

A UNIQUE LEAD MEDAL OF FILARETE IN THE NUMISMATIC COLLECTION OF CIVICO MUSEO CORRER (VENICE, ITALY): COMPARISON OF MULTISENSOR LASER SCANNER SYSTEMS

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Abstract:

In the Gabinetto Numismatico of the Civico Museo Correr of Venice is preserved a lead “all’antica” medal with a portrait of Caesar. Attributed in the past to the “Medallist of the Roman Emperors”, recently it was attributed to Antonio Averlino, known as Filarete, the Renaissance Italian architect and sculptor, known above all for having made the bronze central doors of St. Peter’s Basilica in Rome. The medal is very important because it doesn’t exist other specimens. Recent showy alterations caused by the lead oxidation appeared in some parts of the two faces and the medal was inserted in a restoration project sponsored by the Fondazione dei Civici Musei Veneziani.

For this purpose, an integrated approach has been performed, using different laser scanner techniques, in order to produce a 3D high resolution model. Two different instruments were used to compare different resolution and accuracy, from an instrumental point of view, and to acquire more information about the showy alterations, from a DTM (Digital Terrain Model) point of view.

The instruments are contact/non-contact measurement systems; the first one is the Faro Cam2 laserScanarm (stripe laser and touch probe), and the second is OGP SmartScope Flash CNC302, a multisensory system equipped with a through-the-lens (TTL) laser and a micro touch probe.

Finally, a 3D model is presented in a standard format in order to be imported, measured and analyzed using different software environments.

1. THE MEDAL

In the Gabinetto Numismatico of the Civico Museo Correr of Venice is preserved a lead “all’antica” medal with a portrait of Julius Caesar.

Obv. IVLIVS CAESAR; bust r., laureate, wearing cuirass and *paludamentum*.

Rev. CAESAR; Caesar bareheaded, in armour, curved sword in r., l. holding reins, riding r. on horseback; on ground, a crested helmet and a shield; in field, below, S C.

Venice, Civico Museo Correr, inv. 3246

Lead, Ø mm 113

It is part of a group of medals with the profiles of the Roman Augusti Nero, Trajan and Hadrian, and of the Augusta Faustina the Elder. G.F. Hill formerly attributed these works to an anonymous master called the “Medallist of the Roman Emperors”, who, in his opinion, was active probably in the neighbourhood of Milan in the last quarter of the fifteenth century. More recently J. Spencer proposed to ascribe these pseudo-antique portraits to Antonio Averlino, better known as Filarete (c. 1400-1469). This artist was a Renaissance Italian architect and sculptor who was possibly trained in the workshop of Lorenzo Ghiberti. He was called in Rome by Pope Eugenius IV. There Filarete produced, between 1433 and 1445, the bronze central doors of Saint Peter’s Basilica. The reliefs of the doors include decorations with portraits of Roman emperors. Spencer found some epigraphic evidences and formal elements of design in the medallions of the doors, which are very close to those of the medals, and he

supported his new attribution on these similarities. The attribution is now commonly accepted, as we can see in the catalogue of the *Renaissance Medals* of the National Gallery of Art of Washington and in other publications.



Figure 1: portrait of Julius Caesar in the Filarete medal.

The medal in the Museo Correr is very important because it is the only specimen with these types. Probably it entered in the Venetian collection with the legacy of Teodoro Correr, the founder of the Museum in 1830. Recently, evident alterations, caused by the lead oxidation, have appeared in some parts of the two faces and the medal has been inserted in a restoration project sponsored by the Fondazione dei Civici Musei Veneziani.

2. INSTRUMENTS

Two different instruments were used to compare different resolution and accuracy, from an instrumental point of view, and to acquire more information about the altimetric alterations due to lead oxidation (in terms of DTM - Digital Terrain Model).

The instruments are a Faro Cam2 laserScanarm and an OGP SmartScope Flash CNC302.

The first one is a contact/non-contact measurement system, which is ideal for this type of inspection, point cloud-to-CAD comparison and 3D modeling. The precision is up to 0.0006" (0.016mm) and it is more consistent than conventional measurement methods like callipers or micrometers allowing the survey of the integral surface of the specimen. The accuracy is guaranteed also by temperature sensors, which reduces fluctuations in measurements and "measurement drift" by actively responding to changes in thermal variations. Also the overload sensors are useful for constant device monitoring for positions and stresses that could compromise the accuracy of measurements.

The second one is a multisensory system equipped with a through-the-lens (TTL) laser and a touch probe or micro-probe. The TTL system can focus its light very precisely, providing a small spot size and accurate surface focus, where laser and lens are coaxial, meaning measurements can be made throughout the system's entire XY travel range. Furthermore the auto calibrating AccuCentric® 12:1 zoom lens provides excellent optical performance over its entire range. The illumination is provided by SmartRing Light Illuminator, which consists of six concentric LED ring lights focused through a specially designed Fresnel lens. The inner rings illuminate the part from above, almost "square-on." The outer rings provide oblique lighting, ideal for chamfered edges and blended radii. The angle of incidence (45° to 75° from horizontal) of the illumination is controlled by selecting different rings.

3. STL DATA FORMAT

STL is a file format native to the stereolithography CAD software created by 3D Systems. This file format is supported by many other software packages because it is widely used for rapid prototyping, especially when a binary representation is used and it represents a very interoperable data format. Also ASCII representation can be used. STL files describe only the surface geometry of a 3D object without any representation of color, texture or model attributes. An STL file describes a raw unstructured triangulated surface by the unit normal and vertices (right-hand rule) of the triangles using a three-dimensional Cartesian coordinate system.

An ASCII STL file begins with the line “solid *name*” where *name* is an optional string. After it continues with any number of triangles, each represented in terms of facet and vertex, using the following data structure:

```
facet normal  $n_i$   $n_j$   $n_k$ 
  outer loop
    vertex  $v1_x$   $v1_y$   $v1_z$ 
    vertex  $v2_x$   $v2_y$   $v2_z$ 
    vertex  $v3_x$   $v3_y$   $v3_z$ 
  endloop
endfacet
```

The last line is “endsolid *name*”. This is a typical structure where all facets are simple triangles, but more complex possibilities are permitted: for example, facets with more than one ‘loop’ or loops with more than three vertices.

The binary STL file has an header, which should never begin with 'solid' because that will lead most software to assume that this is an ASCII STL file. Following the header is an integer indicating the number of triangular facets in the file and after data describing each triangle in turn. The file simply ends after the last triangle, like in this example:

```
UINT8[80]    – Header
UINT32       – Number of triangles

foreach triangle
  REAL32[3]   – Normal vector
  REAL32[3]   – Vertex 1
  REAL32[3]   – Vertex 2
  REAL32[3]   – Vertex 3
  UINT16      – Attribute byte count
end
```

Many software environments are able to process STL data; a short list includes MeshLab for visualizing, processing and converting 3D meshes to or from STL, SolidView for STL viewing, MiniMagics for STL files inspection and compression, ADMesh for processing triangulated solid meshes, Free STL Viewer for viewing 3D STL files, netfabb Studio Basic for STL file repair, STL2DWG converter for conversion from STL to AutoCAD. In addition, all the CAD3D software are able to import/export STL models.

4. FARO ACQUISITION AND MESHLAB

The first test was performed using the Faro Cam2 laserScanarm and using, only, the laser stripe, in order to avoid any type of “destructive” contact on the lead oxidation surfaces, before the restoration phase.

The many single acquisitions were cleaned by outlier and spurious data and were merged in a single high resolution model; the conversion to STL data format was made inside the acquisition software and the final model was available in the MeshLab environment (Figure 2). The model has the surrounding box in order to perform some metrics.

The command structure is: Render → Show Box Corner + Show Quoted Box

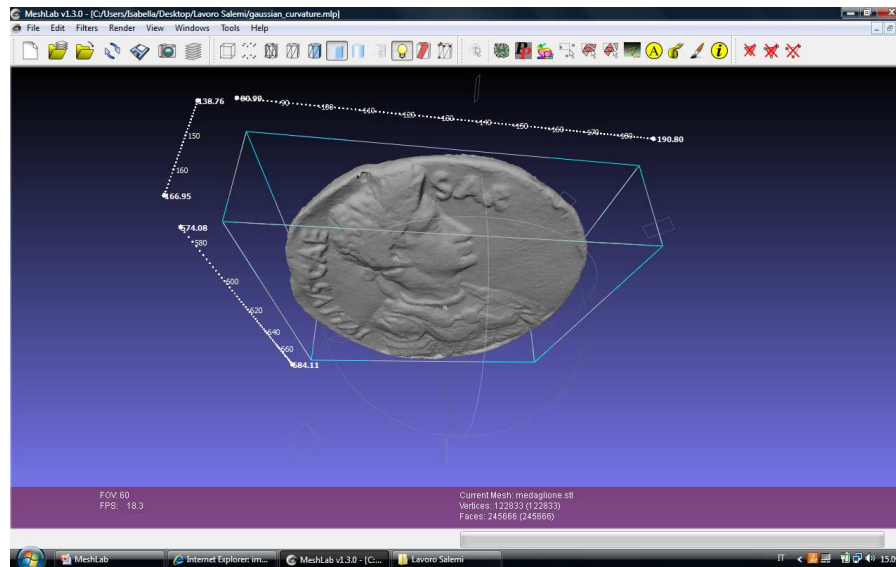


Figure 2: the STL model in the MeshLab window with the metric box

Using some lighting algorithms, more impressive images can be obtained to perform more accurate optical investigations before the restoration. In this example (Figure 3) the model is managed through radiance scaling parameters on the gaussian curvature plot to enhance edges

The command structure is: Render → Shaders → Radiance scaling.

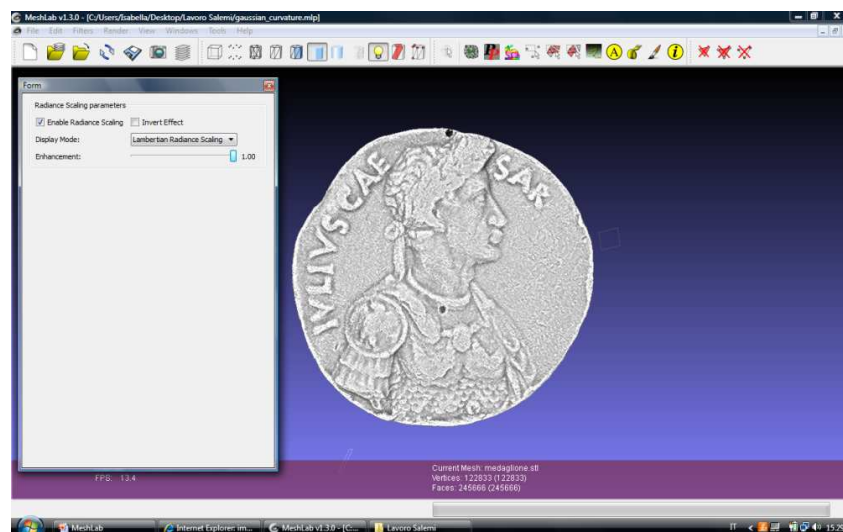


Figure 3: Gaussian curvature plot

5. CURVATURE ANALYSIS

Different curvature analysis can be performed in the same software, using the Filters menu (Figure 4). Using this approach, different false colors maps are obtained where the Mean, the Gaussian or the RMS curvature are plotted. This could be very useful for analysing the alteration patterns, switching from mean surface to edges and enhancing some local micro structures.

The command structure is: Filters → Color Creation and Processing → Discrete Curvatures

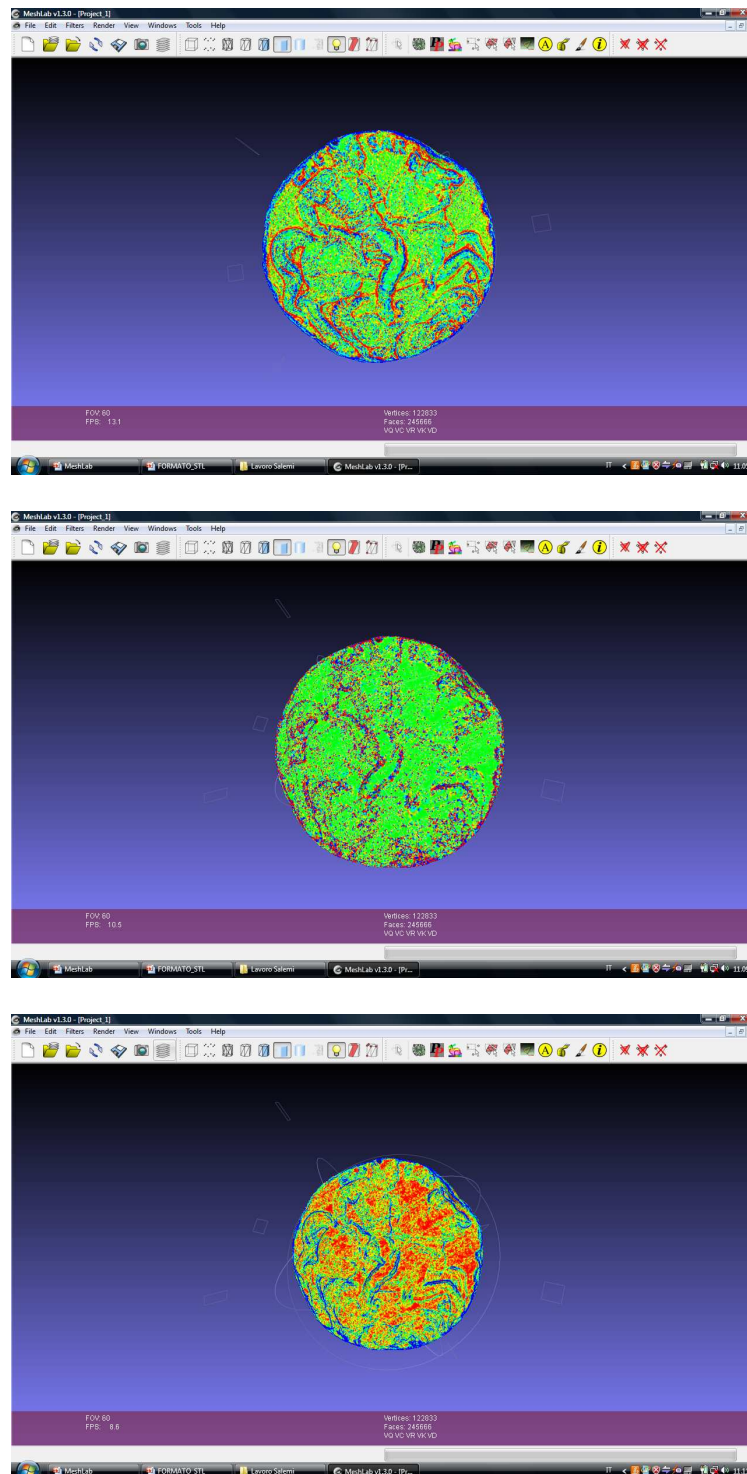


Figure 4: Discrete curvatures analysis; from the top: Mean, Gaussian, RMS

6. OGP ACQUISITION AND MULTIREOLUTION MOSAIC

The OGP SmartScope Flash CNC302 was used to perform a very high resolution acquisition, at a micrometric scale, and to test the possibility to mosaicking different acquisitions in the same frame. In this case, the approach could be very useful to compare different resolutions instruments on the same model and to investigate some areas in a more accurate way.

So, a small area, acquired by the OGP, was inserted in the previous scan, by the Faro; the lacunas, at micron scale, can be filled automatically using standard procedures like “filling holes” in Rapidform environment (Figure 5).

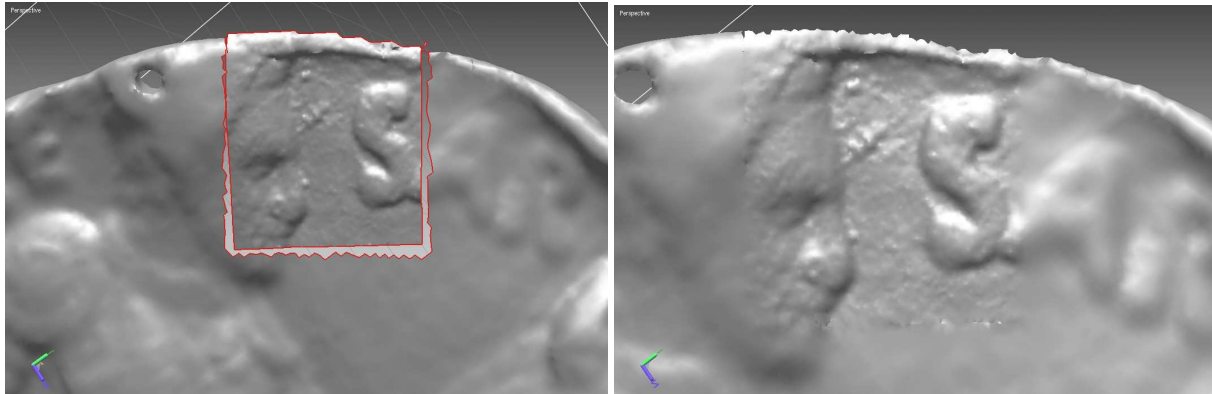


Figure 5: Mosaicking two scans at different resolution in the same model

The above depicted curvature analysis can be executed now on two different data set obtaining the resulting map, where the small area is analysed like the large area but using a very dense acquisition (Figure 6).

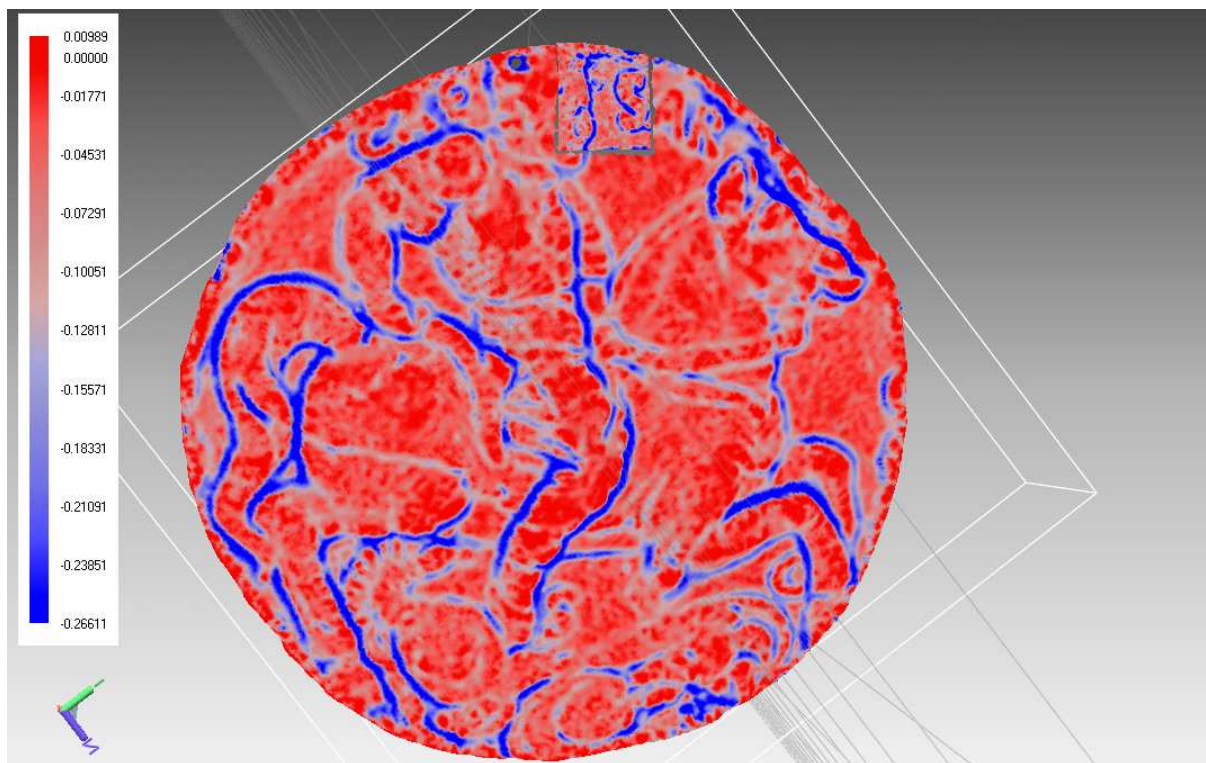


Figure 6: RMS curvature analysis: complete model with two different resolution

7. CONCLUSIONS

A lead medal with a portrait of Ceasar and attributed to Antonio Averlino, known as Filarete, was acquired using two different laser scanner systems, as depicted in the previous paragraphs. First of all, a very high resolution model of the medal was obtained; the model is suitable for optical and metric analysis using standard data format, like STL, and free software like the known MeshLab. This approach permits to a large class of user “to see” the medal without any type of physical contacts, in order to preserve it, and to perform measurements on the model, i.e. on the virtual medal. Different representations were tested and are presented to enhance local features, like letters, symbols or single descriptive elements. To monitoring the state of the medal different kind of measures can be performed, ranging from linear to areal, like on damaged edges or on areas with oxidations patinas. Furthermore, the complete multiresolution model is presented (Figure 7).



Figure 7: multiresolution model of the Filarete medal

8. REFERENCES

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