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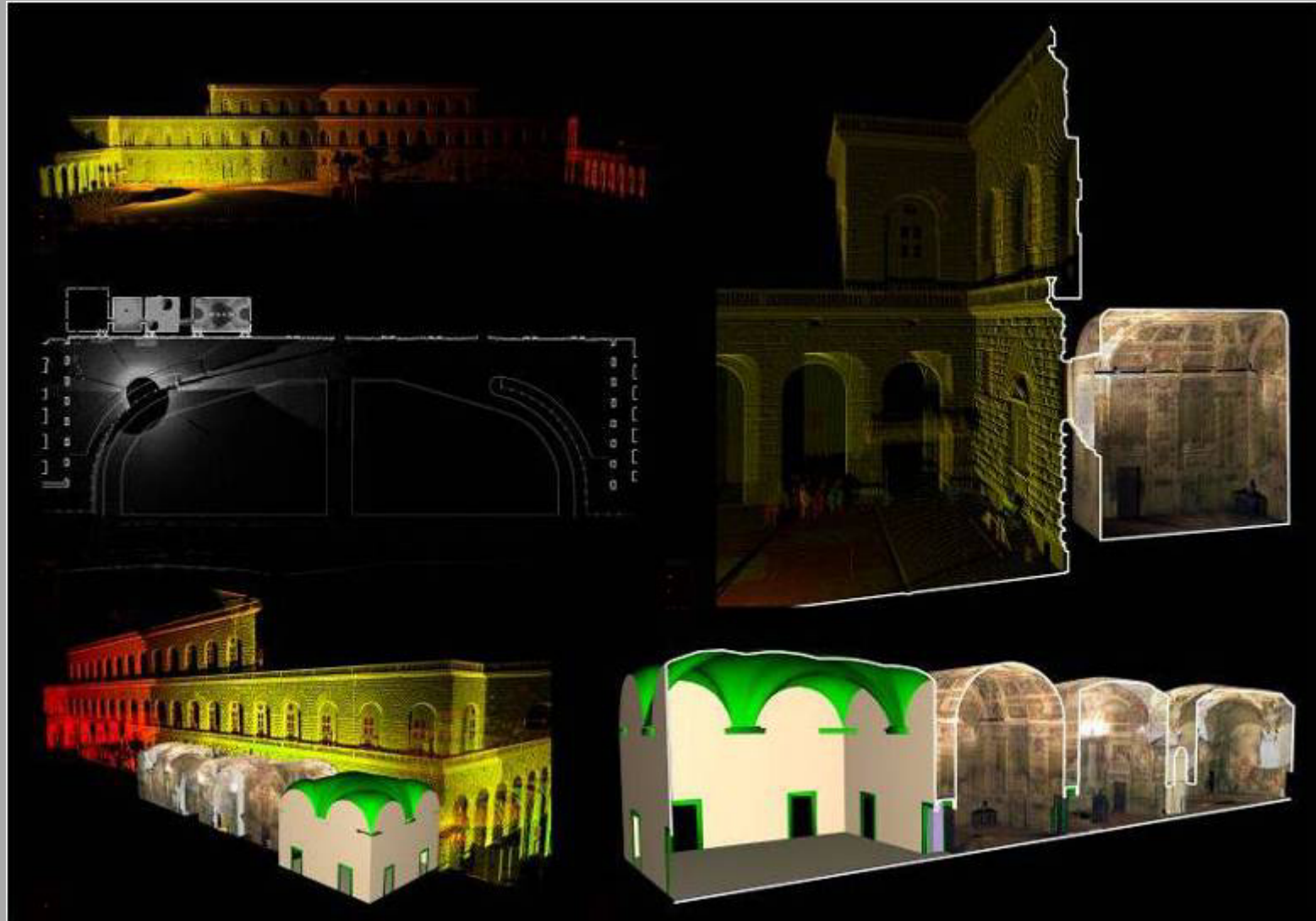
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Survey carried out in 2005



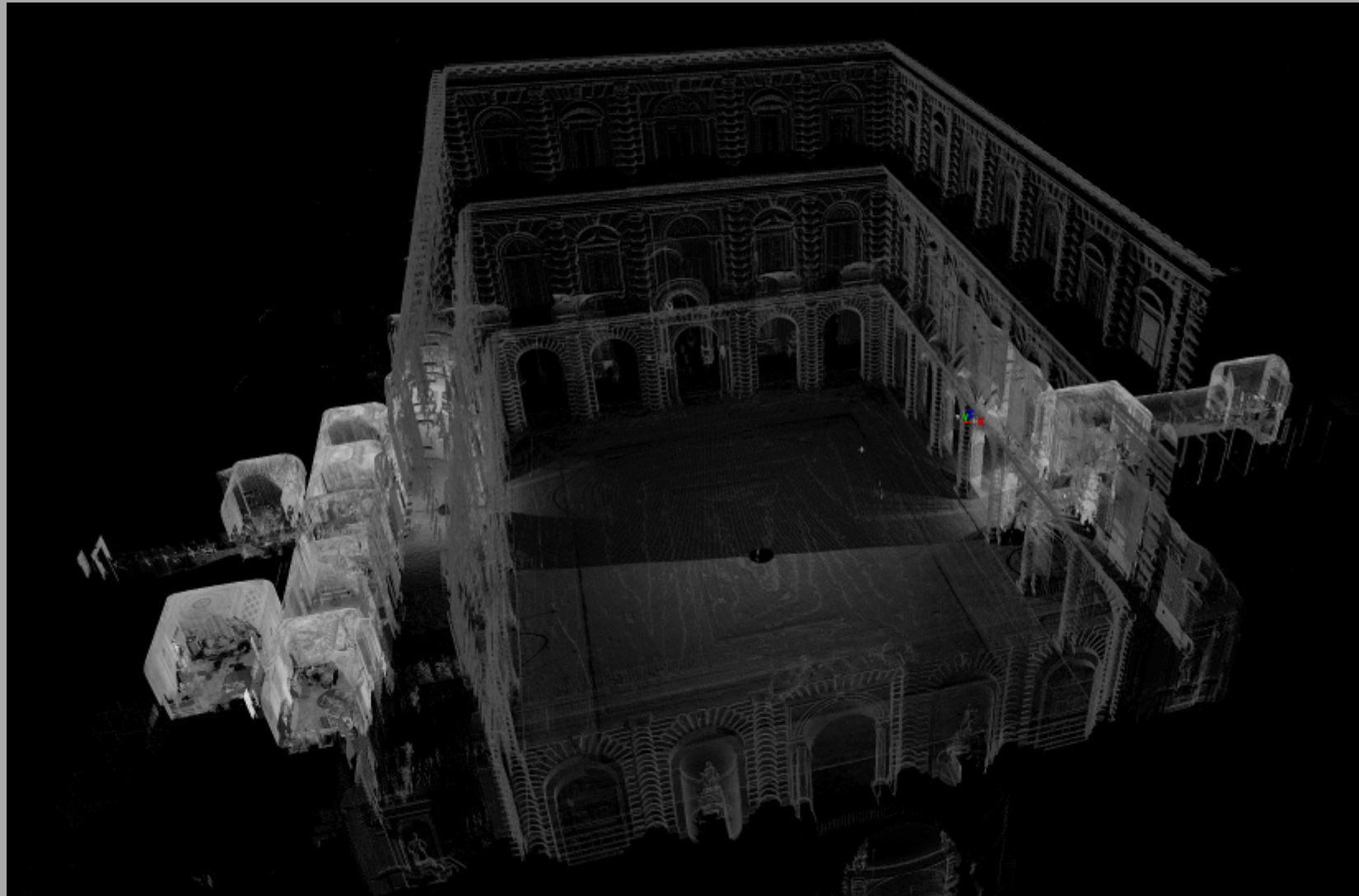
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Survey carried out in 2007



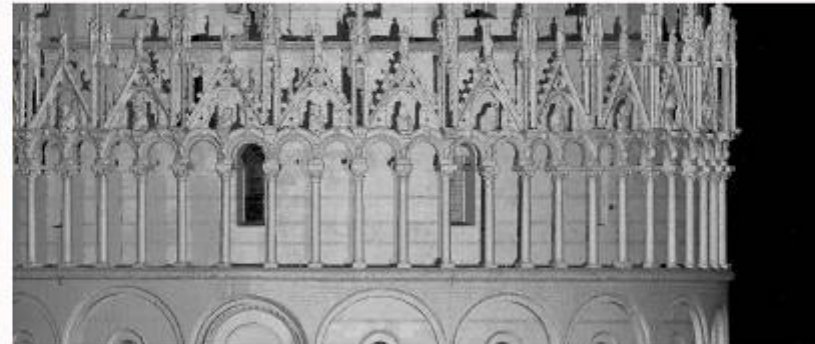
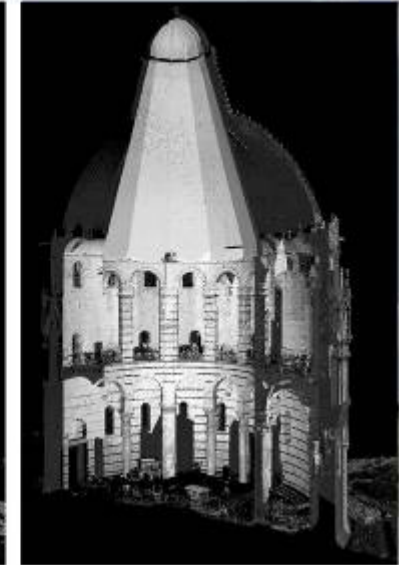
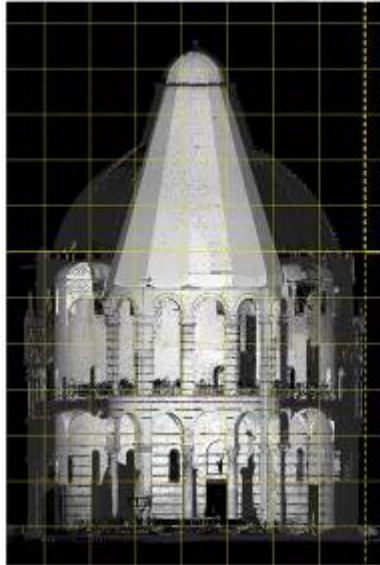
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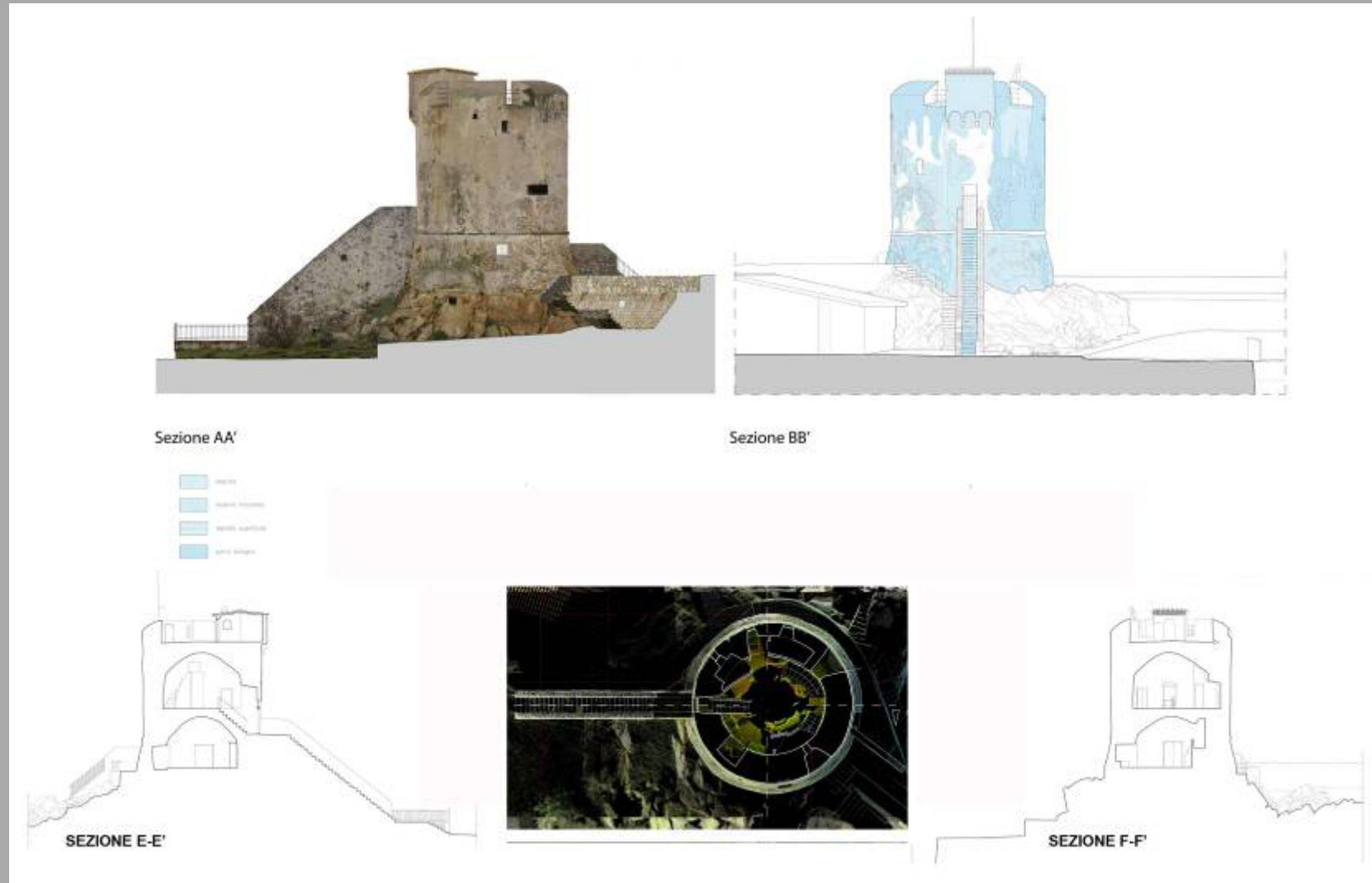
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Survey of the Baptistery, part of the Piazza dei Miracoli complex in Pisa in 2002



Examples of themed maps of the Pieve a Socana (AR) – From left to right and from top to bottom: orthophoto, identification of the material, CAD drawing, analysis of decay



The survey of Torre Medicea, with a circular layout , of Marciana Mariana



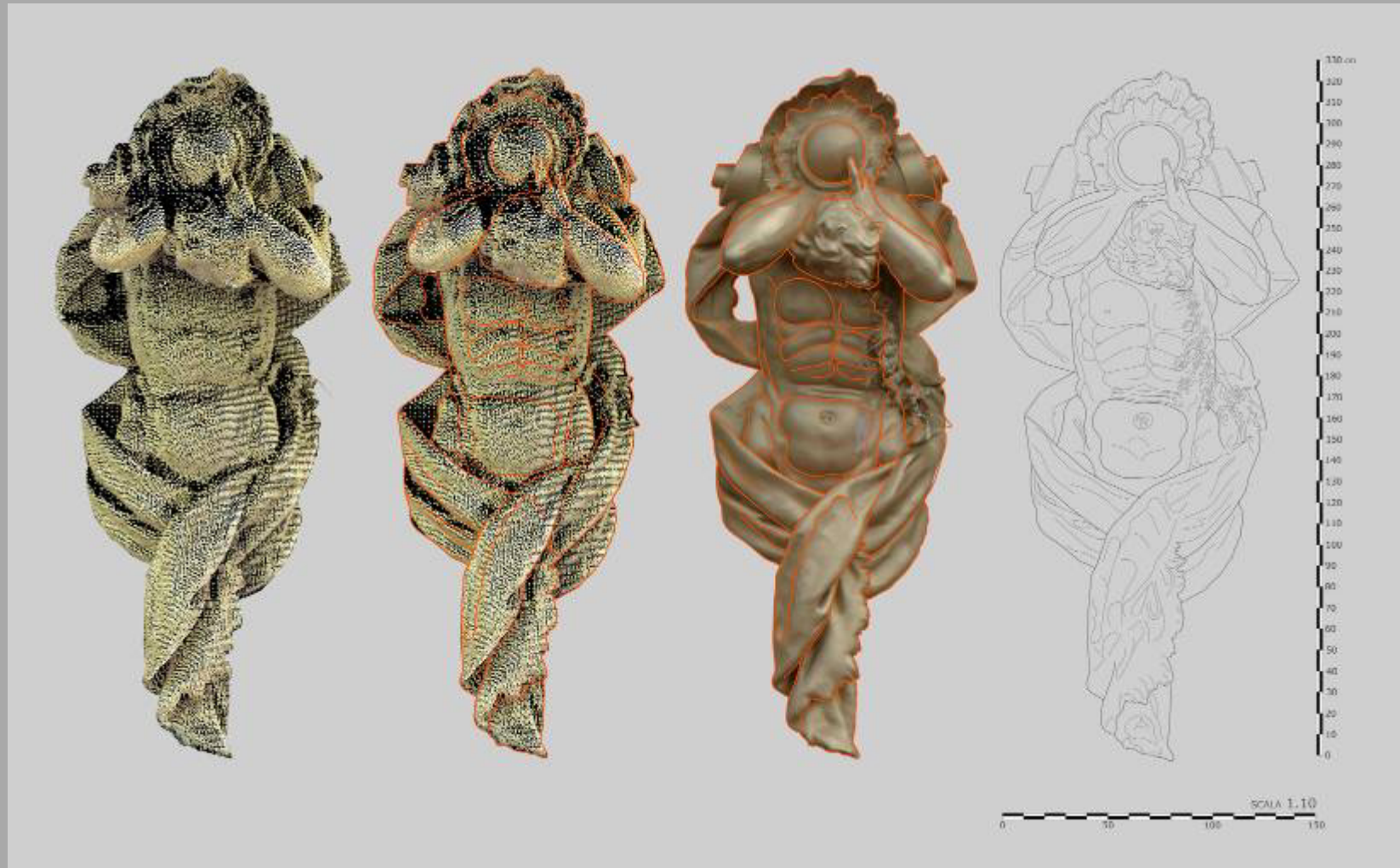
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The atlases of the Eikaterina palace in Pushkin, Saint Petersburg



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The photographic survey of the rooms decorated with quadratures presented various technical difficulties in that the images perceived changed greatly depending on the position of filming.



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Varying the position of filming not only changed the morphological perception but sometimes even the colour perceived.



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- Pitti Palace was originally the town residence of Luca Pitti.
- The palace was bought by the Medici family in 1549.
- It was donated to the Italian people by King Victor Emmanuel III in 1919, and its doors were opened to the public as one of Florence's largest art galleries.



Software instruments used



Survey campaign 2005

Leica HDS 3000 time of flight laser scanner

Survey campaign 2007

Leica HDS 6000 phase based laser scanner

Total station

Leica TPS 705

The software used to manage the point clouds was Cyclone

The following software was used to unroll the curved surfaces :

- Adobe Photoshop (orthophotos)
- AutoCAD (drawings)
- Rhinoceros (modelling and unrolling)





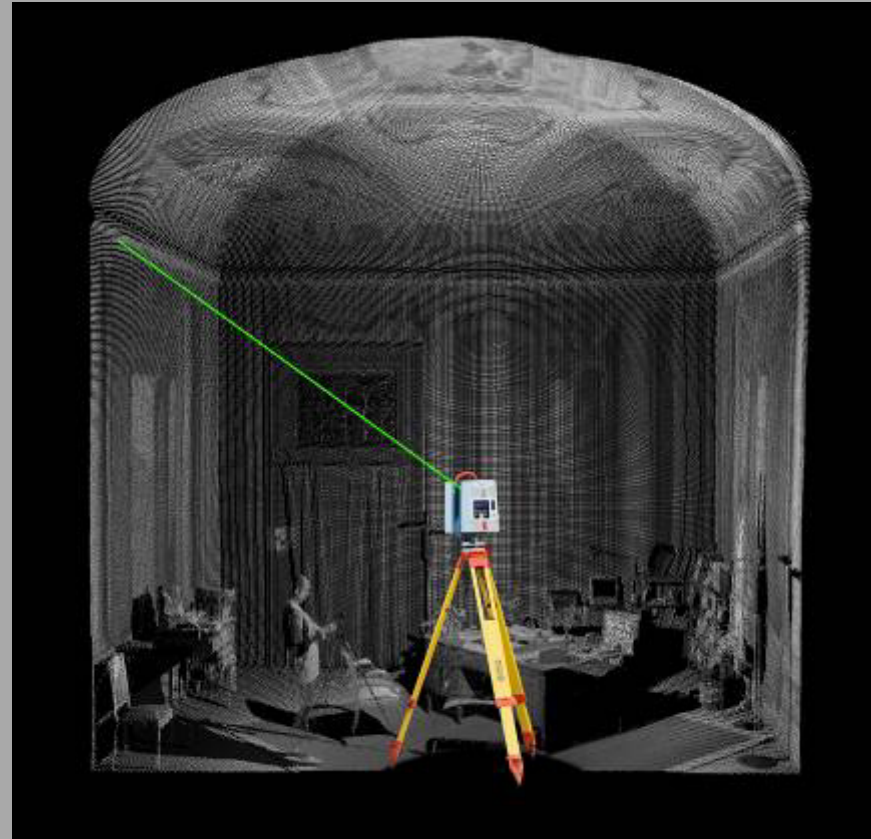
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laser scanner instruments perform accurate high density 3D measurements which provide a “reflectance” value as well as the co-ordinates of the point, thereby making it possible to establish the differences in colour between the measured points.



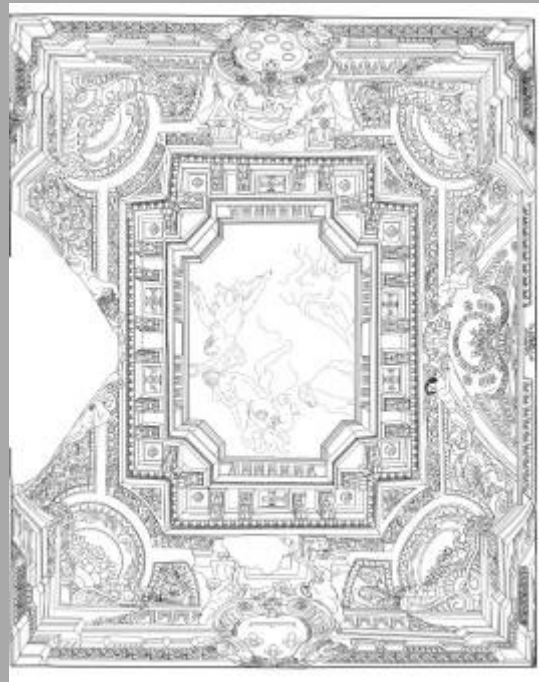
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Snapshot from the point cloud



CAD drawing

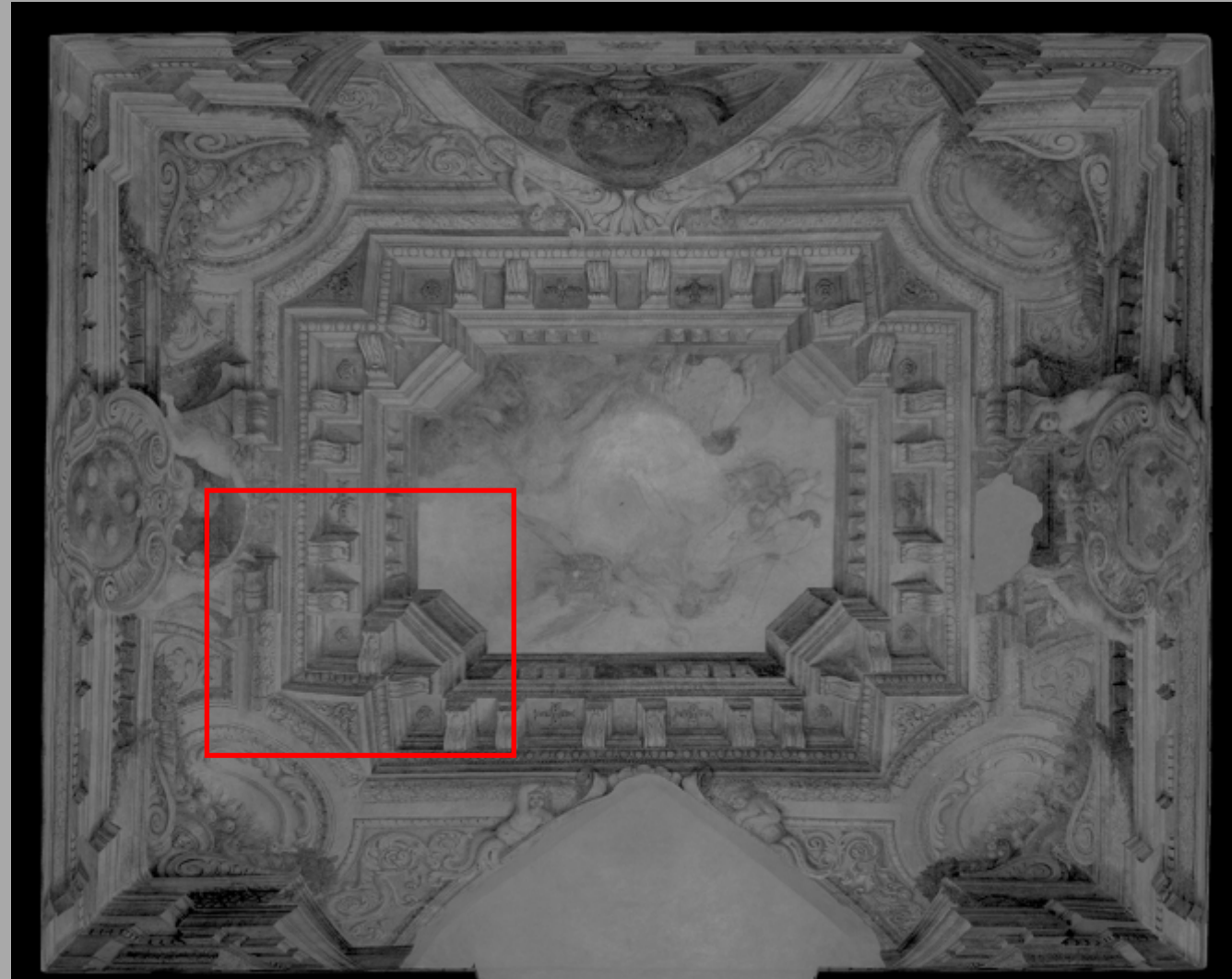


orthophoto



The snapshots of the vaults need to have a very high resolution .

which may vary depending on the scale of representation from 3 to 6 pixels per cm for reconstructions in scale 1:20 or 1:10





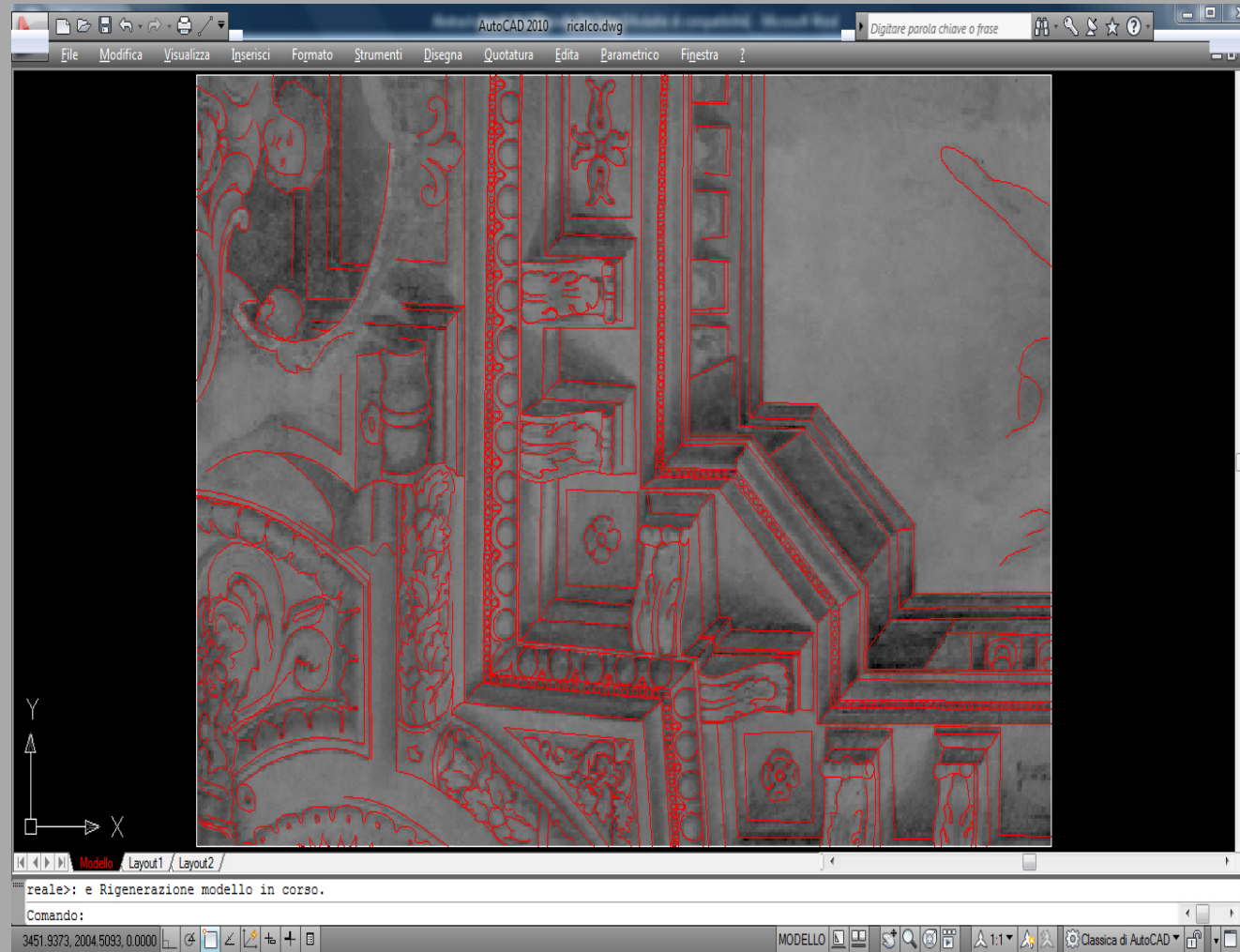
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With the high-resolution snapshot a CAD drawing of the painting can be produced.



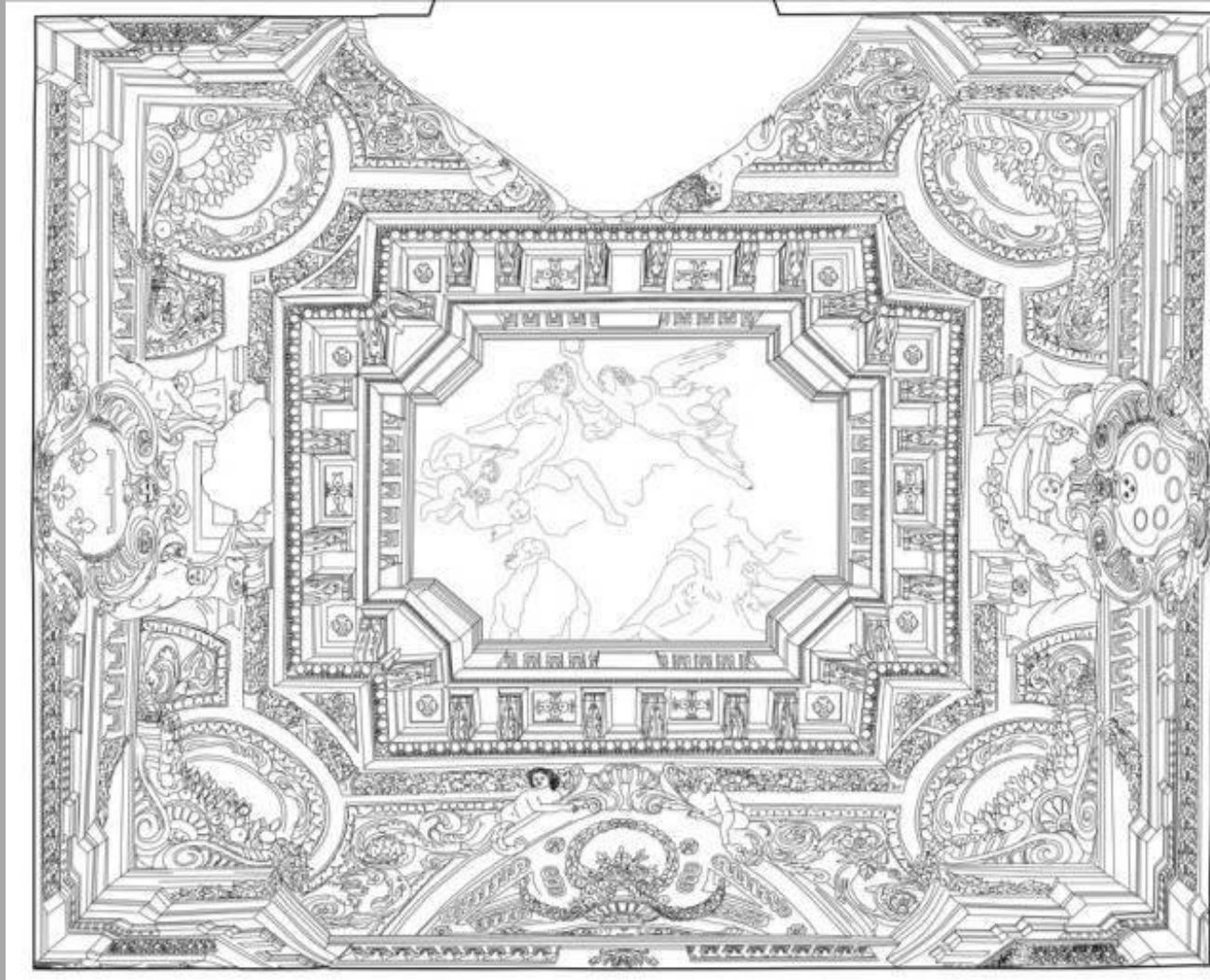
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So, thanks to the snapshot we can complete the drawing of the vault, which we see here in a life size projection of the horizontal section.



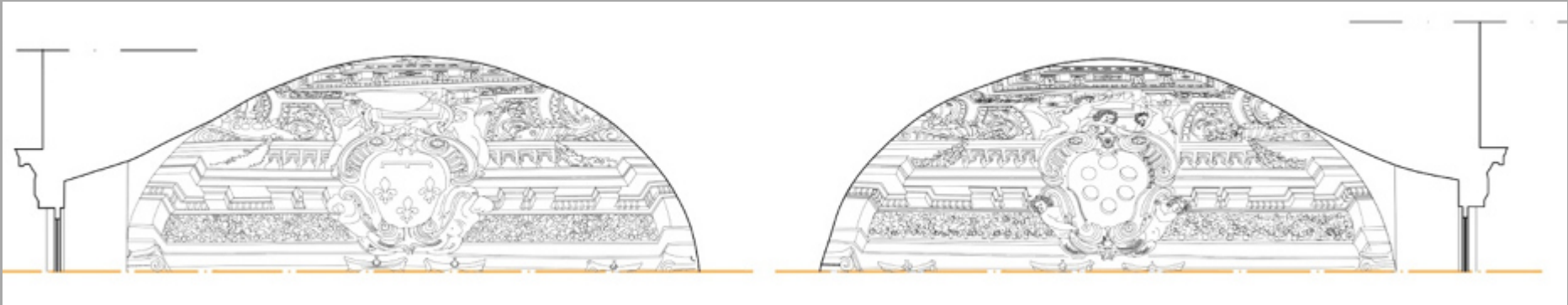
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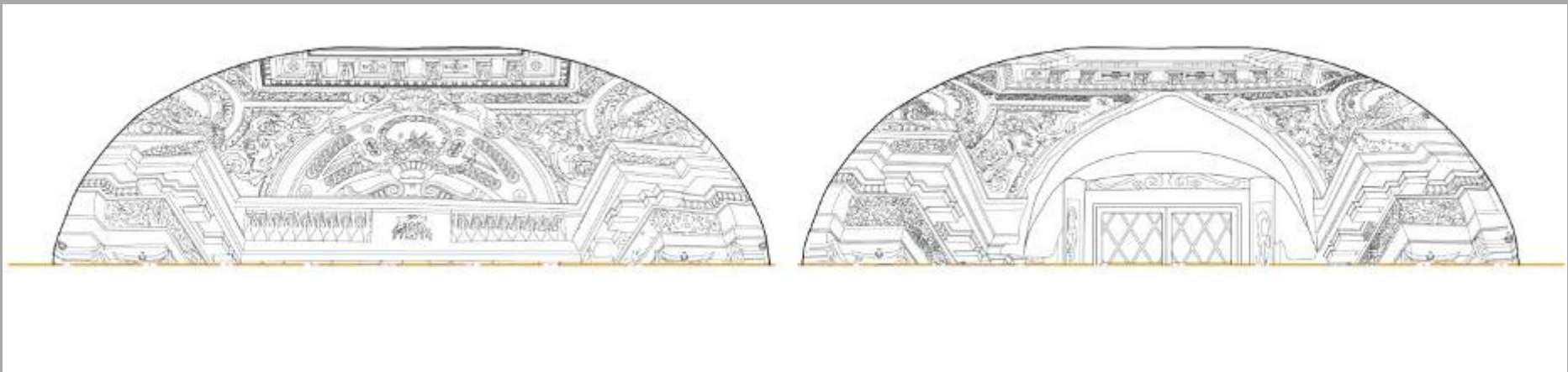
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This is the projection of the vertical sections





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Orthophoto of the life size orthogonal projection of the vault, achieved by calibrating the photographic images, here in the horizontal projection.



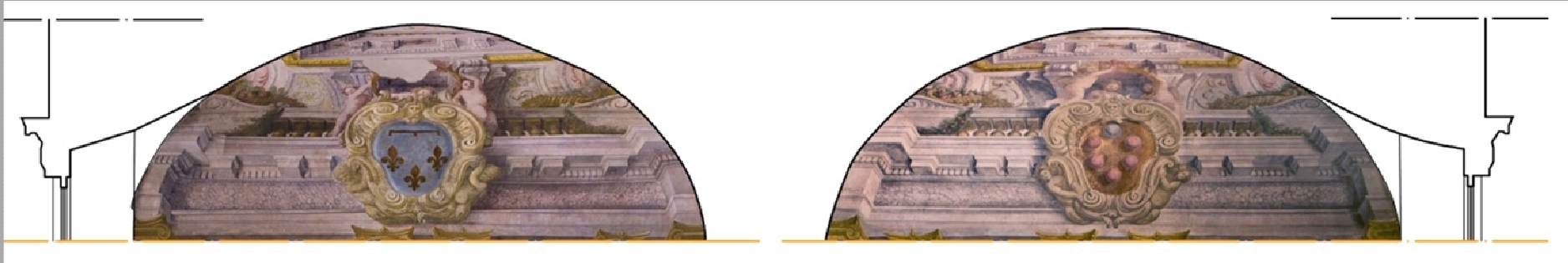
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Here in the vertical projections





Purposes of virtually unrolling curved surfaces

The virtual unrolling of curved surfaces makes it possible to produce a graphic representation of the frescoes in life size from the CAD drawings of orthogonal projections.

Life size pictures, produced without using invasive methods, are often needed for restoration operations and in particular make it possible to create extremely accurate maps of the paintings.

Drawings for measuring and monitoring cracks and studying structural deformation, but also for studying the perspective techniques used to create painted architectural elements.





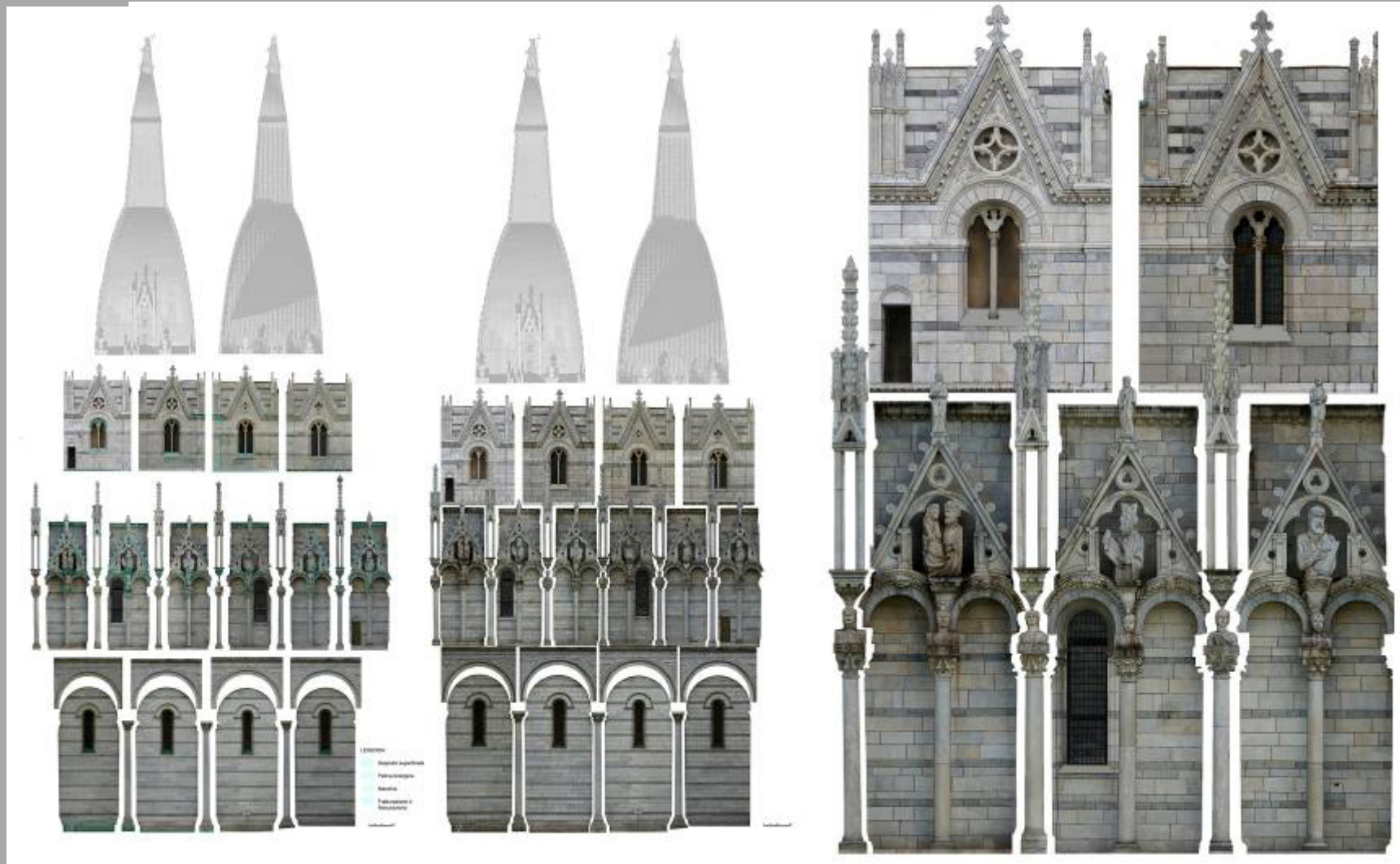
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Reconstruction of Pisa Baptistery (circular layout)

Detail of the facade



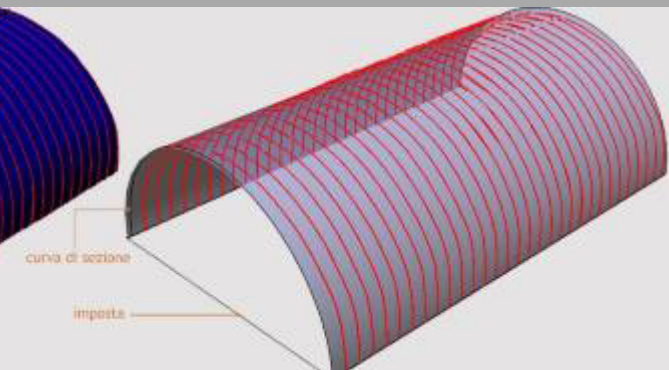
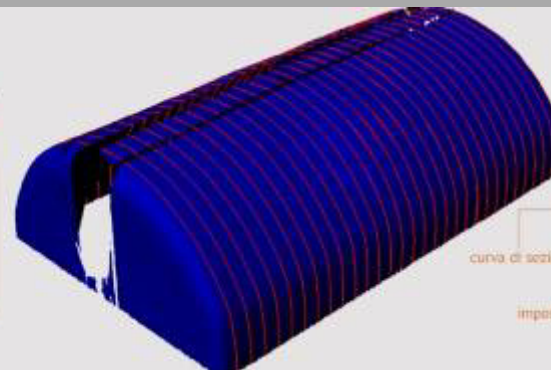
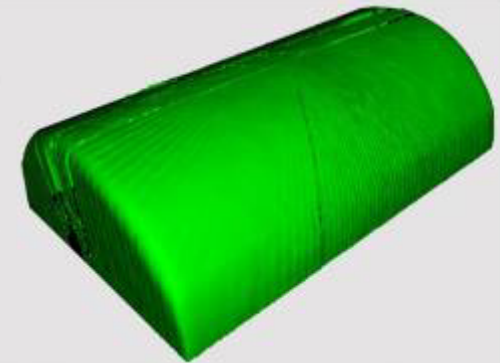
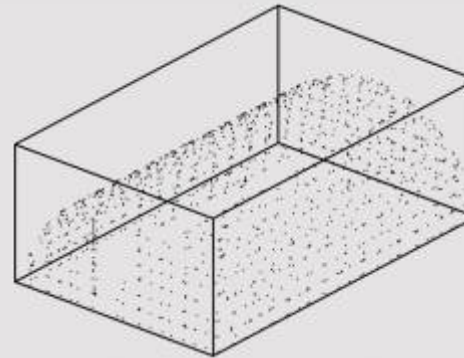
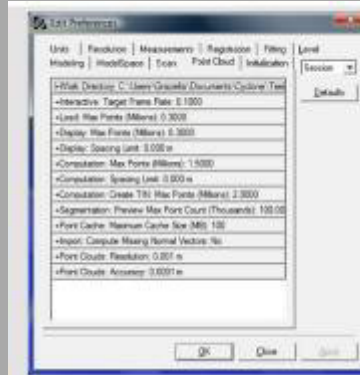
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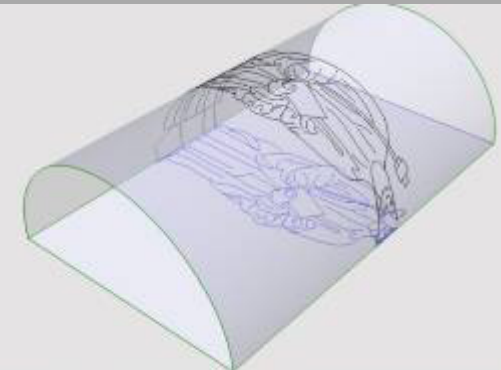
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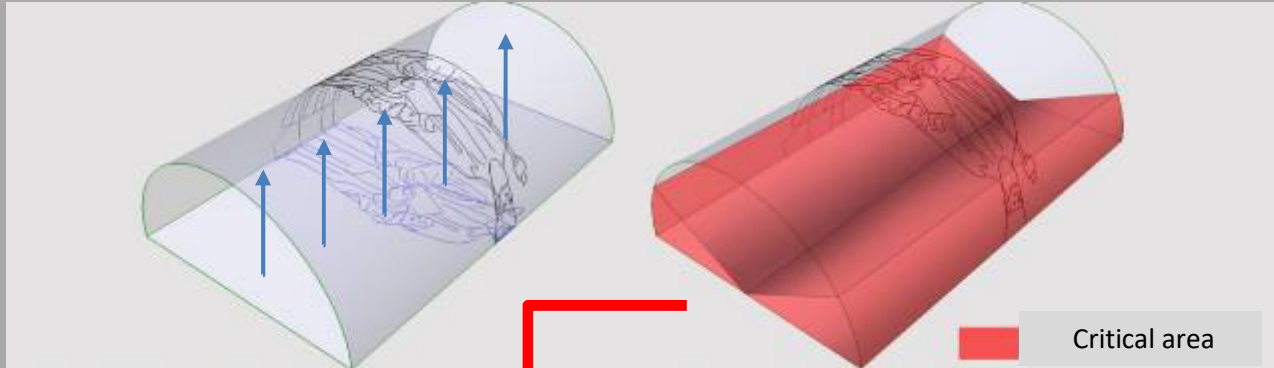
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To unroll the painting a model of the vault needs to be made using the point cloud and breaking down the original data so as not to make it too heavy.



The model is then imported into Rhinoceros® and the design of the vault is projected onto it.



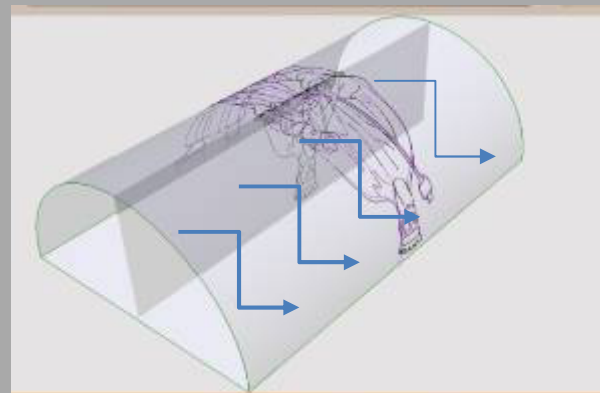


The projection onto a curved surface produces a critical area in the 0 to 30 degree segment



This is caused as a result of the choice of projection plane used to visualise the foreshortened view.

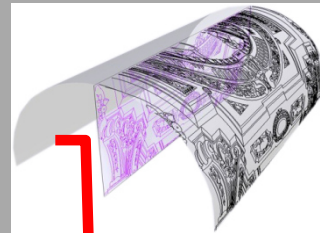
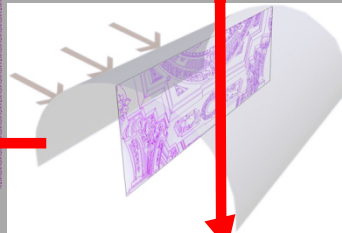
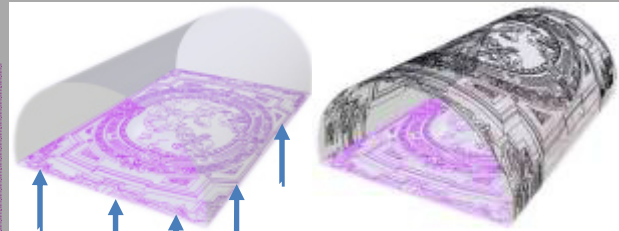
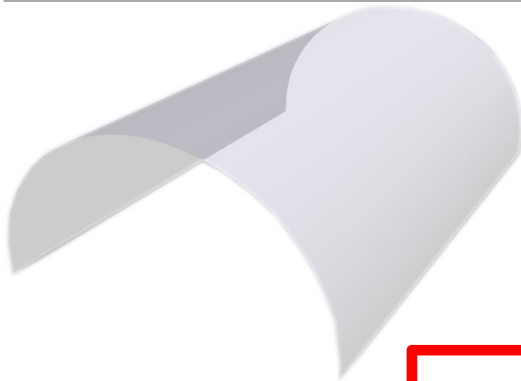
The critical area can even be seen in the photo.



A projection from the vertical plane must also be made to complete the missing part of the data and then proceed with the virtual "unrolling".



Barrel vault



STEP 1

Projection from the horizontal plane

STEP 2

Integration of missing parts with projections from the vertical planes

The unrolling operation is enabled using a Rhinoceros function.

"Smash" transforms the curved surfaces into a plane surface: the partial projections described in "step 1" and "step 2" are unrolled one by one and then....

LE QUADRATURE DELLE STANZE DI VITTORIA DELLA ROVERE E DELL'APPARTAMENTO DEI SERENISSIMI SPOSI A PALAZZO PITTÌ: I NUOVI ORIZZONTI DEL RILIEVO DELLE SUPERFICI DIPINTE.

UNIVERSITÀ DEGLI STUDI DI FIRENZE
 Facoltà di Architettura G4/5 - A.A. 2008-2009
 Laureanda: Graziella Del Duca
 Relatore: Prof. Stefano Bertocci
 Correlatori: Prof. Fauzia Farnetti, Dott. Giovanni Pancani, Arch. Alessandra Marino

STANZA A3: VOLTA A BOTTE

CARATTERISTICHE DELLA SUPERFICIE:
 -VOLTA A BOTTE
 -ASSE UNICO
 -IMPOSTA NON SIMMETRICA
 -SUPERFICIE SEMPLICE: UNA VOLTA DISPIEGATA RISULTA ESSERE UNA FIGURA PIANA QUADRANGOLARE

SNAPSHOT DELLA VOLTA DALLA NIVOLA DI PUNTI

COME SI PUÒ NOTARE DALLE SNAPSHOT OTTENUTE DALLA NIVOLA DI PUNTI, SIA NELLA VISTA DALL'ALTO CHE IN QUELLA LATERALE, I DECORI SULLE FACCE - PIÙ IN SICURO DELLA SUPERFICIE DIVENTANO QUASI COMPLETAMENTE IMPERCEPIBILI ALL'OCCHIO.

Per ottenere il Cartone è indispensabile avere dati ben leggibili e completi, per cui, quando si realizza la proiezione del wireframe sulla superficie è indispensabile compensare queste fasce critiche con ulteriori proiezioni dai piani verticali, dove i particolari sono più visibili.

Successivamente si può procedere con lo sviluppo e la realizzazione del cartone

DIMOSTRAZIONE DEL PROCEDIMENTO

Proiezione del rilievo sul piano orizzontale
 Proiezione del rilievo sul piano verticale
 Sviluppo della superficie

SVILUPPO DELLE SUPERFICI E DELLE CURVE PROIETTATE DAI PIANI VERTICALI E DA QUELLO ORIZZONTALE

Scala 1:20

VERA GRANDEZZA

Scala 1:20

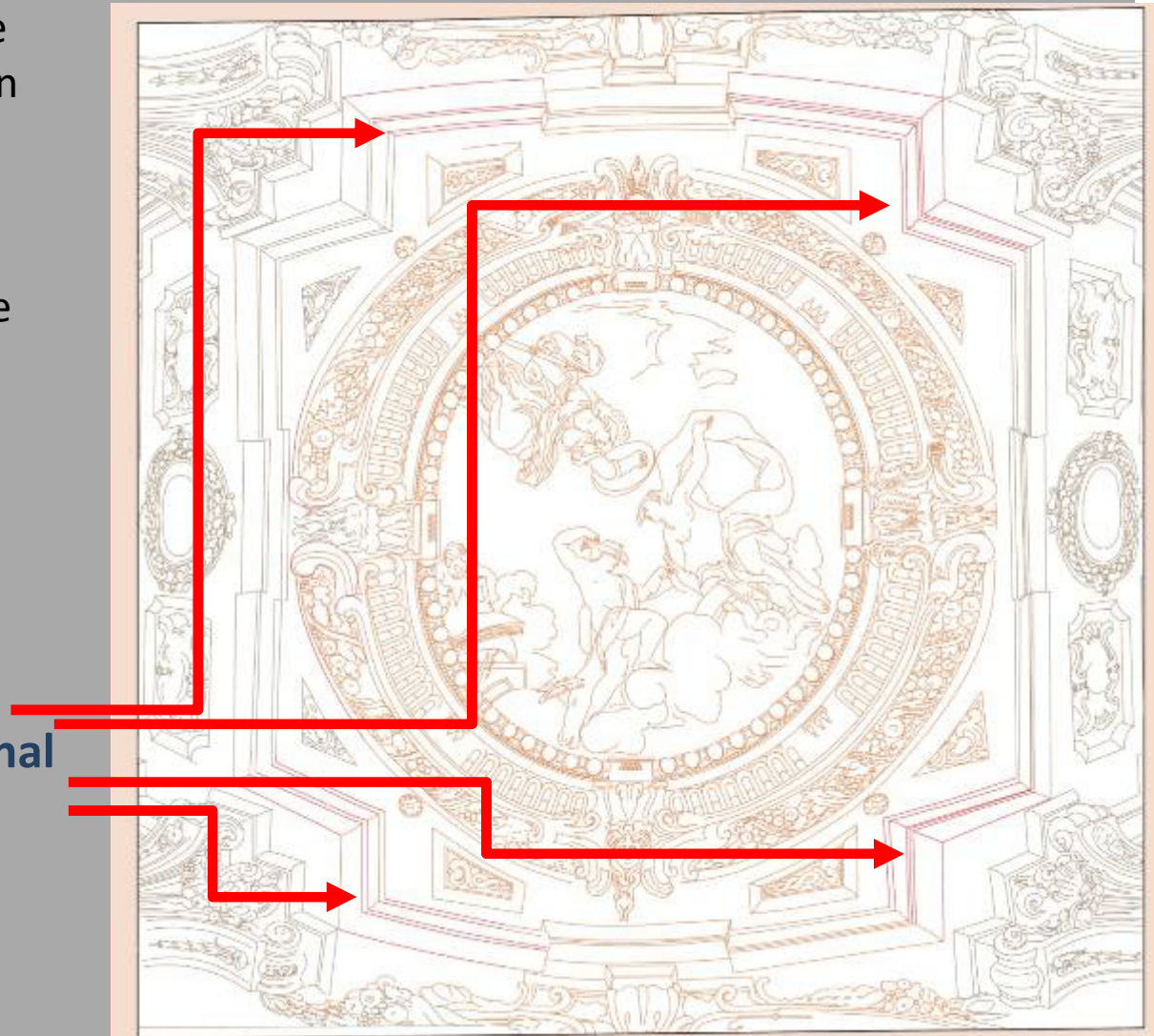
A sinistra è riportato il risultato ottenuto dagli accorgimenti e dai procedimenti spiegati sopra. Attraverso il programma Rhinoceros, e usando il comando smash, è stato possibile sviluppare le superfici e le curve appartenenti ad esse su un piano. La fase successiva ha previsto l'unione degli sviluppi parziali ossia quelli ottenuti dalle diverse proiezioni dal piano orizzontale e verticale. La sovrapposizione degli elaborati ha richiesto la realizzazione di alcune curve di compensazione (segnate in rosso nel cartone finale) per raccordare perfettamente le porzioni. A destra si può osservare il cartone dell'affresco nella sua interezza. Si notano alcuni accorgimenti dettati dall'ottica.



...the three plane drawings are laid together taking care to join them accurately.
If necessary an interpolation between the lines that are not perfectly superimposed may be created.

The result is a two-dimensional reconstruction of the quadratura surveyed representing the frescoes on the vaults in life size!

Lines drawn by interpolation





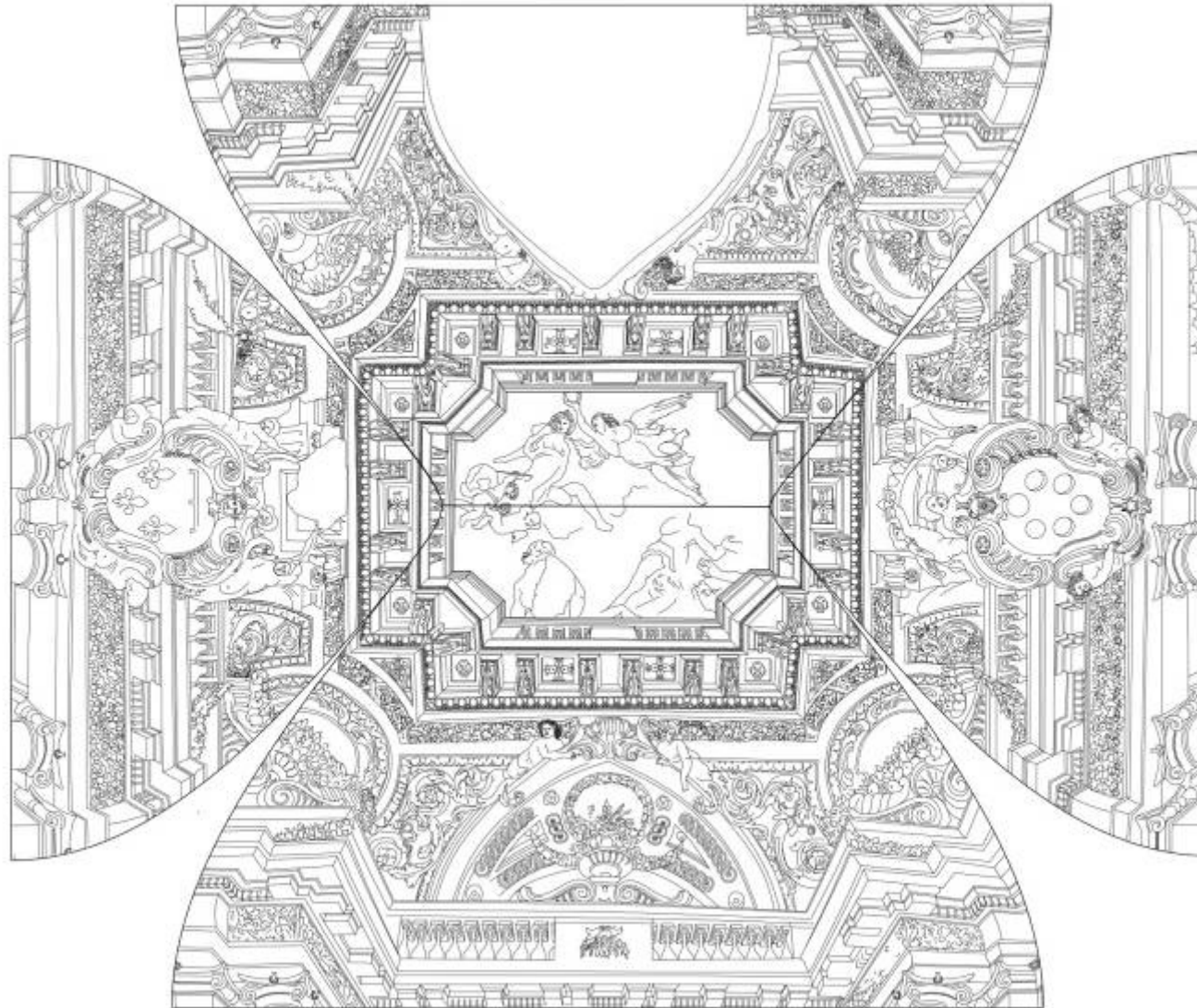
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Complete picture of the CAD drawing of the open cloister vault (unrolled)



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After making the CAD drawing a high definition orthophoto of the vault can be made and calibrated onto the CAD drawing



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The orthophoto only, made of high resolution images



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For an extremely reliable orthophoto the calibration must be painstakingly accurate as can be seen from this detail.



This highly defined detail makes us appreciate the definition of the orthophoto as far
20/09/11 as recognising the construction features of the fresco



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After the vault has been virtually unrolled a life size orthophoto can be calibrated over it so as to appreciate the finer details. The example shows the vault of Vittoria Della Rovere's chamber.





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Detail of the orthophoto with CAD drawing and photographic image only.



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This highly defined detail makes us appreciate the definition of the orthophoto as far as recognising the construction features of the fresco and the signs of decay

Giovanni Pancani - Graziella Del Duca

Thank you

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