REMARKS ON THE USE OF ANALYTICAL ORTHOPHOTO SYSTEM IN NON-TOPOGRAPHIC PHOTOGRAMMETRY

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ABSTRACT

We refer to the current study on the utilization of an analytical system of orthoprojection in non-topographic Photogrammetry and particularly in the field of Architectural Photogrammetry.
There has been, in fact, some quite noteworthy interest in the application of the process of orthoprojection in that sector for various reasons.
In this report a few problems are described which, presently, either limit or render difficult this type of utilization, especially in the case of surface particularly irregular and/or profusely detailed.
A brief outline will be given of a complete general methodology for the survey of a constructed object-a building for example, on the systems available; and a few brief but critical considerations will be made on this methodology.
A few disadvantages will be demonstrated regarding the orthoprojection phase, due to the velocity of the image and the dimensions of the slit. A few practical proven solutions will be indicated with other possible future solutions which suggest intervention on a software level in the general operative program of the orthoprojector.

I would like to refer, herein, to a study under way on the utilization of systems of orthoprojection in the field of Architectural Photogrammetry. Everyone is aware of the application for more than a decade now of orthoprojection in the field of Cartographic Photogrammetry.

From the very beginning, this particular utilization arroused considerable enthusiasm, but contemporarily posed a series of problems regarding several aspects which are still under discussion today.

There exists also a noteworthy interest in the application of orthoprojection in the field of Architectural Photogrammetry.

The main and fundamental reason underlying this interest may be singled out in the possibility of obtaining a complete metric document of the monument, and therefore, one rich in information both geometric and qualitative which can derive from a metric photograph.

This utilization arouses considerable enthusiasm, but it also poses a series of problems, a few similar, but many quite different from those present in the cartographic application.

In this brief relation only a few of these problems are presented which now either limit or render difficult the utilization of the orthoprojection in the above mentioned sector.

It is to be remembered that resorting to the rectification technique in the case of level surfaces to be surveyed is the first satisfactory solution to the problem, particularly from an economic point of view.

This might be the case for example with surveys of regular facades in non-topographic Photogrammy: unfortunately, often for reasons of limited operating space available (for example the frequent need of surveys of the surfaces in the narrow streets of historical old sections of cities) the exposures, at least those pertaining to ample surfaces given that they are economically appreciable, can be effected only with considerable convergence angles which usually in the end are obviously not accepted by the rectification instruments.

If then the surfaces are not regular, the rectification if practicable, presents inacceptable planimetric errors.

This necessitates, therefore, recurring to the photogrammetric restitution, technique valid for surveys of surfaces no matter how irregular. And this is what has been done.

The proposed utilization of orthoprojection would give us back a photographic end product, even for quite irregular surfaces.

Recurring to this method results to be simplified by the fact that the orthoprojector can today be an "analytic system of orthoprojection" (A.S.O.) and therefore a process that is more complex but surely more flexible, and in respect to the, let us say, "analogical" projectors, capable of a much more ample type of performance.

The orthoprojector can obviously be used in its lower limitation to effect rectification also: in particular, knowing only a few points, for example only four (plano-altimetric), situated in corner position, the calculating program organizes interpolation among them: the result obtained is better in quality than with normal photographic rectification procedures; furthermore, it is obtained more quickly, because almost all of the preparatory work is carried out by the calculator of the orthoprojector; theoretically, it has no limitations as far as angular parameters are concerned.

However, as we have said before the most interesting applications regard the survey of irregular and highly detailed surfaces.

Let us first of all mention briefly a methodology for obtaining the kind of survey able to be used for an analytic system of orthoprojection which has been widely experimented by us.

The stereoscopic views and the control points are effected. On a restitution instrument, better if an analytic one, the photographic stereoscopic couple is mounted; and the internal and external orientations (relative and absolute) are effected.

Appropriate series of profiles or a certain number of opportune points of known depth are recorded.

If the orthoprojection is meant to be a complement to the restitution, then the normal restitution continues, perhaps reduced, drawing perhaps the lines of the surface deemed to be fundamental and if necessary effecting a representation with Contour-lines.

If, however, the orthoprojection is considered a substitution for restitution, the recording of the above mentioned data can be the end point.

In that case, the orthoprojection procedure is carried out (if the known depth points have been recorded, then we must have at our disposal a particular program allowing us to calculate from the recorded points the altimetric profiles) again with the possibility of utilizing an input photogram even one different from those used to form the model in the restitution instrument (here, we are referring specifically to utilization of an A.S.O. and in particular to the Orthocomp Zeiss and to the O.R.1 Wild).

We see that both in the case of complementarity or of substitution it is, at present, always necessary to pass through, a restitution instrument, so as to obtain the necessary altimetric data for orthoprojection (in fact, they are rare cases where the material is already available from which it is possible to deduce this information, as can happen, however, in Cartography).

As far as work involved the two solution most certainly differ one from the other.

The final product can in any case be the same, resulting from the combination of restitution plus orthoprojection in the first case, and in the sole orthoprojection in the second.

A few brief remarks on the methodology indicated are necessary: the camera operations must result to be more accurate than for the ordinary work involved in picture operations for restitution: in fact the orthoprojection of a bad photograph (bad due to over or under exposure, to much or too little contrast, blurred, etc.) without a doubt will be a bad orthophotogram.

We remember, of course, that from an original in color, we are able to obtain an orthoprojection in color: also, in this case, a good photograph can mean a good orthophotogram.

The control-points must be found on the surface of the object in question by the orthoprojector.

The recorded profiles must be studied carefully: everything having to do with the surfaces to be examined must be decided upon the direction and the length, the width between the various profiles (variable or uniform), the density of the points for each profile.

The recording of all this data on the restitution instrument must be compatible with the unit for reading the input data of the computer system of the orthoproiector.

In the surface of the object, even if irregular, does not present unexpected variations of "depth", the orthoprojection process will not present any particular problems.

But if there are rapid jumps in depth, as often happens, in particular with architectonic surfaces or where there is more than one different surface, at the present time anyway, orthoprojection gives rise to considerable problems.

The architectonic contour lines, for example, (usually segments of straight lines) come out clearly deformed in the orthophotogram and in some cases even crushed; they can cause blurring which on the orthophotogram are always ruinous for entire zones of the surveyed surfaces (the image, that is, results blurred and illegible).

If, in fact, there exist rapid variations in depth (even if quantitatively speaking not noticeable), it should happen that even the movement of the images given by the optic-mechanic system of the orthoprojector (usually consisting of a zoom lens

and therefore an element which has the function of enlarging or reducing the image; by a suitable prism that is an element which has the function of turning the image and from the projection slit, supported by the opportune mechanical elements) should have the capacity of adapting itself, functionwise and in accordance with the dimensions of the slit used.

They can, therefore, distinguish for the purpose of simplifying a problem related to the velocity of the images and one related to the dimensions of the slit.

The first, having to do with the movements of the mechanical elements, seems to be difficult to solve in the context of the current philosophy of instrumentation function.

The second problem, on the other hand, has already been faced by the manufacturing firms which have reduced the size of the slit to the dimensions of 0.2 mm (Zeiss Oberkochen) and 0.1 mm (Wild, OR 1 per b/n) while the length is variable from a minimum of 2 mm to a maximum of 16 mm (OR 1: da 3 mm to 16 mm, step 1 mm; Z2: 2-4-8-16 mm).

Perhaps even more inferior dimensions can be reached (for example inferior to 0.1 mm in size) and this then could facilitate the resolution of the problem posed, even if it then will create a necessity of a more delicate procedure of production of instruments.

Let us take a look at how, at the present, we can solve these problems of orthoprojection and how they can be solved in the future. It is always valid to take into consideration the fact that orthoprojection usually takes place on a surface called a projection plane: if therefore, care is taken to refer only the basic suface, by means of the opportune choice of control profiles and of the points of the profiles on the surface, a good orthogonal projection can be obtained at least of the points on this surface: points belonging to other surfaces, in overhang or in depth, will obviously result to be in wrong positions according to their dislevel; in respect to the fundamental surfaces dragging down effects on the images are avoided.

If then we wish to project other surfaces correctly, we can take care in repeating the operation of orthoprojection laying down the new surface in question in the same way that we have seen and proceed in numerous passages.

And finally it is necessary to put together with a photographic montage, various previously effected orthophotograms.

The method is certainly laborious and in a certain sense reduces the advantage of orthoprojection as a quick survey procedure.

The other way of solving these problems is by means of intervention using software, that is in the general operative program of the orthoprojector, all necessary interventions cn the instruments effected previously.

This type of intervention should permit the evidencing of, by means of calculation, more than anything, the jumps in depth not to be disregarded along the surveyed profiles. In correspondence to these points of discontinuity and for the correlated combination of these points, the image then should be able to block itself so that the projection can be effected in a way that is adeguate to the situation being examined.

The variations in velocity should, therefore, be linked automatically to the above investigation until it becomes easy to to reach zero velocity, in order to give the optical system the advantage of the instrumentation of enlarging, turning and

translating the image, according to necessity.

This is quite easy to say and perhaps a bit difficult to carry out, but certainly not impossible with current technilogical knowledge. We must remember, however, that the problems examined are characteristic of non-topographic Photogrammetry and only in part are of interest to Aerial Photogrammetry; therefore, there is no real interest on the market or anyway, the interest is limited to that sector of the manufacturing firms concerned with solving these problems.

Perhaps these limitations are one of the reasons for the difficulty that presently exists in the application of orthoprojection to surveying of an architectural type.

Orthoprojection, however, represents, a need, one that I would say is indispensable, to Architectonic Surveying for the completion of the information that it supplies, information which gives the possibility to be totally knowledgeable of any architectonic structure at all. As a support I do believe in it as fundamental, for example, to restoration operations and similar.

And therefore, I do certainly hope for the overcoming of these problems. This is the direction of our studies.