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## Abu Simbel

### A re-lecture after half a century

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**Abstract:** In the past century, at the end of the fifties, the project of the Aswan High Dam, put the monuments of Nubia in danger. UNESCO promoted the “Nubian Campaign” to involve western countries in the salvage of the Abu Simbel Temples. The survey of the area, essential for the operations, was made by the Institut Géographique National Français (from 1956 to 1963), using innovative – for those times – technologies like photogrammetry.

As it is well known, the salvage of the monumental area was done cutting the statues and the buildings in parts and moving them to a safe position near their original site where they were reconstructed in the best possible way. After 50 years, it is possible to attempt a new reading of this impressive operation, analyzing the original photographic survey made by IGN and applying the same methodology used in the past with a computer software: through the stereoscopic photographs and the coordinates taken during the survey campaigns it is possible to digitally reconstruct the main parts of the Great Temple façade, into a digital 3d model. This will be an interesting contribution to the knowledge of this monument, offering a reconstructive representation of the original temple. But the research project is intended to go far beyond this step. In the next months it will be possible to document the monuments by means of laser scanning, there will be the opportunity to compare the old survey made on the original site of the monuments and the new one on the actual dislocation to compute a map of differences, which are due to possible erroneous reconstruction or changes with time, and to investigate the state of the monument in details.

The poster proposed here will show the state of the work in this challenging research.

**Keywords:** Abu Simbel, Nubia, Unesco, Photogrammetry.

### A short history of the monument

The two Abu Simbel Temples were created by King Ramses II during the 12th century B.C., in Lower Nubia 280 km south of the First Cataract of the Nile, at Aswan. They are two rock temples of different size, situated on two sides of a natural recess of a hill. The Great Temple was officially consecrated to the gods Amun and Re-Horakhty: indeed the Great Temple was executed for the king, as an incarnation of the god Horus. The Small Temple was dedicated to Nefertari, the great royal spouse, identified with the goddess Hathor. Both temples were hewn out of the rock and each consists of an outer façade and of inner rooms, 14 in the Great temple, and 5 in the Small temple. The Great Temple façade has a width of 35 m at the base and 29 m at the top, and a height of 32 m. It is dominated by the four colossal statues of Ramses II himself, each about 20 m high, and in addition, a great number of smaller statues. The Small Temple, originally located just above the high-water level of the Nile, has a façade 27 m wide and 12 m high, is dominated by six upright statues 9–10 m high, four of Ramses and two of Nefertari. The temples remained unknown until 19th

century. The Great Temple was located by Ludwig Burckhardt and then released from the hill of sand that covered the façades, by Giovanni Belzoni in 1816. The French-Tuscan survey mission, in 1828, was the first interested in a modern documentation of the temples. Plans, fronts, epigraphs and colours were studied, drawn and collected in publications by architects and archaeologists under the guide of François Champollion.



Fig. 1 – View of the Great Temple Façade (Ph. Elena Fabrizi).

The temples, since their discovery in modern times, have been always an object of interest, and they have left in their original condition until the 20th century, when progress and technology challenges came. The revolution of 1952 aspired to an economic and social renaissance in Egypt and one of its vehicles was the Aswan High Dam. The production of electric energy, the improvement of agricultural land, the prevention of Nile's floods leaded by the dam were urgent facts, more than the sacrifice of Lower Nubia and all his archaeological sites. In 1960, the great works began officially: they have been completed ten years later. A very small number of monuments could be saved from the submersion, and for this reason, in 1954, UNESCO entrusted the inventory and the documentation of the archaeological sites to the new-born "Documentation and Study Center on history of the art and civilization of Ancient Egypt".

In this way the Nubian antiquities wouldn't have completely lost even if the original couldn't be saved. The Documentation Center consigned the task of surveying the temples to different groups of specialists and institutions. The missions had their headquarters on boats docked on the Nile shores, supplied with a photographic laboratory, and advanced technical equipment. Every national mission could bring on their surveys on the temples. Every hieroglyph has been copied by a group composed by Egyptian, Italian, British, German egyptologists; the Greek engravings, and inscriptions in any modern language, were studied by Egyptian and French epigraphists. Archaeological descriptions were made by Egyptian, Italian, French

egyptologists; architectonic surveys by an Egyptian and a Swiss architect. Pictures by Egyptian and American photographers; drawings by Egyptian and french drawers; mold and models to Egyptian artists, photogrammetric surveys by french surveyors from IGN "*Institut Géographique National Français*". It performed the duty in many photogrammetric survey campaigns done from 1956 to 1963.

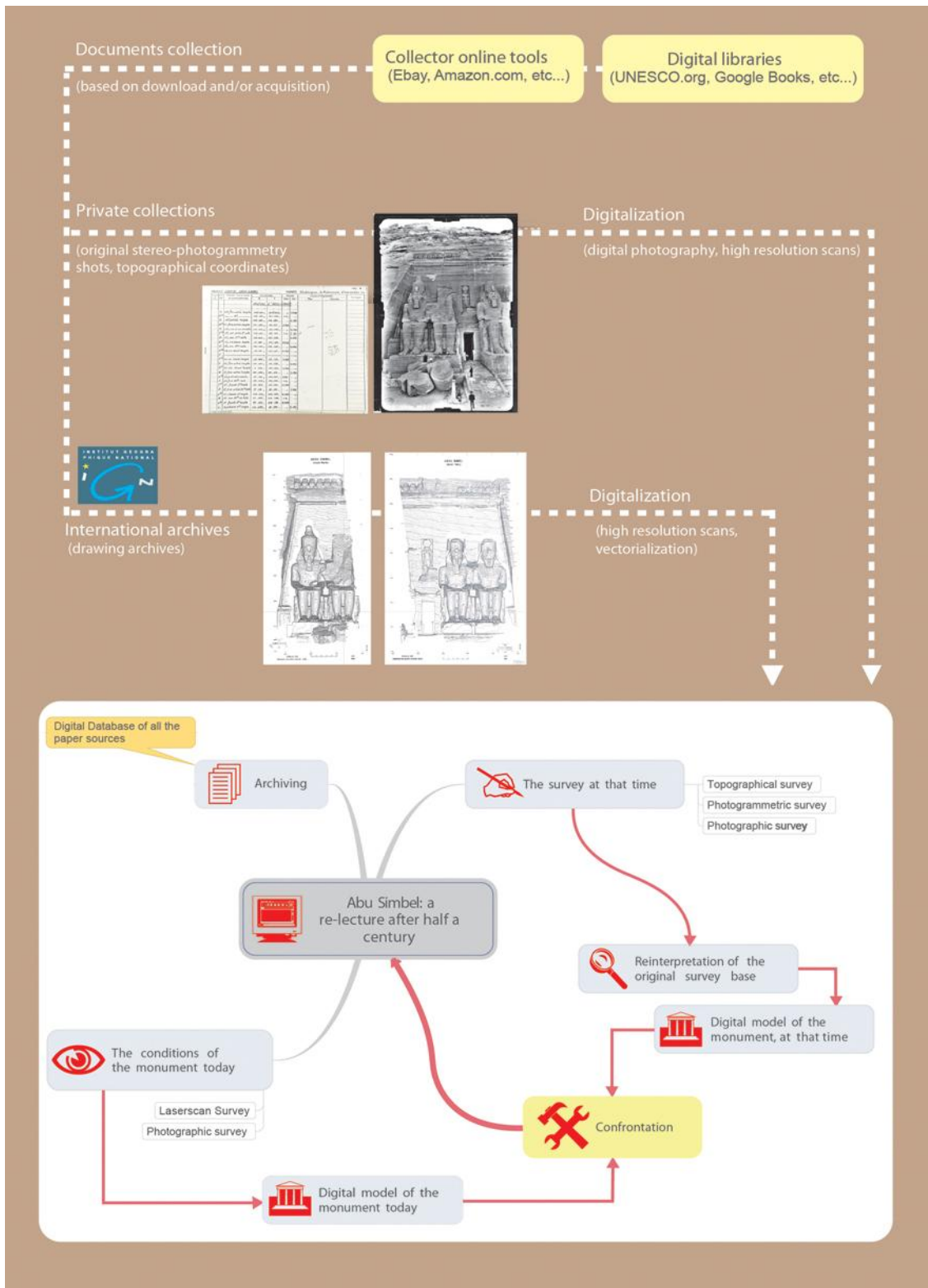


Fig. 2 – Schematic model of the collection of monuments and digitalization process.

The Nubian Campaign to save the monuments, officially began the 8th March 1960 with the appeal of the UNESCO Secretary to the governments, to public and private institutions and foundations to contribute with services, instruments or funds. The salvage operation was an outstanding example of collaboration between people of different categories and professions and also many different nations. Until this time, every monument situated inside the borders of a country was that country's affair. Since the Nubian Campaign a new idea was born: monuments were considered as part of the Cultural Human Heritage and became subject of interest for the entire international community.

### **Collection of documents**

The search for documents has been largely helped by the Internet and particularly by the UNESCO website. The international character of the Salvage project, the press campaign all over the world, the different nationality of the researches done in the field fifty years ago, fragmented the whole documentation. The collection has been easier through on line collector sites and digital libraries. Tools as Google books, Amazon.com and Ebay.com helped us to find paper documents in University libraries or buying them from private collectors (from Italy, UK and USA). To manage the large, enormous amount of documents written around the world about this monument and about its salvation, a specific offline database has been built, it collects all the records about this library and it was developed little by little incorporating each meaningful document. In this way it is possible to quickly investigate all the resources organized inside this research. Obviously it allows a good query inside the whole archive, accelerating the whole retrieve process. The progressive digitalization of the UNESCO library is giving us a wide panorama of the subjects involved, without necessarily being physically inside the library. This would have requested a really long time, since the material on the subject (newspapers, magazines, books) is huge and written in different languages. Obviously, the easiness of the download really helped making more affordable this phase of the work. On the other side, the photogrammetric material has been collected from private collectors and IGN archive. The documents, pictures and sheets, both on paper, have been digitalized in high resolution photos and scans. These scans have been converted into vectors using Autodesk Autocad in a long operation of following each path of the contour lines and re-drawing them. In this way all the drawings has been accurately transferred into the digital age, allowing the use of this data inside a CAD environment and making it possible to use this information for new modeling from the survey data of the original monument. Even if this is a time consuming task, the choice to almost manually redraw every line allows a great control on the accuracy of the resulting digital tracing. Before deciding to complete this task in this way various automatic tracing software were tested (Softsoft Wintopo, Avia Scan2Cad, AlgoLab Raster to Vector Conversion Toolkit), but none of them was capable to offer the same correspondence between the original image and the result if compared to the human drawing process. It is worth to say that in our research we were mainly interested in the photogrammetric survey done by IGN. We are now completing a digital data-set of the state of the Temples before the moving and in this first phase of our research we concentrated our efforts towards the Great Temple façade. This is due both to the dimensions of the area and to the fact that we easily found a very well preserved drawing of this part of the archaeological site. This part of our work we consider as the first fundamental test of this research.

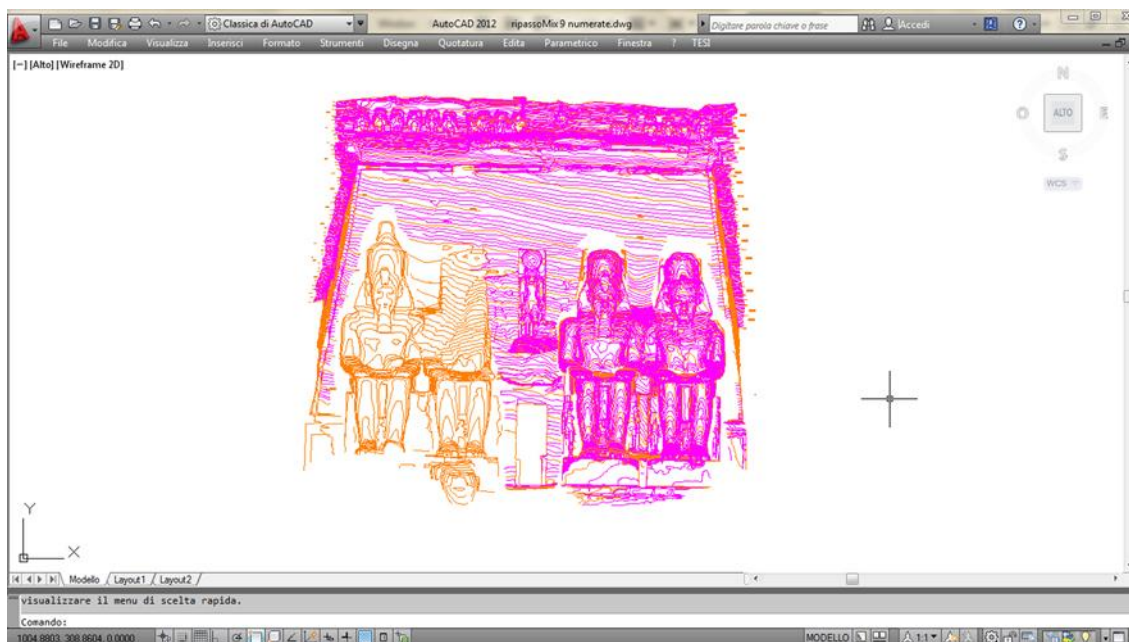


Fig. 3 – Screenshot of the re-drawing process. Contour lines of the Great Temple Façade.

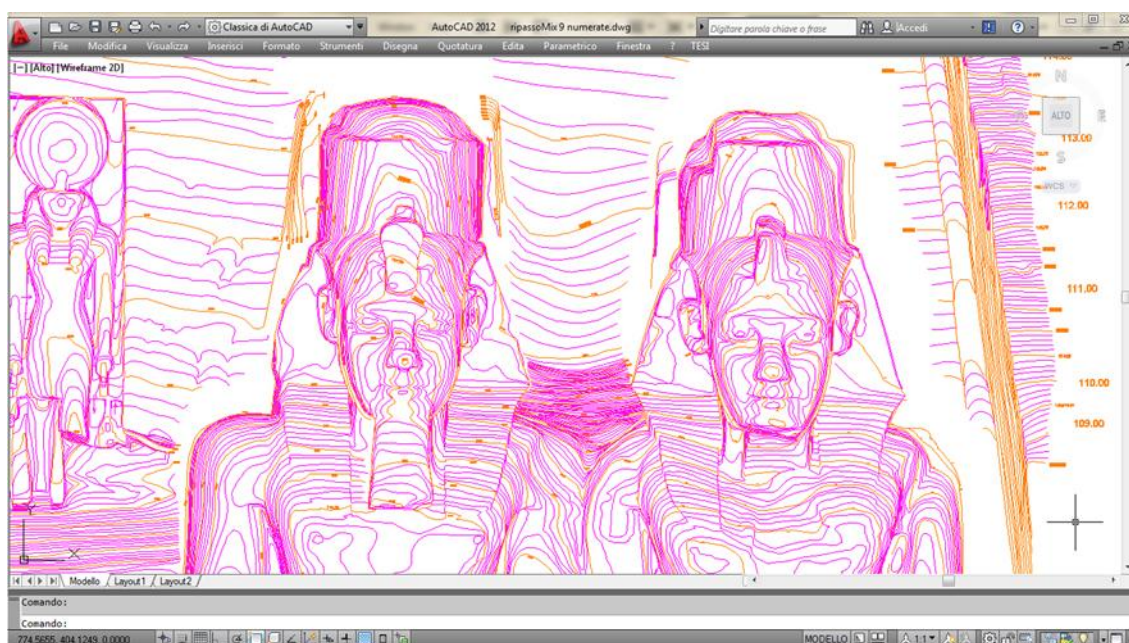


Fig. 4 – Screenshot of the re-drawing process. Contour lines of Pharaoh's heads of the Great Temple Façade.

### Photogrammetric survey

The photogrammetric survey of the temples was entrusted to IGN by the "Documentation and Study Center of Ancient Egypt". Photogrammetry was used to survey monuments since the second half of 19th century, and was born together with photography. It is a science based on perspective laws coded by descriptive geometry. It is commonly used for topographical survey with aerial measuring pictures, for architectural surveys with precise terrestrial measuring photographs, and it was applied to the temples' site in similarity to terrain surveys. In particular, in Abu Simbel, IGN used stereophotogrammetry: a branch of this geometry

based technique that involves two photos of the same object, taken from two different points of view. Through a mechanical, analogical or digital machinery it is possible to have a three dimensional view from the stereo shots, to see the different levels of depth and to draw contour lines of the temples in the same way as for land surveys.

IGN surveyors took the stereo shots of the exterior parts of the monument with a 13x18 cm (5x7") precision view camera (the contact print available from the "Istituto Papirologico" in Florence clearly show this), working inside and outside the temples. It was a very professional solution for that time: glass negatives have been used, in order to minimize negative distortion. Developed with field equipment, and soon being contact printed for security as well as for the fieldwork images.

Within the photographic campaign a series of points in a local XYZ system of coordinates were taken, such which are best visible also in the stereo images. Each of these points was precisely located with a needle in the field-copies and numbered in order to guarantee correspondence between nature and photographs.

These so called "passpoints" had to be visible in both perspectives of the stereo pairs.

Today we want to use these photos to have a survey of the monument as it was before the dismantling and the moving. We have the source shots, the system of points and the resulting contour lines, but no correspondence between them. We have couples of shots referenced with coordinates: on every picture there are at least 6 points that, most important thing, don't belong to the same plane. Their position is known in a XYZ system so it is possible to set a relation between the 3D space and the projective plan of the two shots. The real problem to correctly use these shots is the missing data about the orientation of the pictures. Computer technologies help us to provide for it, thank to the modern digital photogrammetry we were able to get through this lack of knowledge. Using an AutoLISP code it is possible to bypass the problem, through the known point coordinates in a 3D Autocad space. AutoLISP is a programming language, specific for Autocad, it enables group of existing commands to encode procedures. Knowing 6 non-planar points, with their coordinates and their position on each shot, it is possible to determine a projective transformation matrix associated to each picture. Having at least one couple of pictures and their associated projective matrices it is possible to determine the position of a point in coordinates XYZ from his two projections on each shot. In this way it is possible to draw contour lines (using the polyline drawing tool).

This method allows the correlation between the real point in the 3D space and their projection, and may permits also the opposite procedure, the reference of the 3D point to a point on a plane. This verifies the correctness of the process in presence of curved surfaces. As an additional feature, when it will be possible to survey these monuments directly a laser scanner campaign will be planned, it will allow to project the new real condition of the object in the old pictures to compare the new with the old and to see the probable differences after the moving. The comparison will also be possible between each single point in the ancient 3D space and the actual one in form of a point cloud.

## Conclusions

The will to investigate, understand and unveil something left inside this meaningful match between humanity, heritage, industrial needs and genius, is the backbone of this research, thus the incoming dramatic Egyptian events have stopped the whole process, the idea to develop a complete analysis about the condition of the

Abu Simbel monument is still at work. This intention is aimed to produce a definitive state of the knowledge about the sense and the real result coming out from this long experience, to bring to light the meaning of the whole operation. Was the monument saved or the transformation went too far off the original one? The following studies and the next steps in this research, now still under development will try to put an answer to this, according to the effective possibilities given by the global situation.

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