

# Stereophotogrammetric Open Digital Archive: StereoFot 35th Anniversary of the Earthquake, November 23, 1980, Basilicata, Italy

Pietro GRIMALDI, Italy

**Keywords:** Digital Archive, Stereophotogrammetry, StereoFot, Normal Case, GIS

## SUMMARY

The work described below was produced by highlighting some of the contents of paragraph "*aiuti uso restitutore*" (<http://stereofot.it/restitutore/aiuti/fotarch.html>)" relating to the results of the research developed by the Laboratory of Architectonic Photogrammetry Polytechnic of Bari in the last 45 years.



The Laboratory of Architectonic Photogrammetry Polytechnic of Bari was created (before the establishment of the same Politecnico di Bari) from Prof. Antonio Daddabbo, who directed the laboratory until October 31, 2008. Currently, the scientific manager is the Prof. Arch. Claudio D'Amato Guerrieri, Director of the Department DICAR the Polytechnic of Bari and the laboratory is coordinated by the undersigned.

It defines architectonic photogrammetry the survey technique, which allows to obtain metric data (shape and position) and quality of an "object" through the acquisition and analysis of a couple of stereometric frames.

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The activity of the laboratory of architectonic photogrammetry the Politecnico di Bari was founded on three basic principles:

## **"Know to Protect"**

The preservation and the circulation of a historic car is only possible if there are connoisseurs of engines, or even a "Ferrari" becomes an expensive, dangerous and polluting to be sent to the demolition.

## **"A good survey is already mid-project"**

a project worthy of the name, was born from a detailed analysis of the existing. The set of analyzes, carried out in time, allows the medical history of each cultural asset, which "is born, lives and dies", and like all living things, turns and needs care, based on a story to date.

## **"The documentation of cultural heritage is not for a few and no one can delegate. It is important that we teach the documentation and that we give you the tools, then it is the story that will speak of our culture"**

a cultural heritage is that it is a "source of culture", so it must be studied, starting with the survey, which obviously can not be reduced to a simple graphical representation. If in schools of all levels, has been included, which governs voluntary, the "architectonic photogrammetry", interested students could adopt a monument and update data during the entire course of study, the power, at no cost, the "online archive".

Based on these principles, a distance of 45 years, the photogrammetric open archive Architectonic Cultural Heritage of reaching the destination by CIPA (Comité International de Photogrammétrie Architecturale) at its first meeting (Paris, 18 and 19 June 1970): the creation of an international photogrammetric archive surveys Architectectonic Heritage, duplicated and distributed in an appropriate manner in two security centers.

The main difficulties that have hampered the creation of this archive were essentially:

- **duplication of frames.** At the time, terrestrial photogrammetry was derived from aerial photogrammetry, aimed at the graphic rendering, giving primary importance to the precision. So the rooms metrics used, which support the emulsion sensitive, glass plates rectified, low-sensitivity and, therefore, of high contrast. Duplication as well as bringing a significant cost, was not without a degradation of the image;
- **the different size of the metric cameras.** Every company, a manufacturer of tools for photogrammetry, chose its own format and, therefore, each room required an own renderer, which in addition to particularly high costs, could be used only by specialized operators. The two central archives would require prohibitively expensive, both because of the equipment is not depreciable, either because of lack of use.
- **the use of frames.** When users spoke of photogrammetric survey, they were referring exclusively to the graphic rendering, which, made in specialized laboratories, completely separated from the needs of those who had to use the pad, so that these, even for economic reasons, preferred to use the tape measure. Couples stereometric frame, not only were not used due to very little knowledge and dissemination of stereoscopes, but were split as they are considered "copies".

Today, thanks to digital cameras, photogrammetric survey is available to everyone.

Once clarified the concept of "normal case", anyone can calibrate their camera and use three simple mathematical equations with one unknown to make restitution.

## **Normal case: the geometrical concepts**

This renderer has been programmed for the restitution of photogrammetric surveys performed according to the so-called "normal case", that is, with the optical axes of the rooms arranged to form an angle of  $90^\circ$  (in a manner orthogonal) to the base (the line joining the two rooms).

In the planimetric representation of Figure 1 are summarized and colored in yellow two cameras that pick up the point P, whose image is projected through the objectives O1 and O2, the frames (segments in light blue).

If the cameras are arranged with the optical axes of the objectives parallel and coplanar with the frames, by the similarity of triangles, dashed lines in the figure, one can derive the two formulas shown in the figure.

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Taking into consideration the **XY** Cartesian system, we can detect a correspondence between the coordinates **(x,y)** of the point **P** and the linear coordinates **x'** and **x''** (in the reference frame) of the images of the same point.

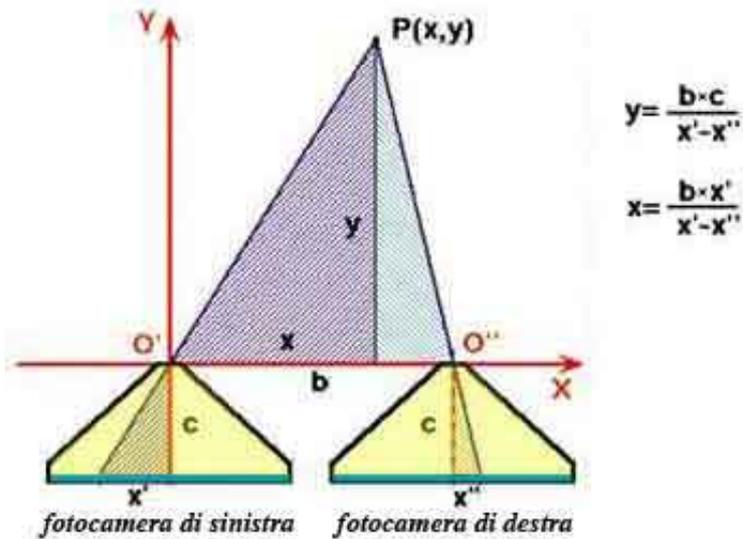


fig. 1

Looking, then, the spatial representation of Figure 2, by similar triangles colored in blue, shows also a proportionality between the **z** value of the point and the corresponding representation on the frames and they can easily get to the three formulas shown in the figure of the so-called "**normal case**", the terms of which are: **optical axes parallel and coplanar frames**.

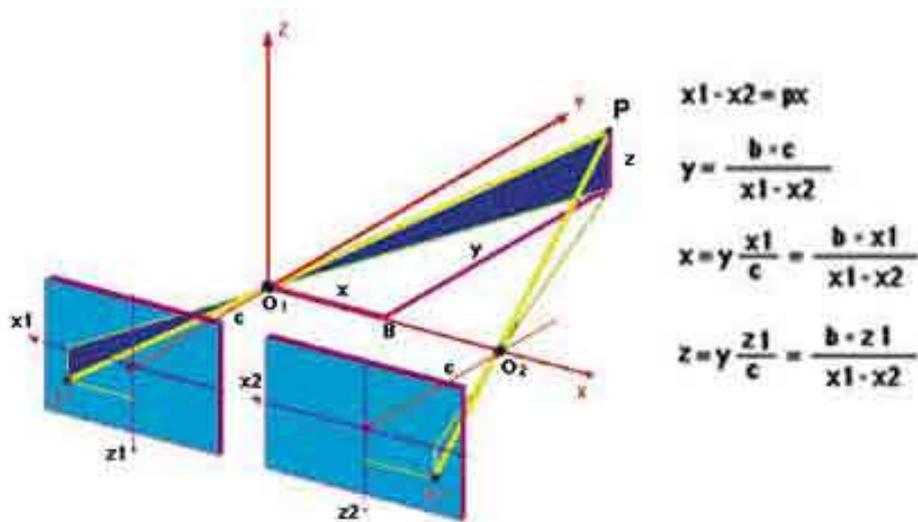


fig. 2

Regarding **c** is appropriate to specify the difference between the distance and the main focal: a metric camera can have the focal length  $f = 60$  mm. and principal distance  $c = 63.68$  mm. This last is the distance between the center of the projection lens and the plane of the frame, at the time of shooting. In Figure 3, we consider the similarity between the triangles colored in green, denote by **A'** is the length of **a** horizontal rod and photographed in his image and **C'** distance of the rod from the camera, with an acceptable approximation , the principal

distance is given by the formula shown in the figure itself.

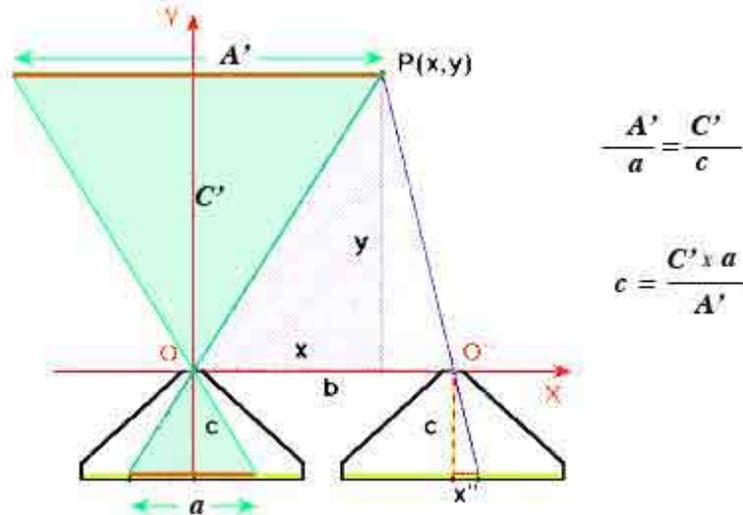


fig. 3

The last consideration is the unit of measure and the possible measurement errors.

Meanwhile, we note (formulas) that any error in the measurement of **c (principal distance)** only affects the **y (depth)**, intervening heavily, because measured with the precision of a hundredth of a millimeter. To get an idea of the influence of various parameters, we make the assumption that we have available data colored in green in the following table and alter 1/100 values colored in red (in the last line of the principal distance has been rounded):

base	c	x'	x''	x	y
1,20	63,68	5,96	3,08	2,48	26,53
1,21	63,68	5,96	3,08	2,50	26,75
1,20	63,69	5,96	3,08	2,48	26,53
1,20	63,68	5,97	3,08	2,47	26,44
1,20	63,68	5,96	3,07	2,49	26,62
1,20	63,00	5,96	3,08	2,48	26,25

The program StereoFot® 7.0, with its archive, wants to be a concrete example.



If we think:

- the current digital cameras automatically provide, in support of the images, a series of information, including the principal distance and the geographical coordinates;
- the internal orientation of the frame is fixed, in reality no longer exists the film, subject to deformation, displacement and misalignment;
- duplication of images is a "no problem";
- the acquisition and accuracy shootint, with a little organization, can be verified immediately, with the advantage, thanks to a simple electronic key storage, you can store the frame in real time (it really is not necessary, the process of development and printing frame with its long times);
- it can be said that the only problem to be solved, to make the photogrammetric survey, is to take the two photos without changing the direction of the optical axis, in practice just slide the camera along a bar to "L" and measuring the displacement of any point of the digital camera.

To obtain a restitution of the metric information is sufficient:

Click "Import pictures";

enter the required data (those are indispensable in red);

click the "record"

perform calibration, if the images are loaded for the first time;

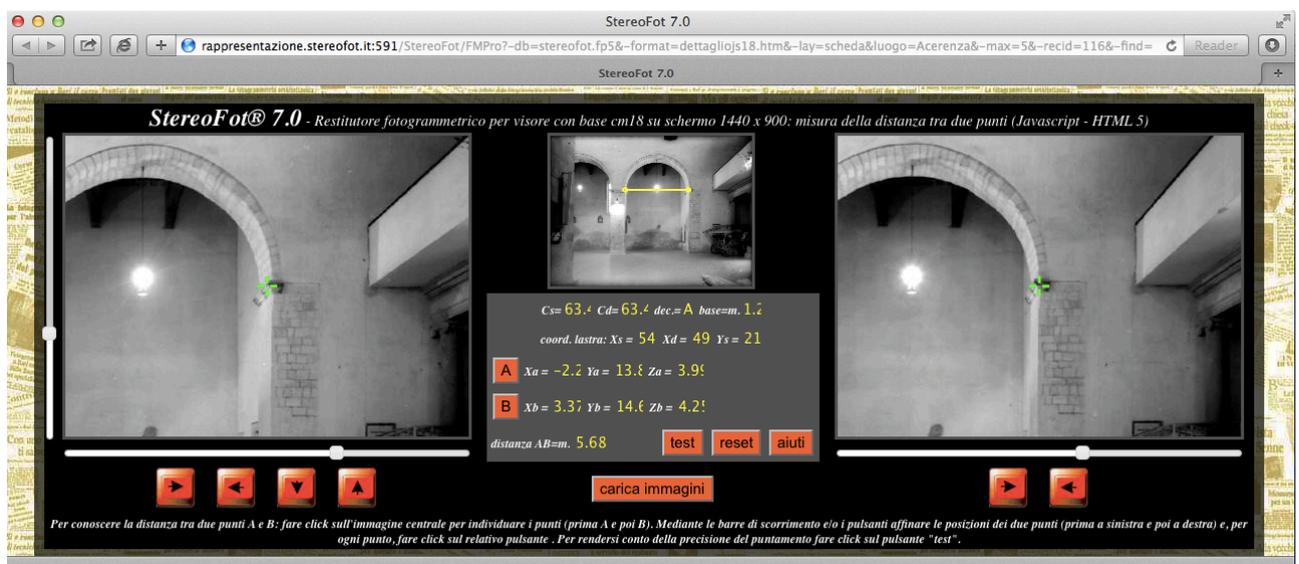


As for the results, and, in particular, the accuracy of the survey, we have to rely on the law of the Internet: the survey not profits will not be consulted and will drop in the rankings!

Here are some cards of stereophotogrammetric survey made during the stereophotogrammetric survey occurred in 1980 and 1981, on the occasion of "Irpinia earthquake", in Italy (Basilicata, Campania).

The survey was carried out by the stereophotogrammetric Unit of Traffic Police of Bari coordinated by Prof. Antonio Daddabbo.

The equipment used was the stereophotogrammetric camera WILD C120, development and printing of negative plates Ilford FP4, used for filming, were performed 1990 by myself and the digitization of stereophotogrammetric couples was performed in 2000.



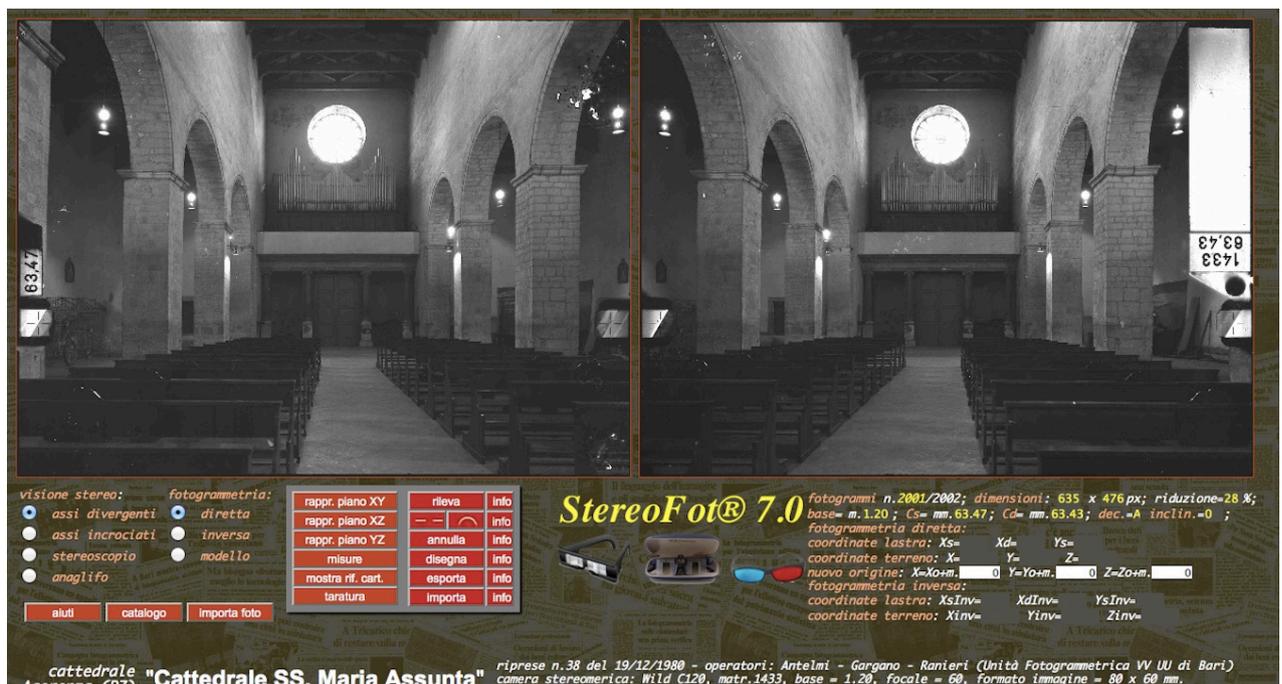
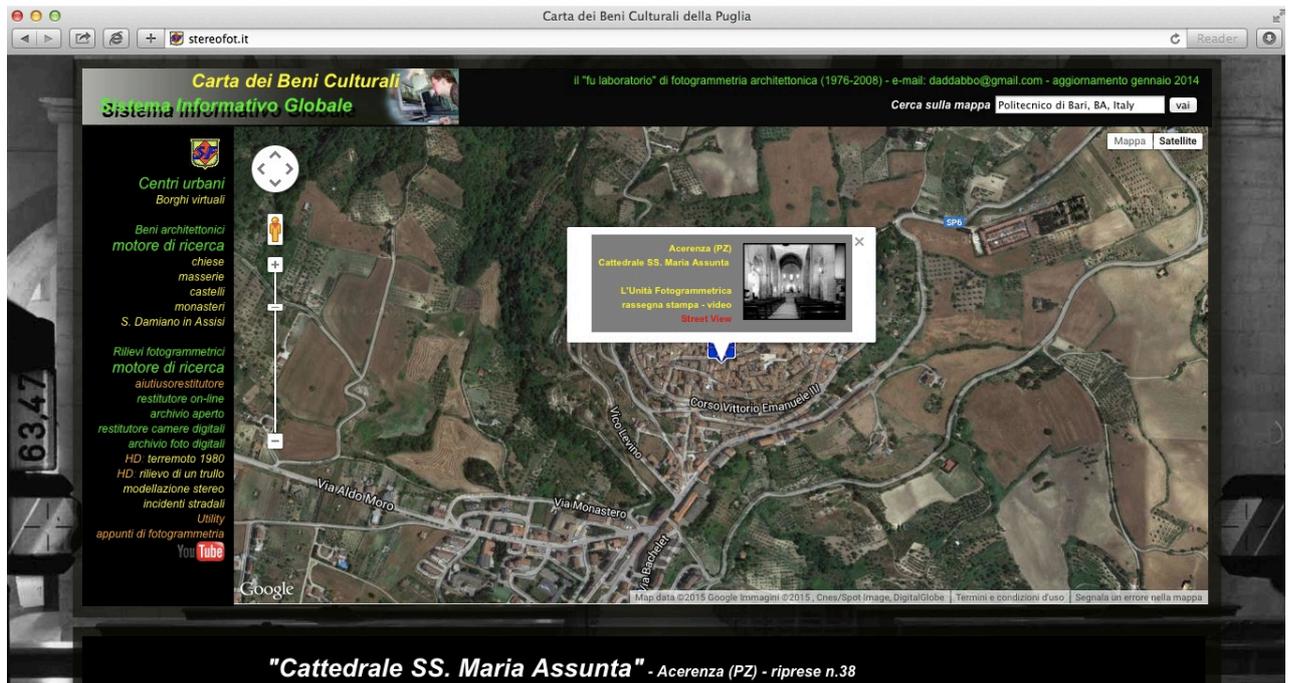
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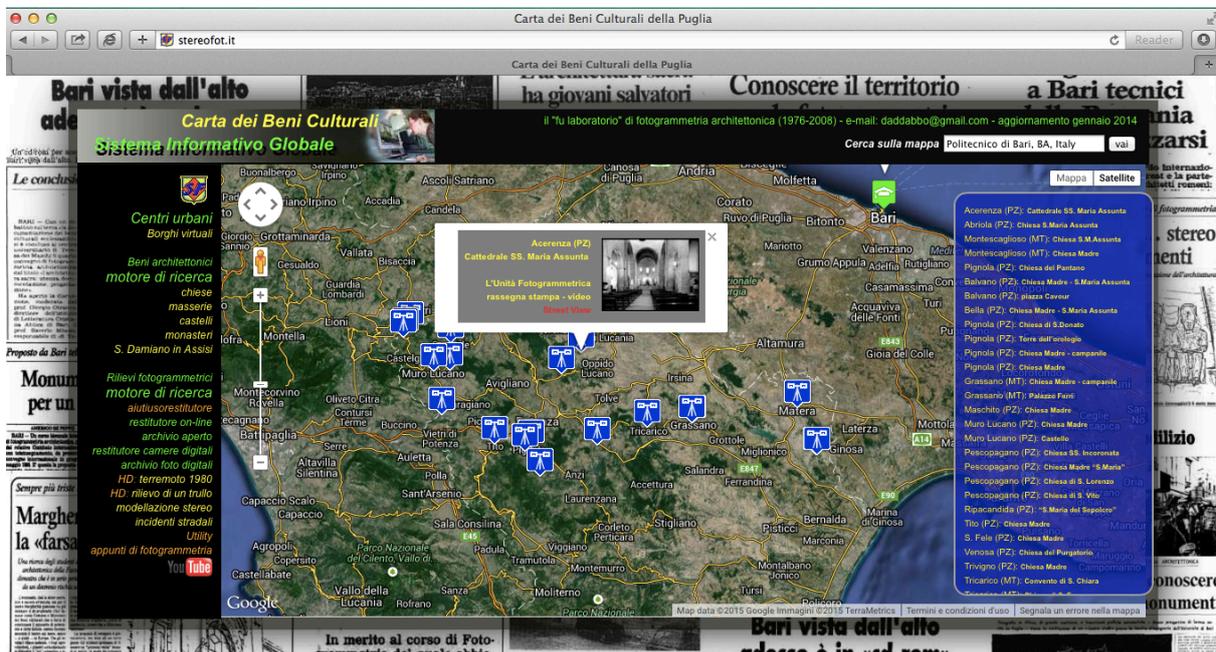
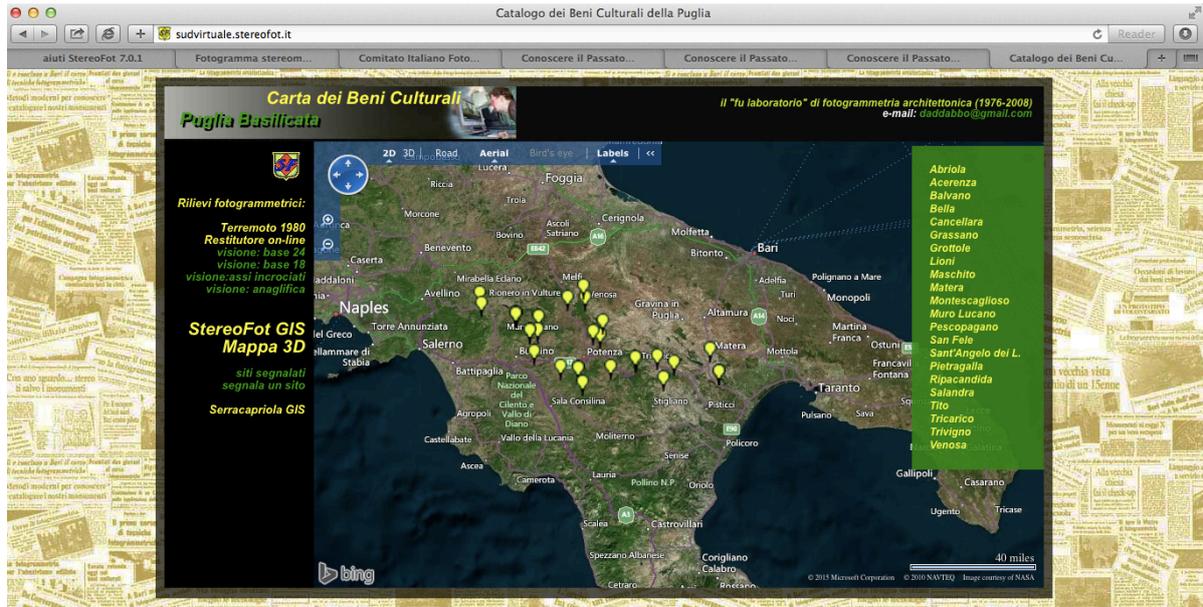
<http://stereofot.it/restitutore/stereofot.php?c=40.79686877,%2015.94071149&s=7>

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The stereophotogrammetric survey of Irpinia and Basilicata allowed to realize the GIS accessible through <http://sudvirtuale.stereofot.it>



Bari, 25 aprile 2015

Pietro Grimaldi

Presidente Comitato Italiano Fotogrammetria Architettonica - COIFA  
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## BIOGRAPHICAL NOTES

Pietro Grimaldi (<http://rilievo.stereofot.it/studenti/Tutorato/Grimaldi/curriculum.html>), formed under the Civil Engineering Building (School of Supsi in Lugano and at the Faculty of Engineering in Bari) since 1982 is interested in "Architectonic Photogrammetry" is the remarkable photogrammetric documentation of the "Convent of San Damiano in Assisi" performed in 1990, available on line <http://www.rilievo.stereofot.it/progettoArca/Europa/Italia/Umbria/Assisi/SDamiano/> and published in "I Beni Culturali Ecclesiastici" by Pietro Grimaldi, Levante Editore, 1994 - <http://www.levantebari.com/fcibemis.htm>

Grimaldi turns great interest to architectural documentation with the use of new technologies following the development of digital technology in Photogrammetry and starting, in recent years, the study in addition to the finalization of the survey, the proper use of laser scanning 3D and thermographic technology in architectonic documentation.

Focussing the documentation of cultural heritage as evidenced by the last "business" of initiating a "Center for Documentation of Cultural Heritage on line in South America" <http://coifa.it/patrimonioonline/> with the sponsorship and contribution of the University Central of Venezuela (UCV).

Finally, the participation in and publication of some 50 works, most of them in international conferences (Spain, Poland, Romania, Greece, USA, Brazil, Venezuela, China, Costa Rica, Iran).

At the moment Pietro Grimaldi is in the position of expert on the subject of photogrammetry and 3D laser scanner in the Politecnico di Bari (Italy).

## CONTACTS

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