

# EXPERIENCE USING NON-METRIC CAMERAS IN PHOTOGRAMMETRY

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## ABSTRACT:

The use of images obtained with digital non-metric cameras to metric surveying three-dimensional photogrammetric of objects, it's investigated at the moment in the world by the specialists of the field, constituting a very current thematic and of great interest. In the presently work is exposed the results reached by the author in experiments developed in this thematic with the means and available systems in the country. The work presents results of surveying two objects of interest for the conservation of the architectural and cultural patrimony of the Old Havana; the final verification of results is made comparing magnitudes measured in the original photogrammetric with the corresponding direct measures on objects.

## 1. DEVELOPMENT

When the non-metric digital cameras are used for photogrammetric works, the technical characteristics of utmost interest are the metrics qualities of the objective, where the magnitudes of the distortions should be known and they cannot be extreme, other aspects of interest are the dimension of CCD (Charge-Couple Device) and the dimension of pixels, they impact directly in the accuracy of the results and they define the area of covering of the possible object to get up with less images.

To investigate and to control the geometric precision of the cameras the calibration it is made, that is usually made in a calibration bank or using a polygon as pattern. They become generally serial several calibrations to determine their stability, that its function of the variability of the results obtained in each test, in these investigations the Elements of Interior Orientation and the distortion of the objective are determined; parameters that we should know to develop the works in the Photogrammetric Digital Stations with the accuracy that the applications Photogrammetric demand.

Cuba doesn't have photogrammetric digital cameras, but have photographic digital cameras non-metric with a resolution of 5 and more megapixels, that subjected to an investigation process in which the elements of interior orientation and the distortion of the objectives are determined, they are used to develop works of digital Photogrammetric, particularly for applications in the field of the close range photogrammetric.

During the developed investigations were carried out two practical experiments that are exposed next:

The getting up of the decoration to relief of the Theater Martí, work of patrimonial and historical importance in The City of Havana is in restoration phase and it is interest of the office of the historian of the city. Before beginning the cartographic works it was carried out a study in the place of the object, starting from which the procedure was planned to continue to develop the works of photographic rising and the development of the base of points that serve as support in the Photogrammetric works. The measuring to determine the coordinates of the points were made using a total station Leica TPS -1200, realizing with the specifications demanded to assure the required accuracy, they were carried out the measuring in

two cycles towards the objective of controlling possible rude errors. The photographic takings were made at a distance of 2 m of the object with a focus of 28 mm, using for it the scaffolds installed for the restoration of the theater.

The cabinet (restitution) work was developed in a station DPS DeltaGeoSystem, subsequently we proceeded to the edition to give an appropriate termination to the restored graph, and the final results are shown in the figures 1 - 4.

When concluding the works, to evaluate the finally achieved accuracy, it was carried out a control where magnitudes corresponding to the same elements of the object were compared measured in the field and in the photogrammetric original. The fields measuring were made with a tape metallic metric not deformable of 5 m, with the scale recorded in magnitudes of up to 1 mm. The accuracy obtained (3mm) allows the restoration of the object with a good quality, if we consider that this are makes in a way of the handmade one where the measuring don't have accuracy better than 5mm.

The second experiment consisted on the surveying of the facade of the Convent Santa Teresa, of patrimonial interest, in restoration phase by the office of the Historian of The City. Initially it was made a study of the object in the field, where the characteristics of the facade, their dimensions and their relationship with surroundings were valued, starting from these information and considering to achieve a three-dimensional representation of the elements with an accuracy of 1.5 cm, it was proceeded to the projection of the fieldworks.

The three-dimensional coordinates of the points in field were determined completing the demands exposed in the previous experiment. The photographic digital images were take with the camera Leica Digilux 2, using a focal of 50 mm at a distance of taking of 9 m, in this way was covers the area of interest to surveying with the smallest quantity of images.

The restitution of the elements of the facade was made in a station DPS DeltaGeoSystem, the results show up in the figure 4.

When concluding the works, to evaluate the obtained accuracy, it was carried out a field control. The results of the control were 9 mm in the representation in the plane and 10 mm in the depth, it is better than the one requested by the client for this rising type and this results guarantee the restoration works and the

calculation of other parameters associated to the conservation and restoration of the structural elements of architectural conventional works.

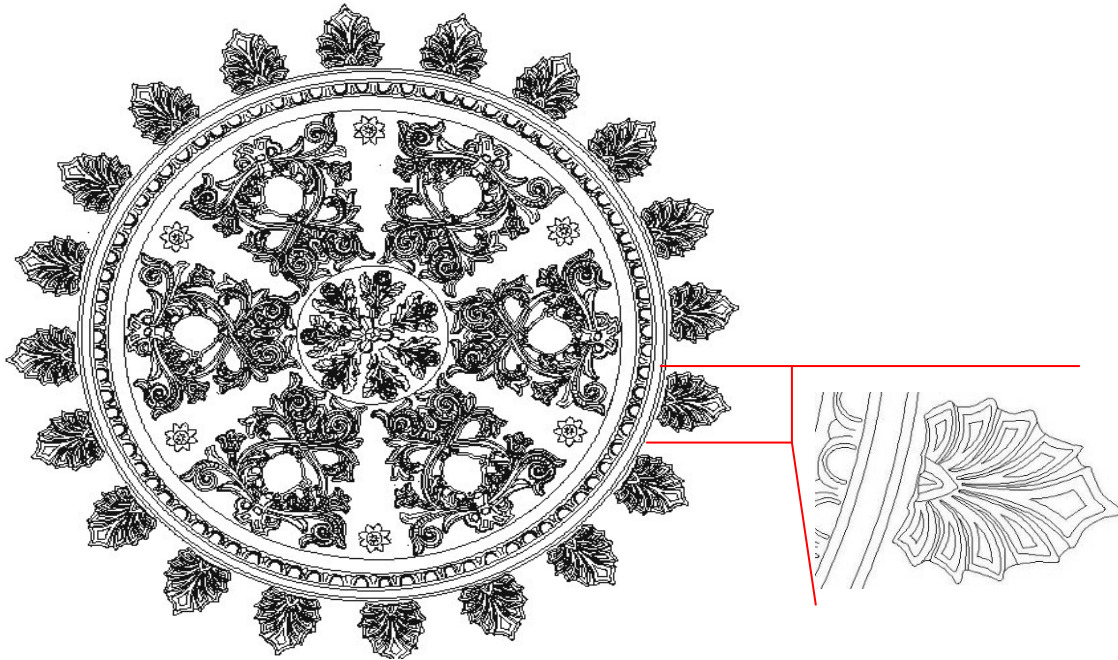


Fig. 1 Result of the cartography of the micro relief of the dome of the theater José Martí.

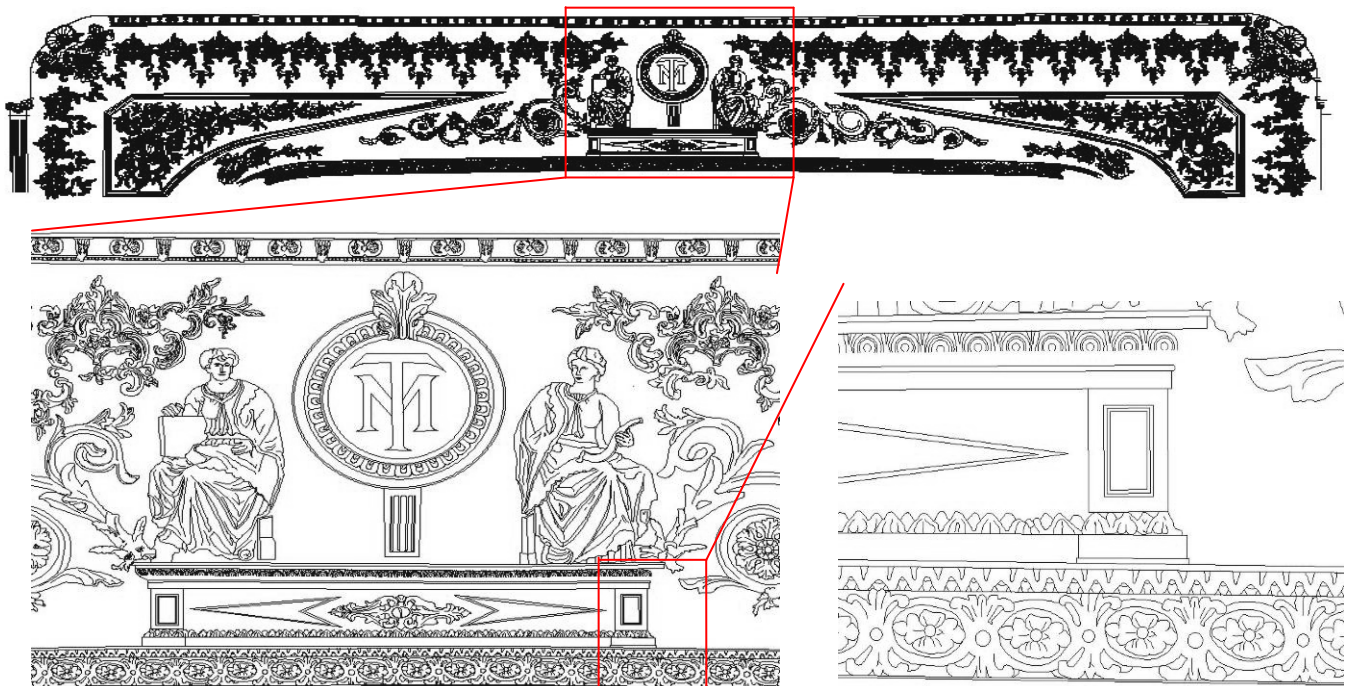


Fig. 2 Getting up of the decoration of the scenario of the theater Martí



Figure. 3. Distribution of the support points and control in the façade.

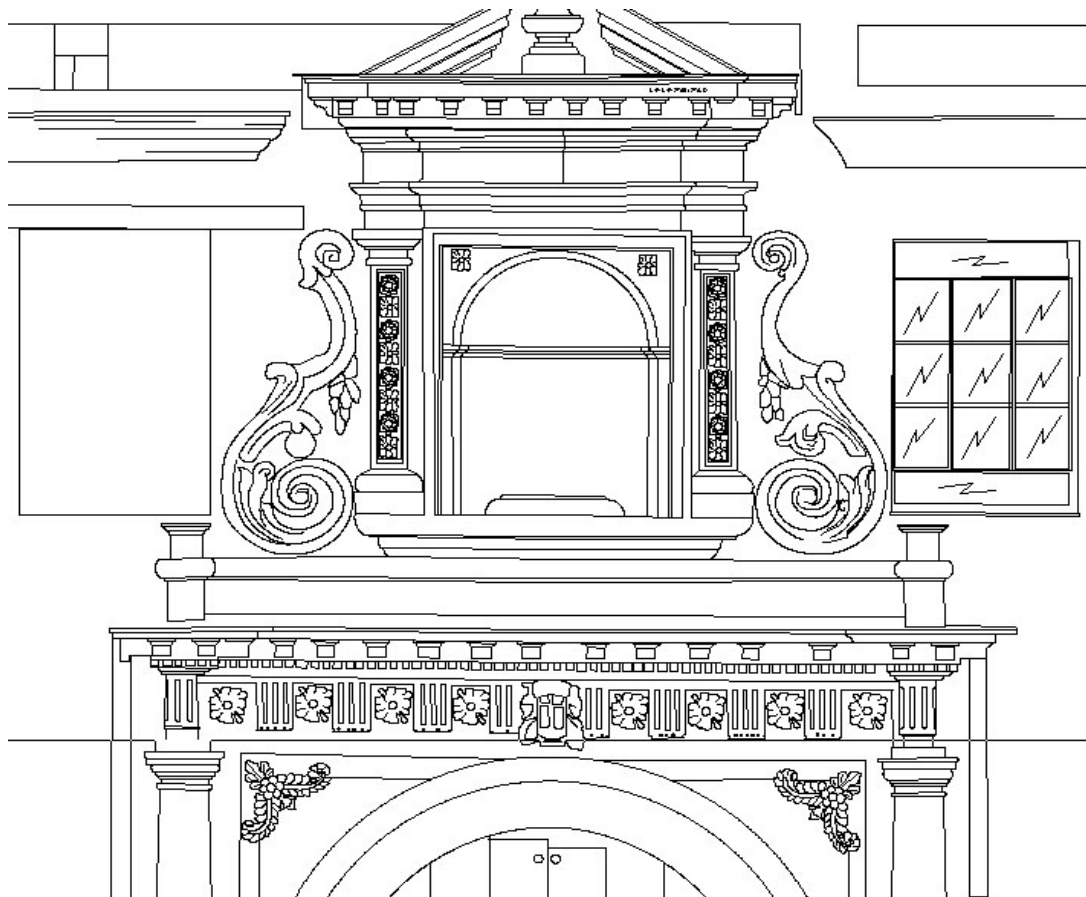


Figure. 4 Result of the restitution of the most complex section in the Convent Santa Teresa.

## 2. CONCLUSIONS

With the current state of the development of the Photogrammetric in Cuba and the proposed technology of use of non metric cameras it possible carry out Photogrammetric works with satisfactory accuracy and, in a particular way, in close range photogrammetry, specifically in the surveying of the decoration in micro relief of architectural works and in the surveying of facades, completing the established demands of accuracy, with a low cost.

## REFERENCES

- Aracena Pizarro Diego, Campos Pedro, Tozzi Clésio Luis. Comparison of technical of calibration of digital cameras. Rev. Fac. Engineer - Univ. Tarapacá. 2005.
- Cebrián Pascual José and Hermosilla Cárdenas Javier. Practical and characteristic aspects of the systems of digital Photogrammetric. Geographical National Institute. Spain.
- Fangi Gabriele. Simple photogrammetric systems for architectural. Recording. Vietnamese-Italian Seminar. The role of Science and Technology to the Conservation and Restoration of Ancient Monument. Hanoi. Vietnam. 2003.
- Sandra H. González García, Lídice Abreu León, Bernardino D. Díaz Rodríguez, Yoelbys Benítez Piñero, José M. Cerra Cruel, Identification of lesions in patrimonial facade using technical Photogrammetric. XII Convention and Expo International Computer Science 2007. V International Congress of GEOMATICA. Cuba, 2007.
- Helmut Mayer. Robust Orientation, Calibration, and Disparity Estimation of Image Triplets. Munich. Germany. 2004.
- Karras, G. and Mavrommati, D. Simple calibration techniques for non-metric cameras. CIPA International Symposium, Potsdam, sept 2001.