UNIVERSITÀ DELLA CALABRIA
IX CONGRESSO NAZIONALE AIAR
9-11 MARZO 2016
ARCAVACATA DI RENDE
UN PONTE TRA ARTE E SCIENZA:
PASSATO, PRESENTE E PROSPETTIVE FUTURE

Structural diagnostic modelling of Vanvitelli's "Ponti della Valle" Aqueduct.

M. Elaiopoulos, A. Smigiel, Marco Fabrizi, G. Zecca, A. S. Pochettino, M. Gentili, R. Scibetta, L. Ancona

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Reggia di Caserta

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WHC. 13/01
July 2013

Operational Guidelines for the Implementation of the World Heritage Convention

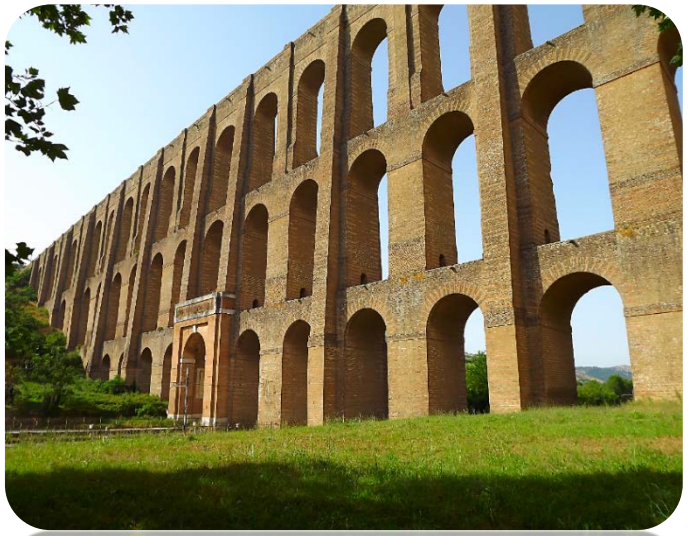
UNITED NATIONS EDUCATIONAL, SCIENTIFIC AND CULTURAL ORGANISATION

INTERGOVERNMENTAL COMMITTEE FOR THE PROTECTION OF THE WORLD CULTURAL AND NATURAL HERITAGE

WORLD HERITAGE CENTRE

Outstanding Universal Value

49. Outstanding Universal Value means cultural and/or natural significance which is so exceptional as to transcend national boundaries and to be of common importance for present and future generations of all humanity. As such, the permanent protection of this heritage is of the highest importance to the international community as a whole. The Committee defines the criteria for the inscription of properties on the World Heritage List.



TEMOTEC

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- RIL • Percorso di conoscenza
- ALS • Analisi strutturale
- DEC • Scelta progettuale

For this case study some serious constraints connected with the accessibility of the site and impossibility to install invasive surveying pillars did not permit the use of traditional surveying routines like total stations. Laser scanning was rejected during the evaluation of the various techniques mainly because in short distances there was a very steep, almost vertical visually while good visual was too far for laser scanning and among too many obstacles. Terrestrial photogrammetry in this context has been considered the best approach, absolutely noninvasive for the structure, secure as did not consider interaction between the structure and any operator, accurate enough as only qualitative considerations were needed and fast enough to respond the monument's management needs.

Individuazione	Elaborazione	Analisi e rappresentazione
caratteristiche metriche	• forma e dimesioni della struttura	**MODELLAZIONE GEOMETRICA**
caratteristiche costruttive	• definizione dei principi costruttuivi	**ANALISI STRUTTURALE**
caratteristiche meccaniche	• natura e resistenza dei materiali	**PROVE SUI MATERIALI**

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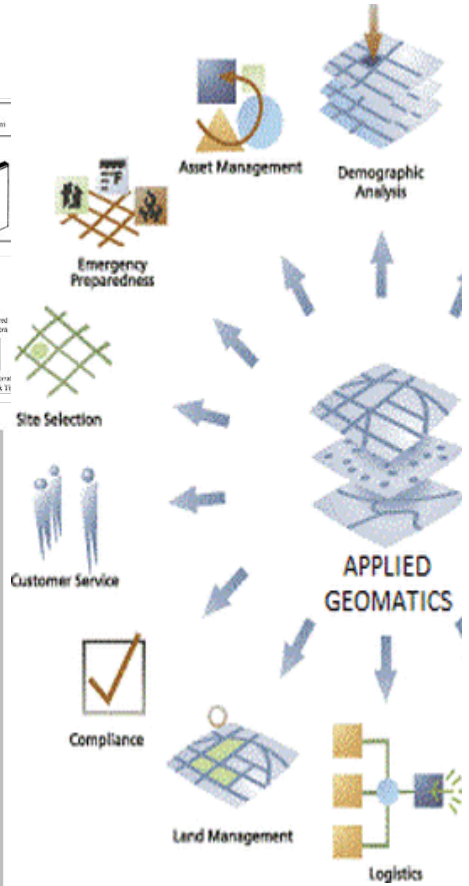

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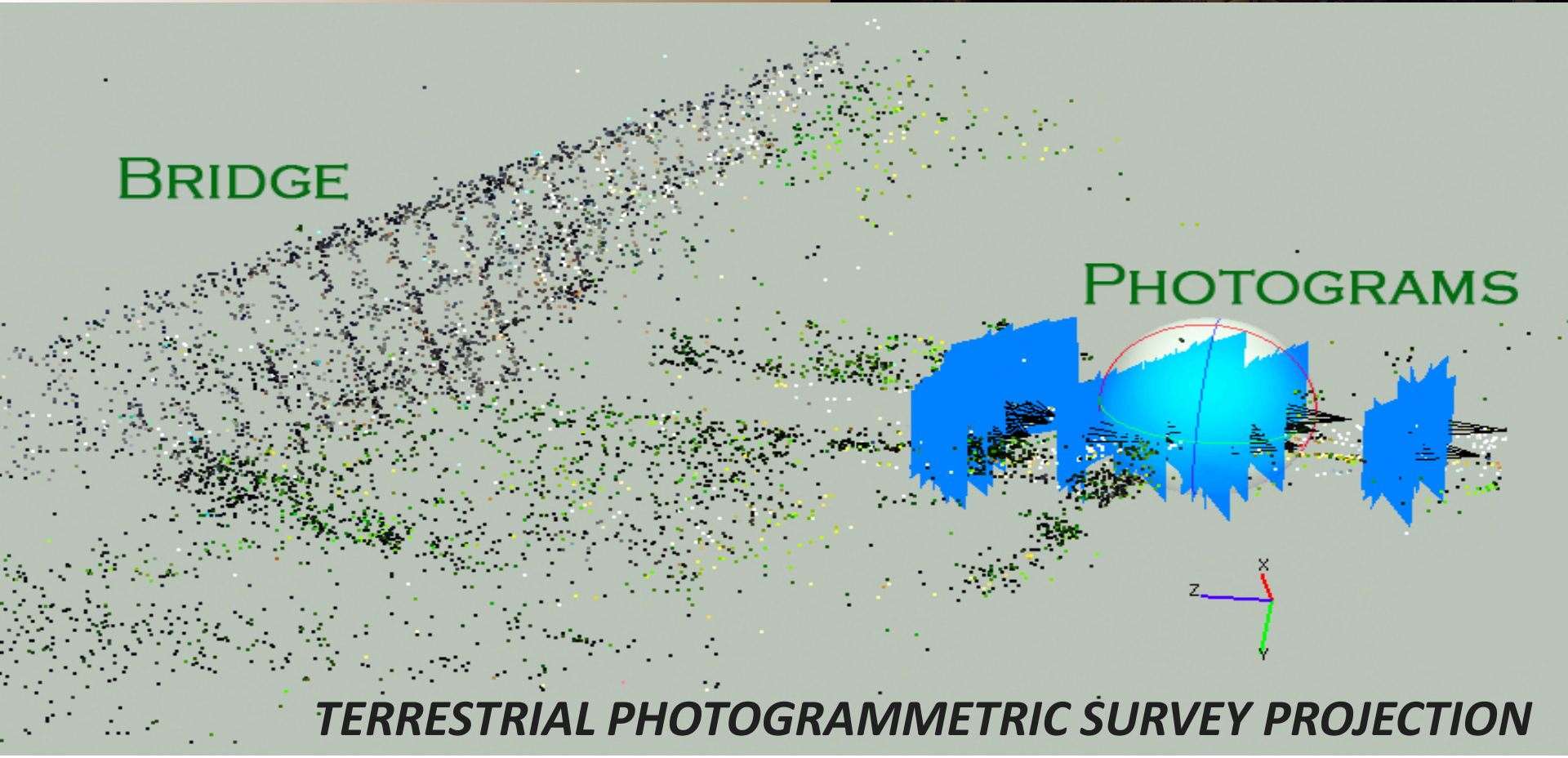

TERRESTRIAL PHOTOGRAMMETRIC SURVEY PROJECTION

One of the most important phases in this work has been the accurate preparation of the photogrammetric surveying. With this information three parallel acquisitions have been made all of them using vertical overlapping of at least 60%. Immediately after the image acquisition a visual inspection of al images was needed in order to decide which of them were able to satisfy the quality criteria and undergo the data processing. Finally, 39 photos where elaborated for the south facade undergoing the well-known routine of photo alignment, sparse cloud generation, dense cloud generation and texturing.

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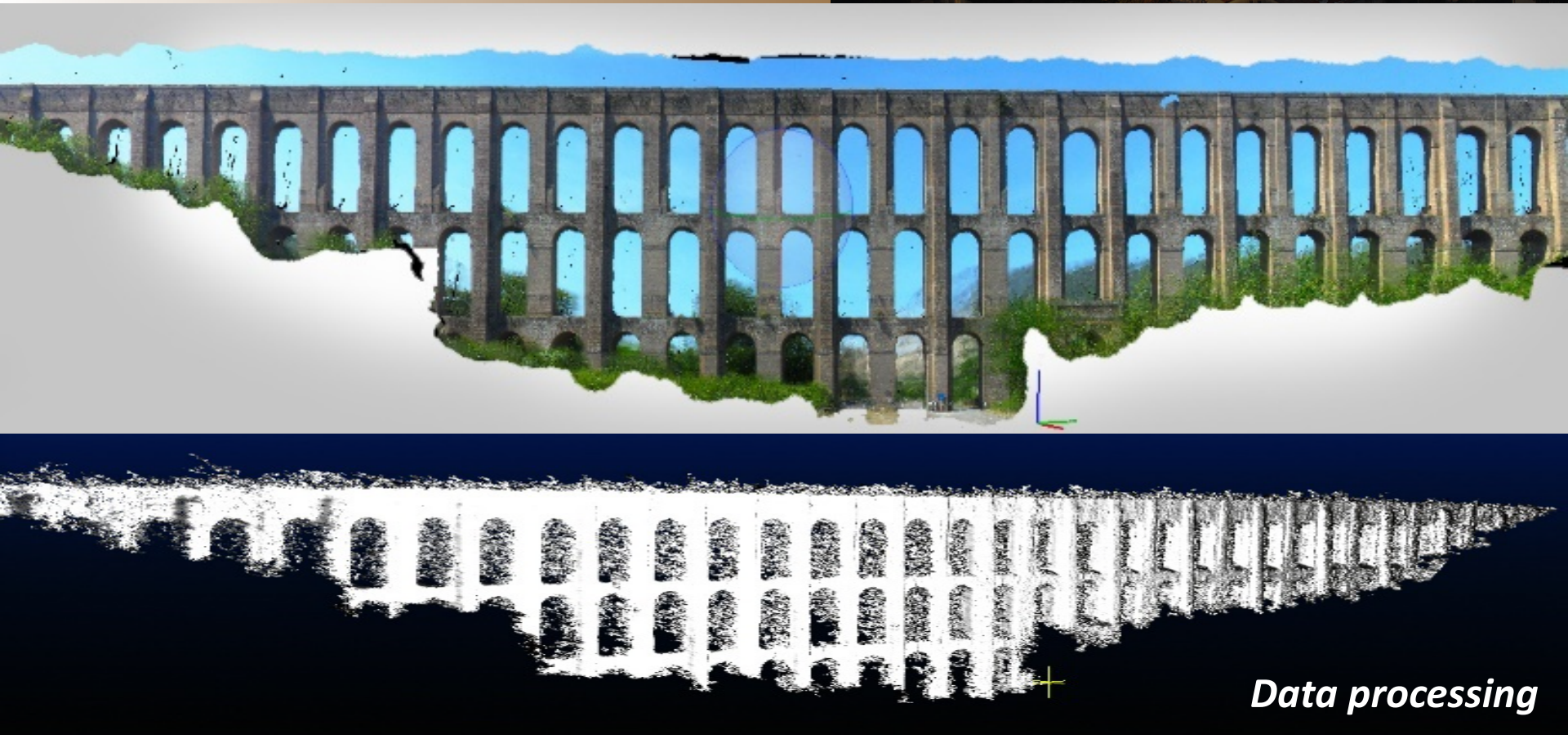

The final point cloud has been exported having 5 million points. The point cloud has then imported for ulterior editing in Cloud Compare open source software. Using a volume point density, the point cloud has been decimated without lowing the information level to one million of points having an average distance of 1cm, more than enough for the scope of this project. The registered and georeferenced global point cloud, has then been roto-translated in order to orientate one of its axis parallel the bridges façade. Thus, the obtained modified coordinates have been introduced in a surface plotting software in order to represent its shape and morphology using color scales that led to an easy interpretation by the structural department.

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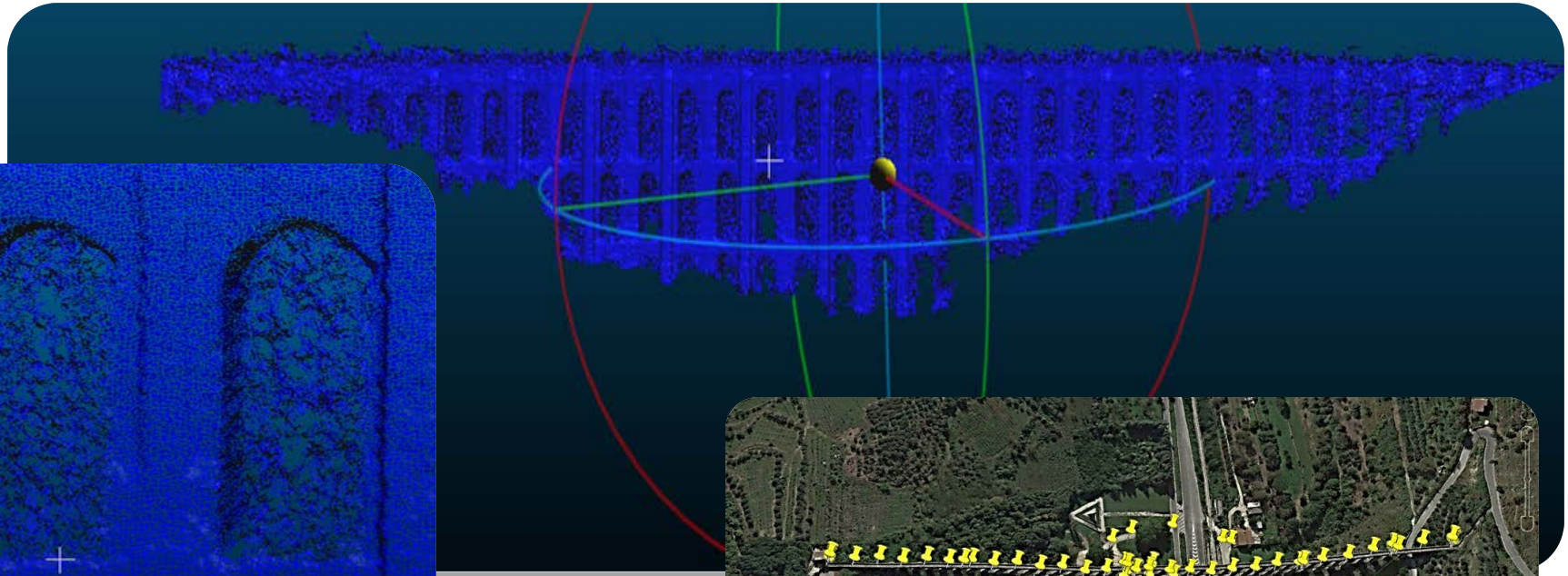
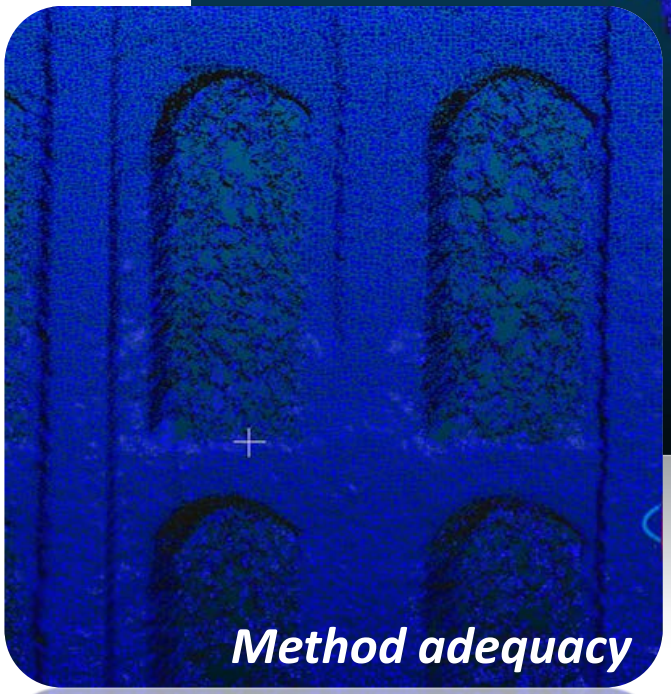
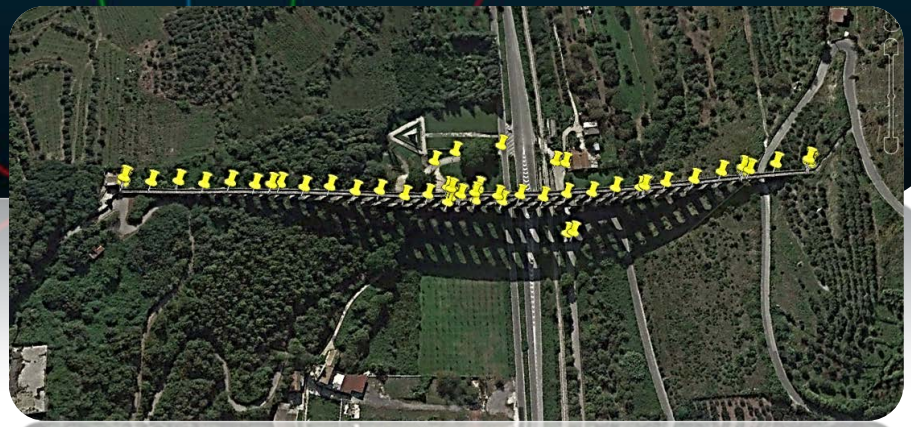




Method adequacy



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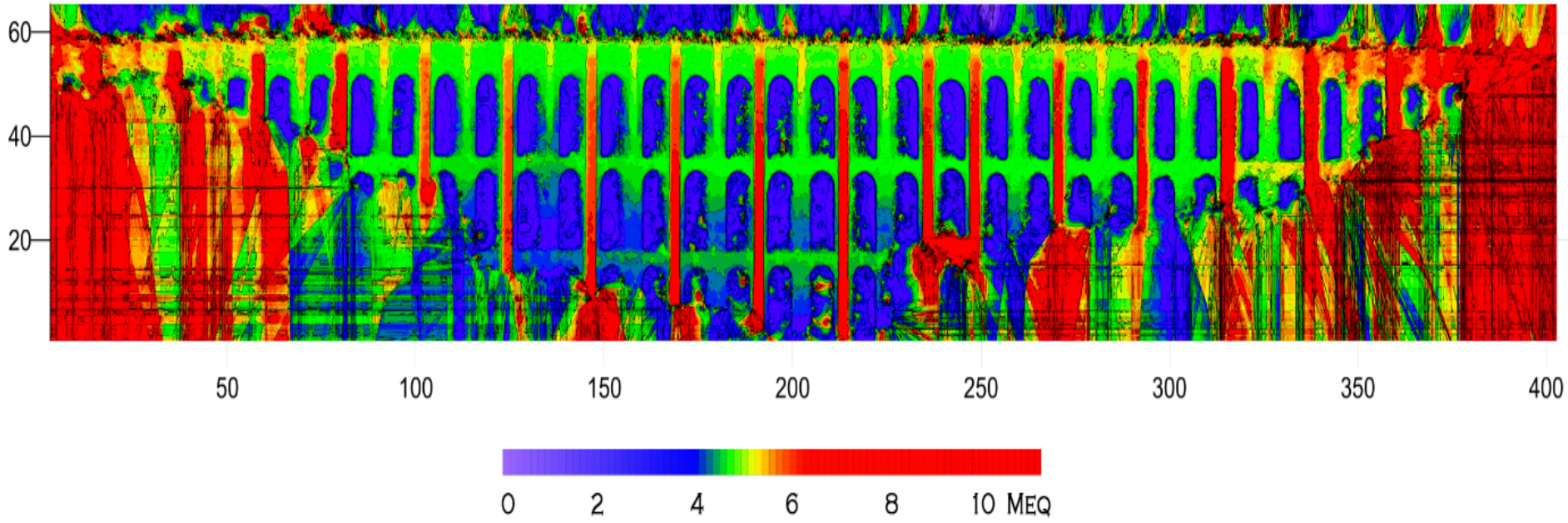
Representation of verticality – geometric anomalies – planarity - coplanarity



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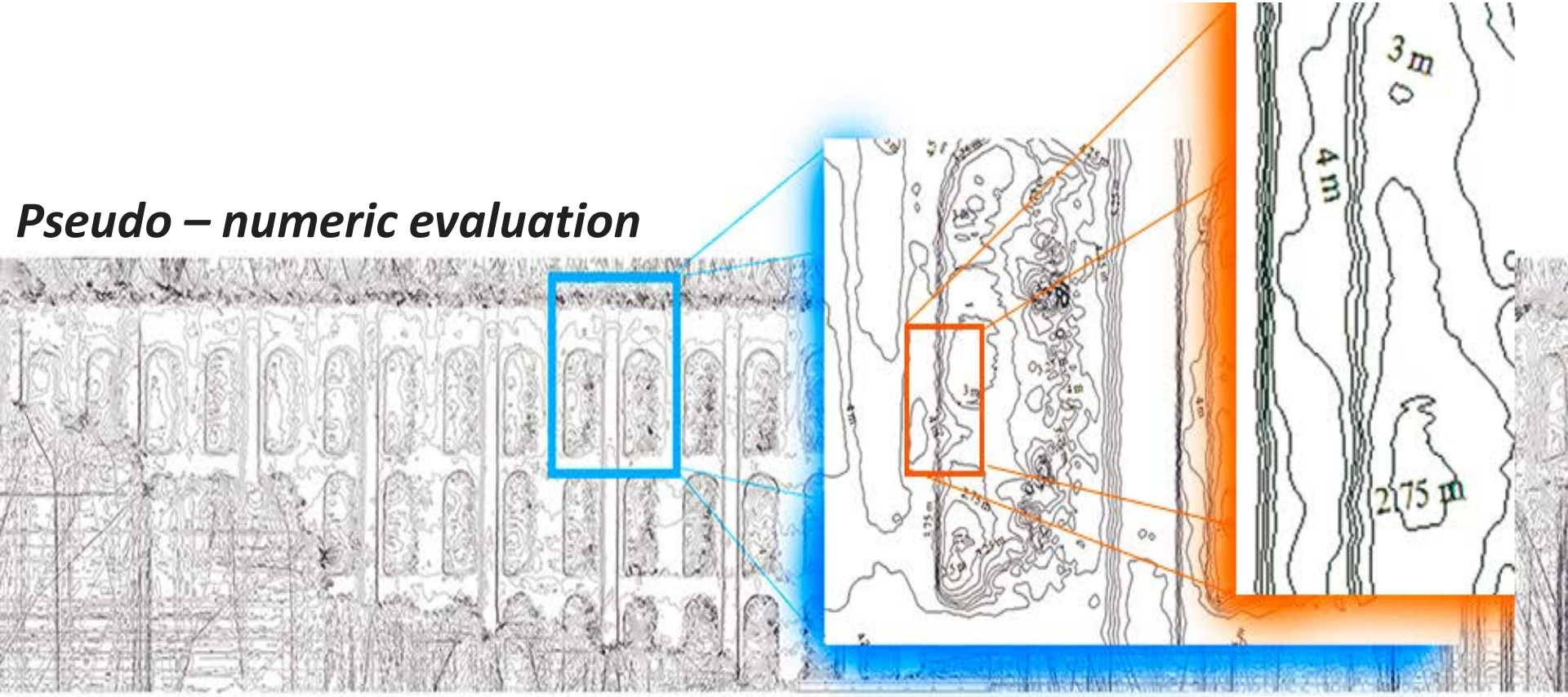
Pseudo – numeric evaluation



A contouring algorithm that permitted a numerical lever curves has been used in order to permit local comparison of the various parts.

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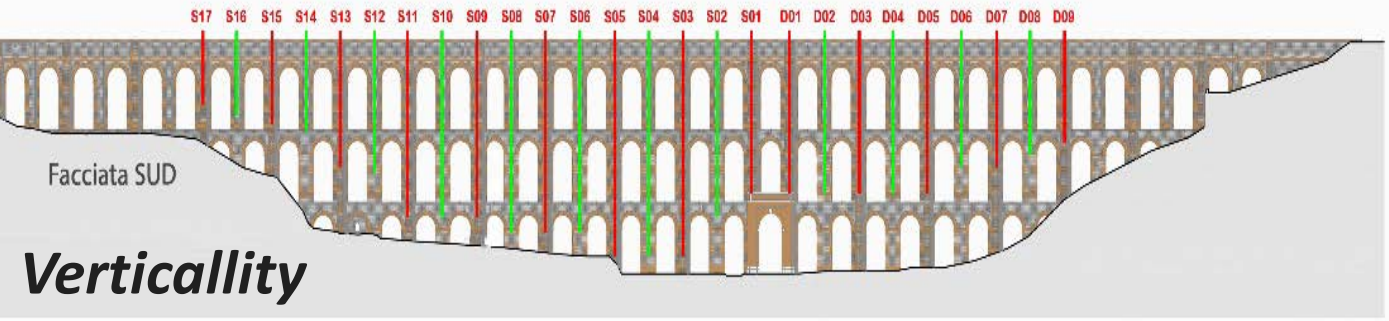
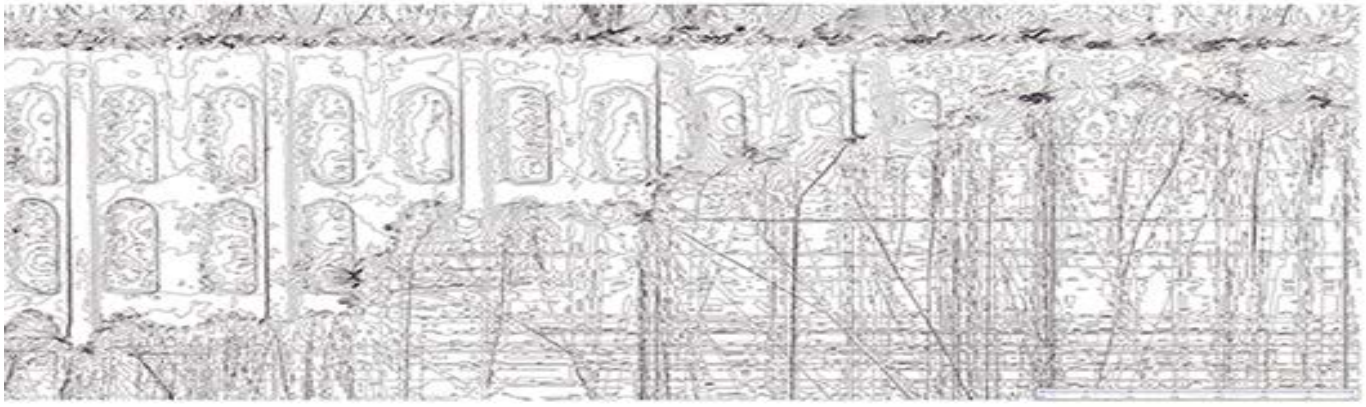
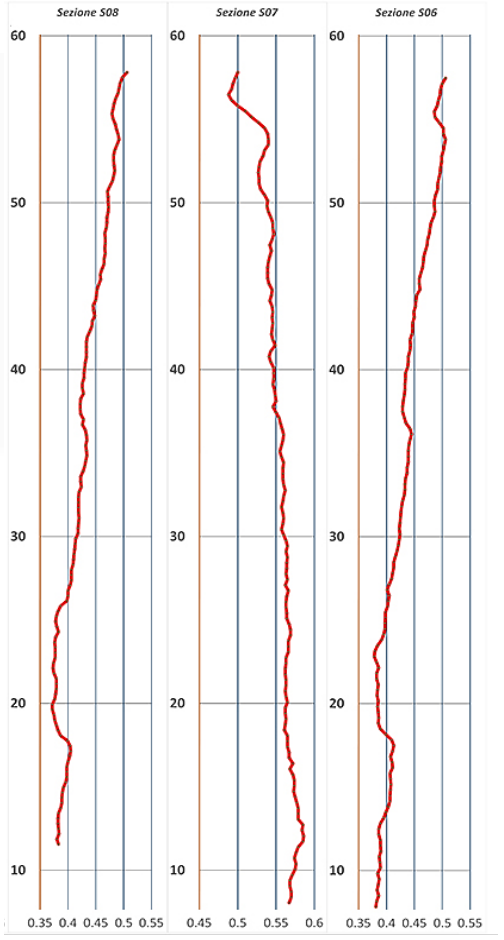


Verticallity





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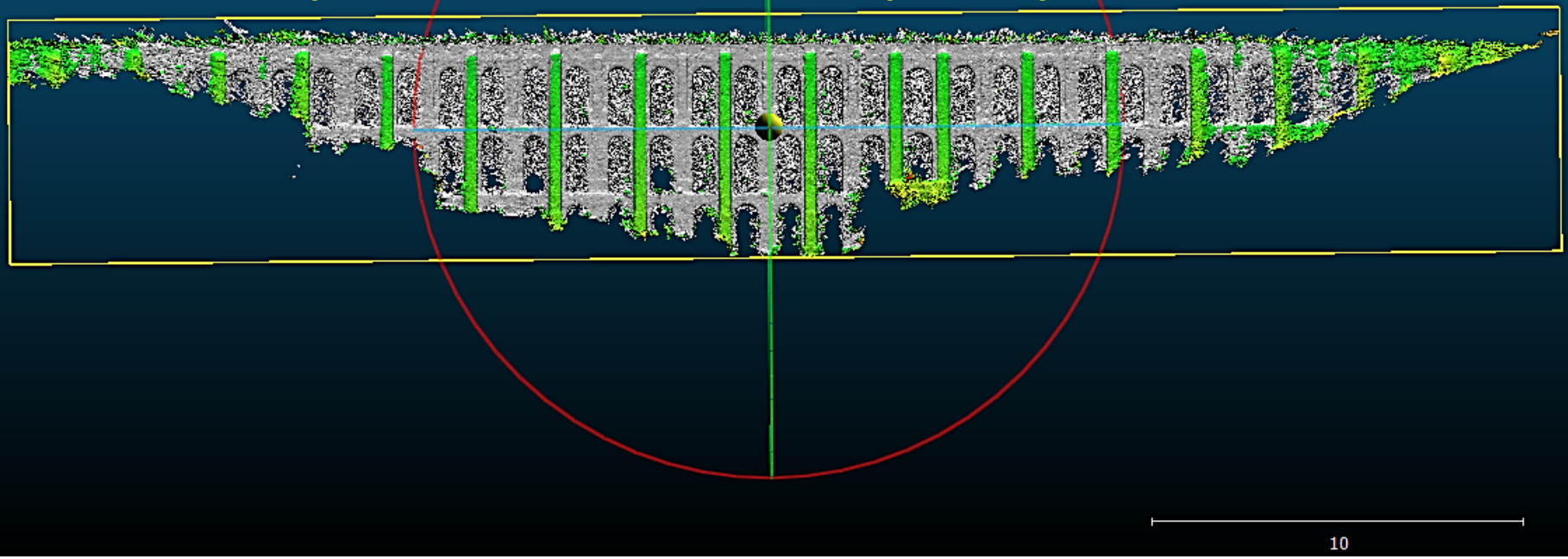
Geometrical inspection: vertical elements' co-planarity



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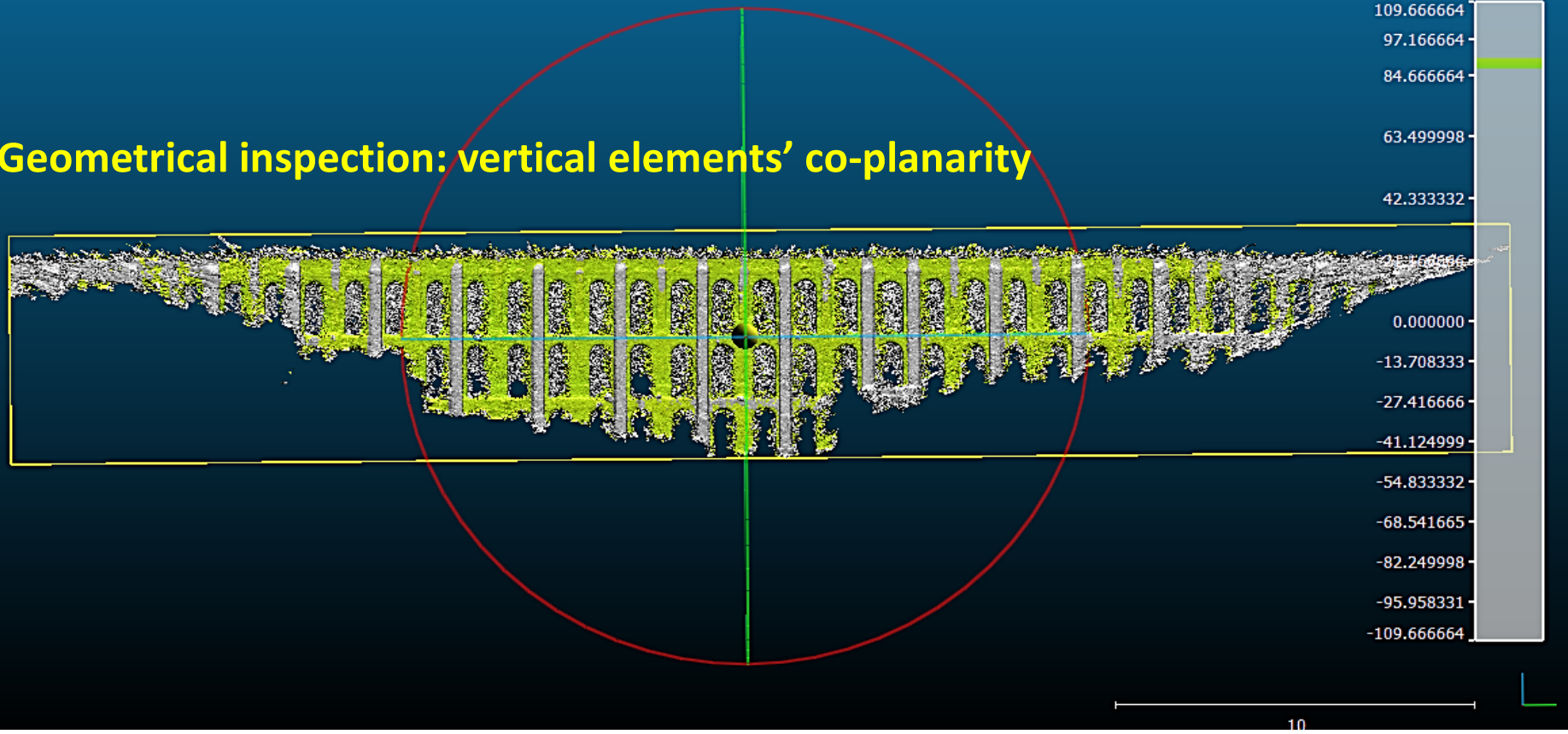

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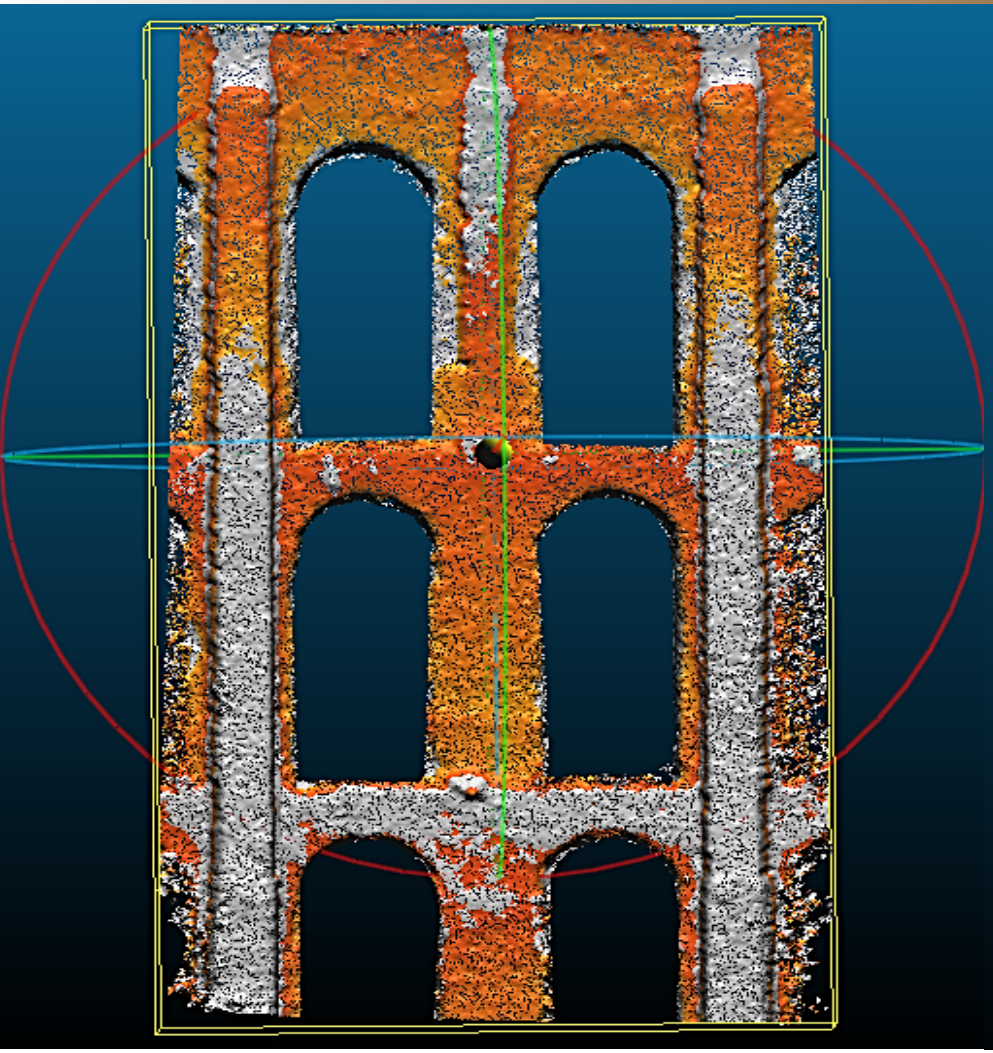

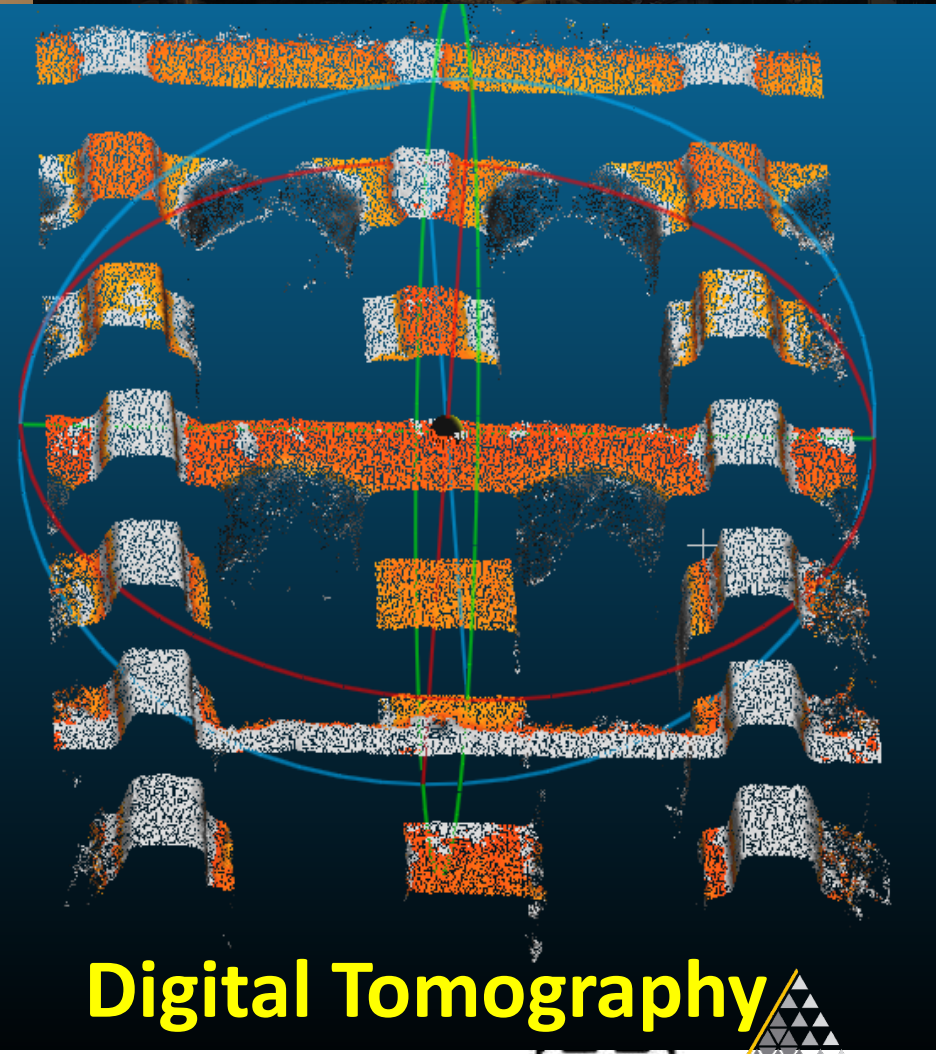

Digital Tomography

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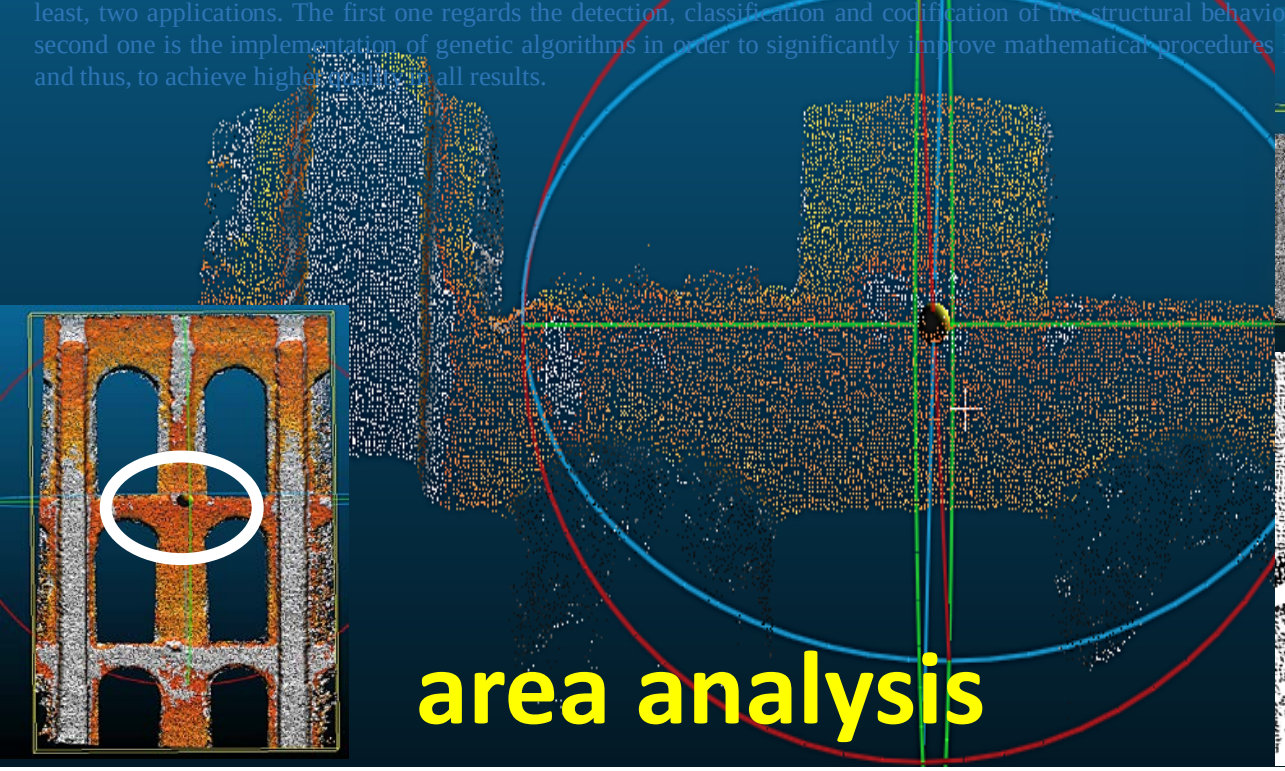
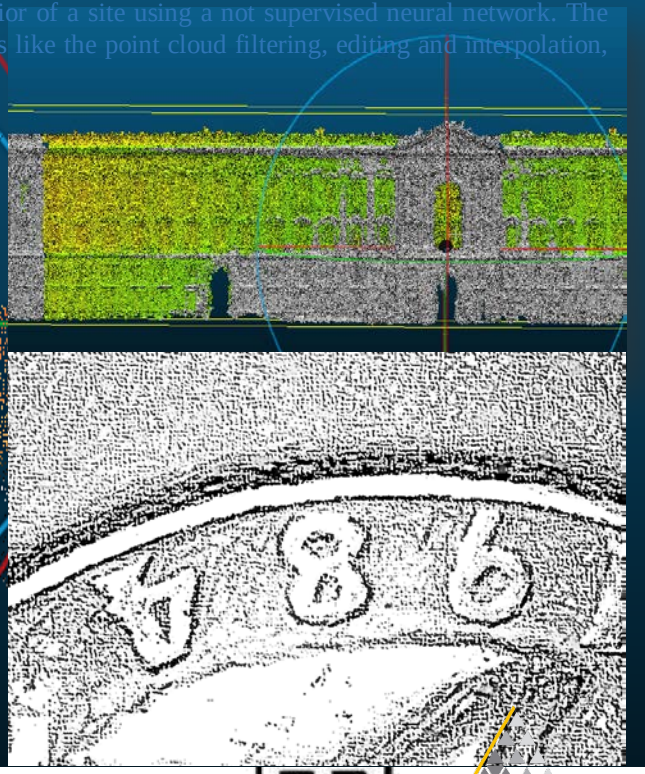
The described methodology represents a synthesis of a simple but quite efficient synergy between more processing algorithms with photogrammetry. It also evidences how new technologies can represent a valid support to the structural analysis of masonry monumental facades, using a risk-free surveying strategy, absolutely noninvasive for the monument, of relatively fast application and economically convenient. Great part of the elaboration procedure has been done using open-source software while the photogrammetric survey has been executed using a commercial reflex camera. Among the proven advantages of the chosen methodology, the adequate resolution, precision and operational simplify have to be mentioned confirming it as a quite efficient way to obtain three-dimensional modelling and analysis of monumental facades.

The methodology can be further improved with the integration of machine learning algorithms in order to enhance efficiency and accuracy to obtain ulterior results in, at least, two applications. The first one regards the detection, classification and codification of the structural behavior of a site using a not supervised neural network. The second one is the implementation of genetic algorithms in order to significantly improve mathematical procedures like the point cloud filtering, editing and interpolation, and thus, to achieve higher qualitative all results.





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Conclusioni

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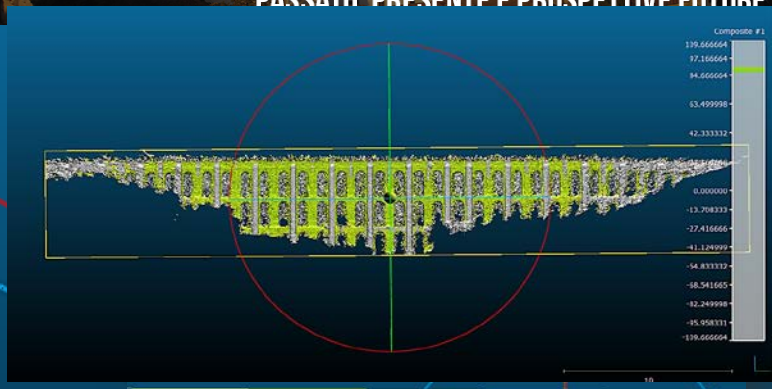

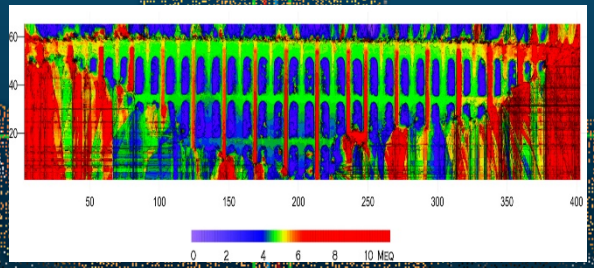

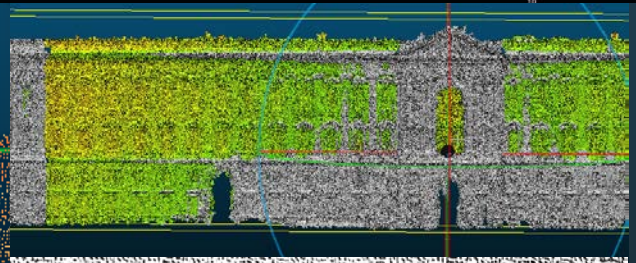

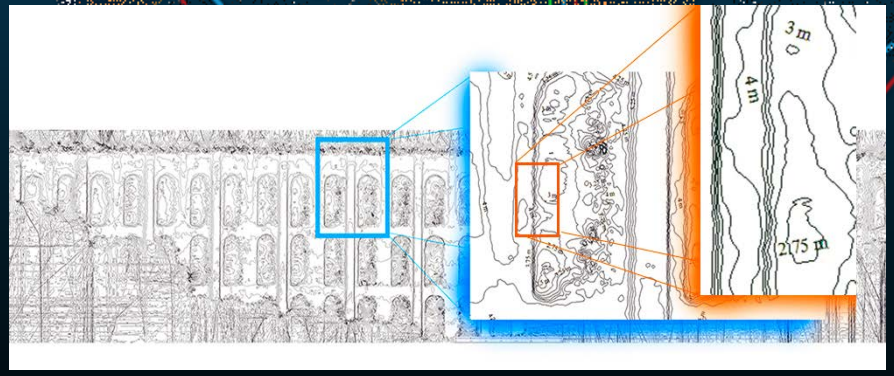

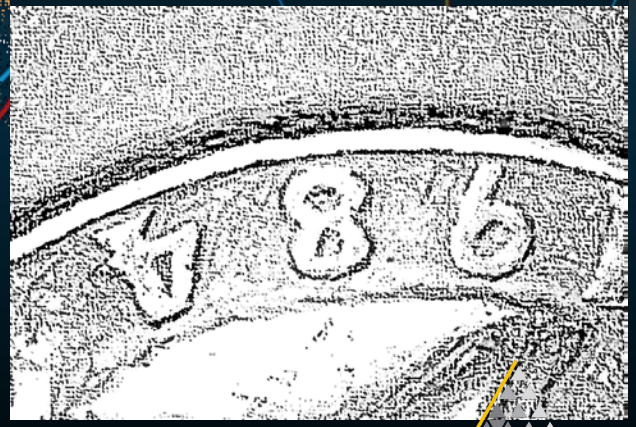

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