CARTOGRAPHY AND 3D MODELLING

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ABSTRACT

The aim of this research is to develop new methods of co-operation between cartographers and archaeologist by applying the latest developments instrumentation, surveying methodology and information management ; integrating the concept of Environmental Archaeological Park.

The proposal is based in two approaches. The first approach is to provide the archaeologist with precise digital maps and networks applicable to any excavation, by applying GPS and integrating it into the national and international co-ordinate system. We are working in the implementation of micronets for the mapping of the site area in scales from 1/100 to 1/500, depending on the extent of the site. From these nets the archaeologists and their teams could make their work easier. An example of this could be seen in the Recopolis case, in Spain.

On the other hand, to represent the Archaeology phenomena in a geographical area, it is necessary to connect these nets with the national or international geodesy. The nets implemented in the Sharjah Project are analysed with regard to their accuracy and possibilities of the Method.

The aim of the second approach is to investigate the design and creation of mapping documents which contain the archaeological information in two different formats : digital format for multimedia interactive applications and hard copies for general use.

The New Cartography models will enable the interpretation of the archaeological phenomena. The information has to be reconstructed and so new products are created. These new thematic maps could be given to visitors of the Museum or of the interpretation centre at the site. These documents could also support, in digital format, multimedia applications, and could be integrated into Internet web pages.

Finally, the research attempts enable the archaeologist to achieve the integration of the Archaeology phenomena in the environment, including them in the developing areas policies.

The project is being carried out jointly by Sharjah, in the UAE and the "Parque arqueologico de Zorita de Los Canes" in Guadalajara Spain.

The investigation project we are working about. has its origins in the excavation works of the archaeologist team of the Ancient History Department from the Autonomy University of Madrid. They are the owners of the site from Tuqueibah in the United Arab Emirates. This site studies an establishment of the 2.000 bc. which break with the theories of the nomadism in that area. It's one of the first establishments along the way of several products very important in that epoch, what come from India and provide to the towns of Petra and Alejandría.

The situation of this investigation and the historical reconstruction in that geographic area, needed plans of that establishment and the area around fields, to discover new ways of digging and do electrical experimental proves and another ones with radar. We had to choose among several scales, analyse the kind of details they needed, theirs ways of sketching, the archaeologist way of digging, etc. It was so, as we took part in the multidisciplinar team with the aim to obtain cartography.

To do the surveying we placed four control points marked with signs. The data were took with TC 1610 station from Leica. The work in field was through the triangulation and trilateration inside the quadrilateral and with mutual and simultaneous visual to the control of the atmospheric refraction. We began with scales 1/100 from that site and the altimetric detail were shaved with level curves at every 10 centimetres. In the following works we did a control of the stay of the signs.

Traditionally it's defined the beginning of one investigation as the fact meet us in the front of one doubt situation, what gives us curiosity and that carry us to continue looking for more data about that matter. In our situation we thought : Is this all what we, specialist in cartography, surveying and geodesy can give to the archaeology ? And we began to wonder us about new works.

We found with the support of the responsible from the Department of Culture of Information of the Sharjah Emirate, help given too by the Investigation Branch of the Polytechnic University of Madrid, and another by institutions among we point up the Technical University, the Chartered Surveying Association, Sokkia, Sigeo and SAF.

We have spent three years with this job and we are in front of five more years henceforth, because a new agreement of collaboration are going to be signed. We count with a strong moral help from the archaeologist World besides the ours. Our great strength is the illusion we have to realize our aim : show all archaeologists the great possibilities of our technology for them.

Our Project is called : *SHARJAH PROJECT : Landscape, Geodesy, Surveying, and Cartography in the Archaeology.*

Our work includes documents of general place of the sites, and the digging areas, to analyse the archaeological systems, and improving the processing of the information. We show two important points of view :

IN FIRST PLACE :

We want give to the archaeologist teams, accuracy cartographical documents which they can use. We want show them as the digital cartography becomes in the base of their information. We had meet us with archaeologist and technics of the teams of work who make the basic surveying of the site with any problem, non needing qualificated staff in the surveying matter. For that they have basic surveying methods, in short distances. They use too total stations easily. But when the area is big, they find problems in order to show the joint among several relative sites, which help them in the historic reconstruction of the epoch.

For take part in that question we decided in 1997 to stablish micro-nets in the digging areas, in the Yebel Buhais and to join them with the Tuqueibah´s ones, using GPS technology.

The main point of our work is the fact to prepare the campaigns for manage unknown fields works. The general design of the project is made in Madrid but it is in the Emirates where really we realice about the great dimensions of the work and about the tasks we must develop. We have basic ways of work but at the same time we must resolve which they gave us during the campaigns. By other hand it is necessary take a great number of data which provide us with enough redundancy as to have the security about the results.

We have talked about two great lines of work, the first give accuracy cartography to the archaeologist teams, and in this line we have made documents at 1/50, 1/100 and 1/500 scales, with 3D representaion. The follwing are aimges from *Recopolis*, in Spain.

In this way too, we are processing the cartography to make maps of general situation, and we are using them by the archaeologist area of Al-Madam. In these days we are working in one main map of the Emirate in order to make bigger the area of site in the next campaign. The original documentation was gave by the Department of Culture and Information to us, are 8 maps of 0,8 meter x 3,20 meter in UTM projection at scale 1/25000 feet, equal to 1/6250 in meter. This documentation is dated in 1992. The origin of the heights is the sea level in Dubai, and all area is in the zone 40.

From the digitalicing of the mentioned maps we have obtained a topographic map of the Al-Madam area at 1 1/50.000 scale. In this one we have placed the archaeologist sites, and the graves, using the coordinates of the control points which were viewed by GPS technicals in the 1997 campaign.

In 1998 we took the data to do the update of it. The survey of the field had as first aim the right interpretation of the drew details. The area of the map is one superficie of 40 x 20 kilometres. In the United Arab Emirate we were surprised by the quickness with which the geographic changes are given, and by the fact that the details that for us are steady, aren't there. The geography is showed here as an dynamic science to which the cartographic ones with their modern technology have many to offer. We must be available to interpretate and show all that morphologic information through our cartography. We must become living to all of we create.

IN THE SECOND LINE :

We pretend create cartographic models which help to the divulgation of the archaeology phenomenon. When the cartography are made we want to broke with it and work in the design of symbols, and in all the component of the map or plan. This new documents have two aims, according to the output format :

- in paper : as data of divulgation in Museums and in Documentation Centre.
- in digital format : to be used as experimental plays in computers and to become the basic of Multimedia applications.

The way of this line of work we can see it in the image. We are trying make maps show together the sites and the Archaeological Museum of Sharjah mainly. The data use to make those maps come from the Atlas of the Emirate of Sharjah, from photographs took at the places, from images through Internet and tourists information from the own Emirate and from its Embassy in Spain.

In the tourist maps of Sharjah are included tridimensional images of the buildings which have certain cultural historical interest. The same as another images which improve the cartography and became it, one document more attractive for the public.

The cartographic processing wants recover the typologists of the old cartography with the modern technologies, in order to find new designs.

The cartographic models of divulgation have two main archaeological elements :

* the sites, before mentioned
* and the objects located in the sites.

For the description in detail of the archaeological objects we are comparing the results obtained by a photogrammetric way and by a photographic representation. For the photogrammetric method we have used non-metric cameras and we have obtained tridimensional views with millimetre accuracy for the details. The non-metric cameras gave less cost, but they need more control points. The methodology has been applicated to a part of a column from the 18th. Century in Spain, as an example.

We made the restitution and we took one group of points and lines after we generated one area which showed the surface of the object which a group of triangle in the program *MGE Terrain Analyst of Intergraph.* We assignated textures and illuminations with *Microstation*, and finally we did as example a tridimensional anaglifique view with *Render Stereo 3D*, which allow us to observe the volume with the glasses all know. Besides we took a film, from one previous defined trajectory with *Microstation 3D*, and we have included it in the multimedia application.

For the description of the architectural structures of the sites, we are working using the classic surveying methods and the photogrammetric technology. For that we have two projects in course in the site of Recopolis in Guadalajara, Spain :

* Obtaining of one virtual model of the Church of Recopolis.

* Obtention of the tridimensional model of the archaeological ruins of one Palace and its surrounding by topographic techniques.

In this way of general design we are thinking about the cartography was included in Internet. We had proposed a model as an example. It is one web page which has text, images, graphics and links. We can't forget about the considerable public who use this net, and its possibility to offer new products as cartographic documents what is our job include.

The maps are images in which are defined some active areas associated to links, to push the icon over one of those areas its possible receive as answer from the server one concrete page. This kind of use of the cartography approach us more to the 21st. Century. The continue references and links do more easy to the public the navigation system. In the work we are showing the access to the maps is made by icons (images in GIF format) what show the index of all we can find. By other hand we had tried that the web page become exciting and that everyone who open it is interesting about that and about the geographic area which draw. With this web page we propose one way in the jobs to transmit the archaeologist data, the sites and the museums of Sharjah take advantage of the sources of the actual cartography technology, mingled with Internet.

Another focus of the research links the environment and the archaeology. We are trying take part in the teams of development and environmental control investigation, which are made in every territorial intervention. The design are preparing to the site of Recopolis applying the thematic too, so as the main cartography to scale 1/1000, showing the application of the concept of the archaeological environmental Park. The idea of that is spread the cultural uses and the way of life of one establishment but relation it directly with the surroundings in which it is placed. By this way the question about landscape, relief, flora and fauna of the place give more interest to the visiting and help to understand globally the archaeological discovers. We are working about the study of the site, study of the terrain, study of the landscape, and study of the routes. That will include round ways with arrivals and departures points, along which is possible see the elements of the site and at the same time the natural landscape. This is our project plus the Multimedia application including the data obtained by our team, that we are going to show you.

Beginning to work with the archaeological teams we have found a clear difference between the situation of the investigation in the experimental sciences and the technology is being to the Humanities. For the engineer is possible study, analyse and improve the technical and method but it is not usual applicate them to another subject, in special to the archaeology.

Our aim is not stay as surveyors or cartography specialists at the foot of the digging, our real job is create ways of work making a general treatment of the cartographical divulgation documents of the discovered elements. The subject of our study is the archaeology and the object is the application of the Geodesy, Surveying, Landscape and Cartography technologies. We have the sure idea of that to our subject "the archaeology" we can apply everything. We can talk about remote sensing, photogrammetry, gravimetry, all kind of surveyings, cartographic designs, treatment of the information through GIS, geodesy, applications of GPS, applications of non-accuracy instrumental, basic sketching and the last programs of edition and draw.