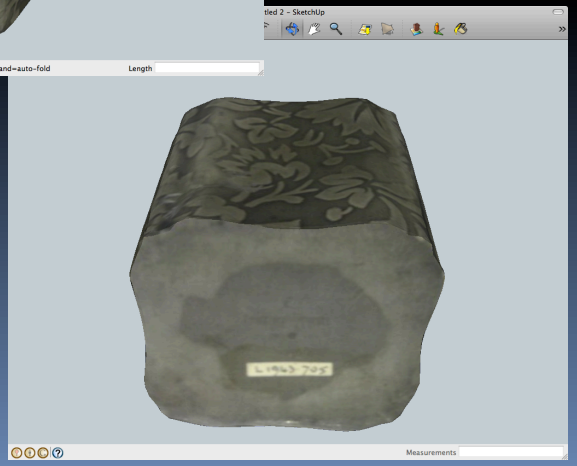












A reference describing the process

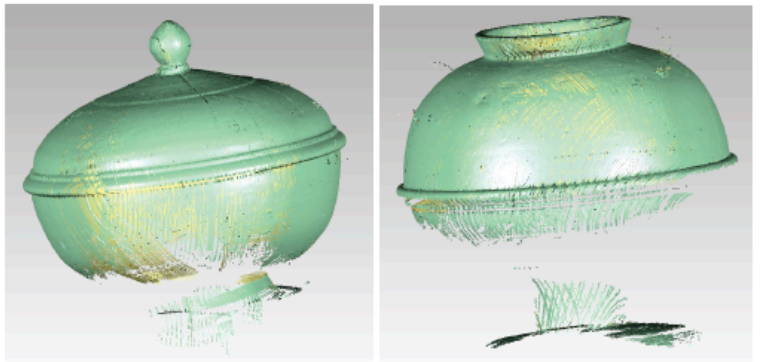


Fig. 3. On the left the top of an object is scanned. Right shows a scan from the bottom of the object. The angle of the incident light has been tightly controlled to reduce noise and unwanted reflections.



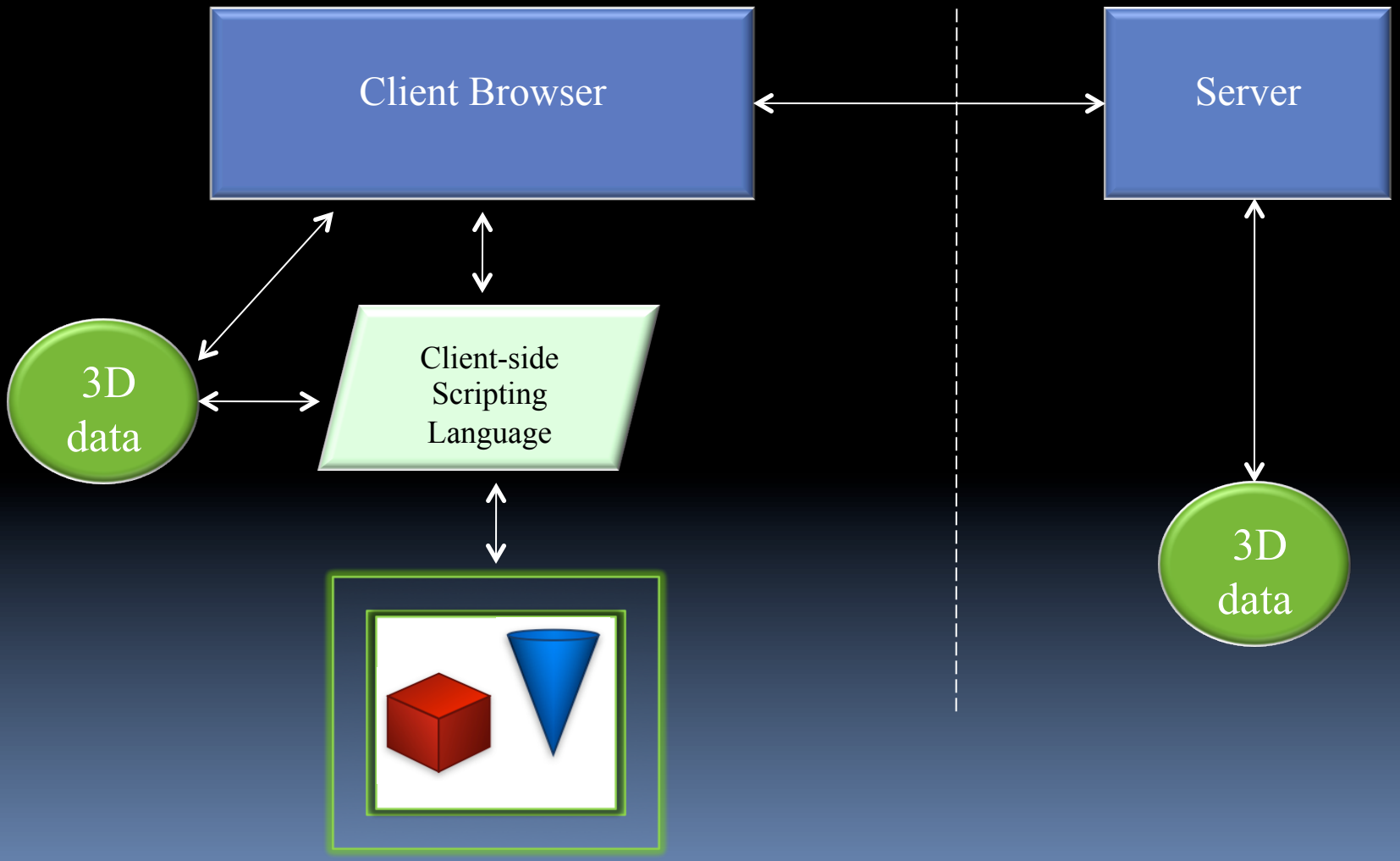
Fig. 4. Left, the two views of the same object do not naturally fit together after scanning. On the right, after cleaning the multiple views, 3D registration is performed aligning the two parts of the model together.



Fig. 5. After 3D registration the point clouds of the two scans are fused into a single object and transformed into a triangulated surface shown on the left blue model. On the right, texture mapping can then be applied to the triangulated surface.

RODRIGUES, Marcos, KORMANN, Mariza and DAVISON, Lucy (2011). "A case study of 3D technologies in higher education: scanning the Metalwork Collection of Museums Sheffield and its implications to teaching and learning". *In: 2011 IEEE International Conference on Information Technology Based Higher Education and Training (ITHET)*, 4—6 Aug 2011, pp 1—6.

Displaying 3D data on the Web



Workable Options (1)

WebGL

The future of the web is augmenting 2D content with the 3rd dimension
Khronos: a 3D web project seeking to create standards for 3D solutions development
The aim is for end users to take advantage of those solutions as part of the normal web experience
First set of standards were published in March 2011
The approach
- An OpenGL wrapper within JavaScript
- Browsers come pre-installed with all necessary plug-ins

JavaScript

- Client-side scripting language
- Developed to add dynamic content to web pages
- JavaScript statements are embedded into html code
- Compatible with all browsers
- The most popular scripting language on the Internet

OpenGL

- The industry standard for high performance graphics
- Comes pre-installed on all major operating systems (Windows, Mac, Linux, Unix)
- Runs on the client machine taking advantage of graphics hardware
- Developed in C/C++ so it requires some programming knowledge to be able to drive the OpenGL API
- Vast number of tutorials on the web

Workable Options (2)

Using Flash

- Flash player is free
- 98% of internet users have flash player installed
- It is platform independent
- ActionScript language (similar to JavaScript) to handle user interaction
- A mathematical 3D engine has been implemented
- NOT appropriate for very large files with many thousands of polygons

Museums Sheffield Web site

http://www.museums-sheffield.org.uk/collections/objects-in-3d/





Follow on: the Man of Steel











Carving a 2m tall Man of Steel from our 3D model





Skills Minister Matthew Hancock MP







Conclusions

- Aims and objectives of the project fully achieved (on time and within budget)
- Models are being made available on the web through WebGL and Flash
- Texture mapping is a difficult task and needs to be designed into the process
- Highly reflective surfaces may require single stripe laser scanner
- Other non-gloss surfaces can be scanned much faster using multiple stripes with automatic texture mapping