Digital Realities and Archaeology: a difficult relationship or a fruitful marriage?

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Abstract

As we stand now at the end of year 2001, supposedly time for the miracle of the Space Odyssey, it looks like most of the archaeologists or keepers of the world heritage do remain "Indiana Jones without even a whip". Far from the dream equipment used by most of the known Tomb Raiders or Sea Looters, we still have to deal with very pragmatic realities that seem to keep us from using most of the recent technologies poured over our heads by an overwhelming industrial development.

But at a time when Hollywood is overusing them to bring to the wider and money spending audiences a vision of our past that is more and more attractive but also disturbing when not totally false, it seems right to try at least to take these techniques over and to try to deal with the new ways they bring not only into the presentation of our research but also in our ways of dealing with the data we are recovering over the years.

While recent encounters around this topic have turned into the sad but truthful acknowledgement of the difficulties that remain in the use of digital technologies to reconstruct the past we are slowly but also more and more precisely recovering, it is important to take note of old and recent achievements that show that a difficult relationship does not have to lead to a divorce. And maybe also be that childish dreams do not have to be forgotten along the way.

These encounters have also clearly shown that scientists working in the digital fields are eager to help us to apply their research to our own, not only because "Archaeology is cool" as someone preciously reminded us, but also because problems we are actually facing represent problems not encountered in other fields, that can open doors on new fields or research for both communities.

We are just at the beginning of a new age in archaeological research and it would be a shame to straightforwardly but bluntly reject new tools just because they are costly, difficult to use and disturbing for our own precious work habits (Though in fact these can look like pretty good reasons to turn back to paper and pencil).

There shall soon come a time when all this shall have become of daily use for most of the good people we are actually working for, and the children of today might very well laugh of our technological fears and shyness. It is a necessary evil to be today the guinea pig testers of these technologies, to be riding the wave while surfing on the net, to be prepared for the revolution these things are bringing in our ways of dealing with our past and turn it into virtual but life-like realities that can be easily comprehended by a wider audience, while also opening our own scientific minds on realities we are not even suspecting to exist today.

Transcript

What I am going to present to you this morning has to be seen as a very personal approach. Following, , I shan't obviously try to present a computer scientist's view: Even if I have been working with computer graphics myself (or at least trying to do so) for years, I was never really trained in computing. By skills and heart, I am an archaeologist and I'm trying to remain one. So my reaction will be one of the archaeologist.

The first thing to note is that up til now, most of the computer graphics that are general knowledge are coming from the movies. We can begin with something that most of you will have seen, something from the film "The Mummy". From the computer graphics point of view, my impression is that it is very good and even impressive. But as usual if you try to take a closer look from an historical point of view there is not one thing that can be said to be "right".

First, this is supposed to be Thebes during the reign of Sethi Ist. But you can see the pyramid in the background, which is situated near Cairo about 800kms to the north. Anyway, I tried to look a bit further in the movie and I watched the City of the Dead sequence. Again for an archaeologist, it doesn't look like much. Even if you're not an egyptologist, this lady to be mummified is furbished with five very nice vases or canopic jars, whereas in any museum or collection you will see hundreds of sets of only four of them. So the first thing to ask is why the set designers working on such a Hollywood feature film would chose to put five jars in the scene and thus specifically show something that has no known ties to any reality. Discussing this with some people who are doing the same job, they told me that they are doing this because it just looks "cooler" or "nicer" on the screen. But unfortunately, even if this may look like a very small detail, they are at the same time passing to the audience a very wrong notion, while the same audience has at the same time the right to believe that the documentary aspect has been dealt with correctly in a reconstruction that costed a few millions of dollars…

So what can we do about this? Or do we want to do anything about this? Do we want to make 3D graphics representations of the past available to wide audiences and try at the same time to convey the right information? My answer is simple and straightforward: one way or another, working with talented 3D graphics designer or trying to do it by ourselves with our limited skills– we should at least try. For instance this is a model that I've been doing myself this year of a gallo-roman temple in France. Building it by myself, I've been doing my best, but the result of course is not the best quality in computer graphics right now. And from ana rchaeological point of view, it is maybe bringing more questions than solving problems. But still it's a very nice and different way to show things to the public when you know that the ruin itself is actually looking like this and there is no way to see or understand anything of the past grandeur of the site when you are visiting it as a mere tourist.

So the question is "What do we want"? Basically, our first call would be for accuracy, some kind of truth (even if we don't exactly know what truth is or was), to bring some sort of truthful communication to the people. Most of the time their access to historically based 3D graphics are feature movies bringing in romance, history and fun. And I would say myself, that's why I like movies! If we cannot work daily on movies we can at least try to be aware of what is possible today with computer graphics, maybe meet the industry in the middle of the road and somehow convey more of our meaning to a wider audience.

 I want to go back a bit to the basics now. Before we can give reality to a dream, and I don't really know whether it's a dream for archaeologists to become either a consultant or to be actually working in the entertainment field, we have also to consider, as some of you already must have, that our way of dealing with the data directly on the site is changing pretty fast. Today we are supposedly speaking of archaeology, but my concerns deal on a more general ground with cultural heritage and I will show you some very different things because I think it is a way to get very different ideas from very different points of view.

So the reality of today enables us to get to the actual data through the use of 3D laser scanning. I have been lucky enough to use it myself for many years now and my testimony is that it really looks like the best thing available: from very different technologies, it is now possible to get virtual casts of objects and to use them in a computer and finally to work away from the site and the object itself. Maybe our first needs for this would be to collect the data with such accuracy that it could turn to be possible to replace the object itself if it was in any danger of being destroyed. Our first aim as scientists is, of course, to understand the data but in a world where heritage gets destroyed by the minute, it is also a very tempting idea to be physically able to save as much information as possible. There are many many threats going against the objects of our studies – mass tourism being one of them.

There are unfortunately still always choices to be made between preservation and presentation of heritage to a wider audience. So dealing with this kind of data, with this kind of accuracy, it is possible in fact to bring the information closer to, I would say, researchers first. For instance, instead of leafing through books, you can interact with a model that is actually moving and changing on the screen depending on the point of view you chose to deal with it.. You can take a look at a statue from very different angles, something that you cannot do while on site because the very same statue is set at about four metres high from the ground, so that you wouldn't see the details, were you on site.

So the first idea is to preserve information and to be able to deal with it, to see it in very different ways. And it is clear that it is already a very rich prospect. But it also brings clearly more possibilities for us to go a little bit further in our understanding of the object itself. For instance, if we take this medieval sculpture, as with almost any sculpture before the renaissance, we know that it was originally painted. So the idea is that we can digitally repaint it, propose to test different hypotheses or simply take the paint away at will. The interest lies in the fact, that, to actually do this scientific experiment and demonstration, we don't have to touch the object; we don't have to harm it in any way. It is just a brand new way to interact with the model we have constructed and the object we are osculting.

And the thing is that – if we are working carefully with the gathered digital data, then there is probably more truth in this polygonal representation than in the statue as we see it today, because medieval people who built this cathedral and erected this statue, never wanted it to be as white as it is today. So we can go back towards the ancient reality of an object, through a 3D object, which is a bit like a ghost of ancient reality. This declaration shall be seen by some as a bit over the edge, or maybe simply as pure heresy. But for me it is already a very big step for us and also for a wider audience, because it is a different way of getting access to the deeper nature of heritage, very different from the experience you can get just through looking at an object in a museum. It makes it possible to go close to it and look for details, to get your very own experience of ancient reality without actually interfering with what is left of this reality.

What remains striking to me is that what I'm showing you now is not just photographs of the object. This is actually images of a 3D scanning that has been transformed into a 3D digital object. Of course, the same thing could have been done with photographs, but through very difficult and time consuming work. What we are envisionning for the first time is the possibility of neutral documentation. But on the contrary, once you have a precisely documented neutral 3D object in your computer, it's very easy then to do this kind of rendition and to use it to access the different aspects that actually partake in the reality of the object, without having to deal with the physical necessities that come with the surroundings of the object.

In some ways, this in an exercice in bringing the past back to life. In some ways it brings us closer to accuracy and historic truth while bringing in also a little bit more fun to the experience. For the general audience, I think this kind of document brings in more possibilities of in-depth understanding, through the possibilities it brings to interact with the digital object. 3D scanning brings us very different possibilities. The digital data can be used to plan basic preservation work on the data; then to present the object as it is, but away from the site, and then the possibility of going further into the restoration work – to go further into presenting the historical object as it possibly was.

But this is also true about more natural shapes. People who are dealing with prehistoric art for instance tend now to think that most of the artistic value of the objects of their studies ends up in the shape of the rock they have been designed on, more than in the actual carving or the paintings. It looks today like the ancient people who have been creating these representations chose these places with great care and because they had specific shapes.

So it brings us to the question of things that cannot be seen here on flat 2D photograph, that 3D models can enable you to understand. I'm not saying that computer and scanning are actually solving everything. Of course the trained eye would be able to see those details. But with the available accuracy of today's machines, it is possible to get information which is very very difficult to see or experience even while you are on site. The novelty for me is that, you can get access to the work of art in itself, while actually being able to feel that it is still part of a natural wall and to understand the quality and importance of its actual context.

To go one step further in the reality of prehistoric rock art, I would like to remind you of other aspects dealt with during another experience led in the cosquer cave. First let me remind you that this cave, like most of the decorated caves, is not open to the public. But furthermore the entrance to this specific cave is under the sea now. Due to a climatic change, the prehistoric people were able to get access to the cave, which they decorated with hundreds of paintings. But then the water rose back to its actual level and in fact sealed the cave, preserving the paintings. That also means that until today only divers are able to get access to the

cave. Even the researchers have thus to be divers themselves to get to the "documents" and study them. So the idea was to in fact to be able to make a global archiving of the cave with photography and photogrammetry, but it was also for the first time that a 3D scanner was used in archaeology.

And it was actually used in very difficult conditions and the whole project ended up in being a very costly operation. And that is one of the questions that clearly has to be raised. For people who are actually working on site, it's almost always very difficult to bring just a simple computer. And here it was something that was costing something like $200,000 worth and it had to go under water and it had to work in very difficult conditions. But still. It was possible for normal divers to handle the machine that was connected to a computer on the top of the cliff way above water. So all this is to show you that even if it is not very easy to use and in fact a very complicated and somewhat fragile piece of machinery, it can enable us to deal with very difficult sites, helping us in preserving information that could not be dealt with otherwise. Through these techniques, you first get an x,y,z point cloud that is the actual digital cast of the scanned object. This point cloud can then be turned into a close fitted 3D mesh that can be finally linked to high quality textures, topologically related texture maps. You thus get 3D objects that are in fact almost exact copies of the actual objects and that again can be experienced by people that are very far away from the cave, a cave which is now in any case not accessible to "normal" researchers. But finally there is also another aspect of using computer graphics and going back to a virtual reality that normally we could not access. We should also try to use this possibility to get closer to something that supposedly is imagination. We thus have to consider elements that are not dealing with the deepcore actual data, that cannot be measured and stored somewhere, but with the very ideas of what was happening in this area in ancient times.

Even if this brings in the difficult topic, for archaeologists, of human presence in virtual reality reconstructions, we nevertheless have to take into account the fac that this cave was chosen by prehistoric people to actually perform some very precise and definite acts in a sacred space. As it is now clear, that it was not just a dead space, it was a very very sacred space where actual ceremonies were taking place. If it is already very nice to make as comprehensive as possible an archive and also to be able to deal with it and to inspect it afterwards from different points of view, we should also try to go a little bit further into what we are usually doing and to deal with information that is linked more to what we actually feel and believe. Because whether we want it or not, we are not only dealing with mathematics or archaeology. We are dealing with human beings who felt and believed themselves. I would say that most of the time, perhaps 50% of what we could say about ancient heritage is linked with our own deepcore human experience, things we are in great difficulties to explain and express but that form part of the realities we are trying to reconstruct. It is not only the data that we are working with, it is the human experience we are putting in fact in these scientific models that in my eyes is more important.

But one must also think about the possibility that there may also be an actual danger in that. Some of the models we are now creating are so realistic in 3D and texture mapping that it's very difficult to say if it's a model or just a movie taken from the cave. And you have to believe me but this is the actual 3D model. Playing with reconstructed ancient light, it is actually possible to try to look at these things in the way prehistoric people were looking at it, and to put more emphasis on the aspect of the natural shapes. To show how the drawings and engravings are playing actually with these natural shapes. It's a way of looking at things that has not been done for millions of years, because this is the cave without water and it's something that doesn't exist any more.

But let us leave the dark recesses of these prehistoric caves, to go back to a different set of more charming realities. We are moving a very long way into the future, and I shall now speak to you about an eighteenth century reconstruction. It's called a folly, a french word for madness. It's just an exquisite little building that has no evident use, set in the middle of a lake. It still exists so it's not actually an archaeological reconstruction, but it is in, I should say, such a desperate state that it's very difficult to imagine it as it was before. So I shall show you some pictures of the actual reconstruction and shall try to show you also how far it is possible to go with this kind of means.

Another interesting topic for those who have been working with computer graphics is the dissemination of the results. Most of the time, once you get a result, it's very difficult to pass it to other people without going

through a VHS tape or through a television set. Because in most of the cases, the data we are working with is huge. But it is the price to be paid if we consider that it's possible to see the construction from very different angles and, once defined, to use the same model to reconstruct very different aspects of the life of the building. Something as simple as just changing the scenery by going from bright summer to winter gives a very different way of looking at the same object and again I think it's part of its life and we have to really take these aspects into consideration.

The thing is that, apart from going outside, it was necessary to reveal what was inside the folly, something that has totally disappeared. Nothing is left for instance of the original wooden moldings, as unfortunateley everything was destroyed in a fire. We thus have to go into very careful documentation, to find parallels and use texts that describes what was there. Here you can see a parallel of a fireplace and the actual reconstruction. And we actually and fortunately know of this fireplace through a very precise text describing this small construction. It was a place for the gentry to have fun and so they had very nice furniture there of which again nothing was preserved. The only thing we know is the description of the fabric that was used to cover different pieces of furniture and so it was necessary to reconstruct everything from other known parallels. The text also speaks of an Ottoman, some kind of couch which came from Turkey as its name clearly shows. So these were all the little objects that were needed for the reconstruction, among them typical Chinese vases that were placed over the fireplace. So at the end you end up with also an interior, that is really looking like a brand new one (maybe too new), but still a very different way of looking at the monument than just visiting the little place in the dishevelled way it is today.

Then you can interact also with the actual model very easily, through a simple precalculated quicktime VR. And that brings us to one of the main points of my demonstration. Once the actual work is finished, it is very important for us to think of how we shall be able to pass this knowledge and this experience to other people very far away from our own offices, from our own computers. And also if we are thinking about our own colleagues, I know that for most of us just buying a laptop to go on site is a very important expense. So again it would also be very interesting to have this kind of results available simply on a web-site or on a CD-ROM. We do have to create very rich files to keep in a safe in a bank to save a precise image of ancient reality, but for our daily use or the daily use of our colleagues, we want to keep the same accuracy while processing documents that are useful and very simple to play with.

I thus tried to show you that when we are dealing with actual archaeological sites most of the time we are actually trying to deal with only that part of reality that we are able to gather from the preserved part of the data. Which means that most of the time we are reconstructing only the architecture. That is a very static and unhuman way of looking at human creations. For me it's very important that we feel that at any time these places were meant to be inhabited and used. People weren't building constructions just to have a neat building somewhere. It was to be used and to be used, most of the time, there had to be something and people inside.

It is thus possible to use this kind of digital documentation to pass very accurate information, but we are unfortunately stopping in our tracks because we are lacking information. Of course this is something we are very prone and right to do because we don't want to put in something that could be wrong. We know from experience that such a thing would not be questioned and would remain for years in a publication. But we clearly can't use this aspect as an alibi to do nothing. I think that there are some choices to be made.

For instance here is a pyramid dating to the Old Kingdom in Egypt. In this case, if the architecture is well known and understood, the decoration of the building is not preserved at all. We know the different kinds of material that were used, for instance alabaster for the ground and red granite for the pillars. But we know also that all the walls were decorated and that in these chapels there would have been statues. So that the choices that were done was to have a very rough, and I have to stress that it was an aesthetical choice, not just a technical problem, a very rough rendering of the decoration. Thus it was decided to show that there was something there, but not to be so precise as to impress the minds of the people looking at this in a way that this would become truth when we know that we don't have any data for this. We have the stars in the ceiling because we know this was a normal way for the Egyptians to decorate a ceiling, but otherwise we have only a few remnants of the scenes. So you will see that for instance in this chapel we have paintings

on the walls. There, the king is seating in front of an offering table. This can be infered from the few remnants of the decorations preserved. So it's possible to show that there was something such as this, but as you have seen, the choice that was made was to have a very faint representation.

It is thus more something like a feeling that comes through these images, not a photorealistic reality that it could transform it in a document by itself that in fact would bring problems of interpretation. This is important as we know that these sort of problems already exist for simple hypothetical hand drawings published somewhere without the necessary carefulness. Years later, another scholar wrote a new article, starting from this very drawing when the drawing itself can be in fact easily proved to be very doubtful or even totally wrong. So we have to keep doubting what has been done before, while actually keeping a doubtful and critical eye on what we are actually doing. We have to keep in mind that the documents we are preparing today are not the last and definitive. We have to keep open the possibility for researchers to question what we are doing.

Photorealism is thus a very potent thing because we are dealing again not with simple mathematicaly oriented shapes but with shapes that were created by human beings or with natural shapes. So if the rendering is not good enough then the document itself becomes shocking in some ways for the mind that is ready to criticize it and reject it only on aesthetical basis. But without tollay rejecting photorealistic rendering and its inner evocative richness, we are to take into account the fact that there are now other options: if we go into non-photorealistic rendering then we can pass the same information without bringing what looks like accurate but misguiding "truth" into the document.

To finish I would like to go back to the living reality we have to inject into these models through the use of virtual actors, animals or humùan biengs. The desert that surrounds today for instance this egyptian monument, was not a desert at all during the time of the ancient Egyptians. It was more like a savanna inhabited by wild animals. This is the reason why we have all these historical hunting scenes from the time of the Pharaohs. The archaeologist in charge of the project decided it was important to have all these animals around the pyramid context to show what actually was there in ancient times.

But we can even go one step further and consider that there are other ways of dealing with reality, thinking that maybe the best way of dealing with reality is when it's not real at all. This is another project and this has been done by a small but creative firm in France which is called *Art Graphique et Patrimoine* (AGP). It is to show you that it is possible to start from a book, not actually working on a character from the book, but on something that becomes quite a character in a book by Balzac: a nineteenth century family house turned into a boarding house. And so the idea of the people working on the subject was to try not to re-enact what was actually happening in the book like in a movie but to reconstruct the place that was described in detail, to bring out the living image of the architectural context of the action and to put it back into its historical context. So this is a typical parisian building of the end of the 19th century and it was done with a serious connection between the writing of the author and a complete architectural documentation of the time. Even for us who are used to dealing with raw data found broken into pieces in the ground, we can go, or maybe I should say, we should go one step further and use the possibilities that are offered to us by computer graphics to put again another layer of understanding. This is not just about raw data and what we know for sure, but also and maybe even more about what we feel.

My last remark shall be about human beings. In everything I showed you until now, you have not seen one single human being. Everything remains dead, even if it has been reconstructed with the highest precision possible. Up til now it's been fine to reconstruct dead people, like for instance the likeness of the dead Rameses II. But to actually have human beings appearing in a computer generated, so-called scientific, reconstruction has always seemed very doubtful, at least to archaeologists. And maybe we are right in raising this objection: for instance here is a reconstruction sponsored by the National Geographic about life in ancient egyptian Amarna. Most of the critics are usually questioning the fact that we are using 3D characters that don't really look like human beings. Wether we know it or not, this is not our knowledge that is buckling against the image, it is our brain who is reacting to false human beings. The natural conclusion is that the right way to do things would be just to take normal human beings with ancient dresses and put them in computer graphics generated architecture. It is what has been done in this set and the quality of this rendering is unquestionnable from an aesthetical point of view. Unfortunately in this

case, the human beings are right but from what I know of ancient egyptian culture, everything else is wrong.

So again there is a balance to keep in the choice we make of dealing with the reality. If we want to pass a better idea of what there was, we have to be careful with every aspect of this reality. We have to be able to deal with technological problems, and most of them are getting solved very fast these days, but also to deal with our experience of the past, and with the knowledge we have gathered. In virtual reality also lies the difficult question of adding people in the model. It is true that the interaction of people with the past we are reconstructing is very important but I really want to stress that it should not be bring more problems than advantages. Let us go now for example to a reconstruction of Machu Picchu made by the Pelleas Studio based in San Francisco, to show you again how important for me the setting and context is. We are now on the top of the mountain, and there is nature in its eternal beauty recreated around. There are birds flying, flowers gently dancing to the breeze and a complex urbanistic set of houses. If the setting is well known, one as to be reminded that the reconstructions of the houses themselves are still doubtful for some points. But one has to note also that if we look closer there are people moving in the village. For me, as well as the birds and plants, they belong in the scenery, they bring life to the scene. They have been living there. They just disappeared. But such a place without people doesn't mean anything. It goes back to just being a touristic site and of course you cannot see it like this today, but there is no reason for me to go to such pain of doing the reconstruction if it's not possible to see how the actual human beings were interacting with the space that they were living in, with the objects that now we are preserving in our museums. And in some ways it is for me the best way also of accessing the information.

There is one more thing I would like to show you and I think that, contrarily to what I have said before, it could be more fun than just science. It is the model of a 17th century military fort built near St Malo in Britanny, France, generated again through the use of a very carefully generated set of accurate 3D data. This place has actually been bought by people who want to restore it to its ancient glory. Looking for sponsors, they decided to have a very precise reconstruction of the site, to compare it to its actual neglected state. I want to stress again the fact, that in this kind of archaeological work, it is possible to get very accurate data and to precisely deal with very accurate data in the virtual reconstruction. But depending on the choices you make while deciding the kind of many different renderings to by applied to the model, you can end up with a result that looks a lot like what we see in most of the games that our kids are playing with today. What it means for me, is that it actually is possible to get fun and interest out of scientific reality and to use it ourselves to understand better the data we are dealing with and to pass information to a critical mass. It is thus possible to use the same model and data to display information on what was happening inside the fort when it was in use, through another technically rich set of computer generated images. You can play with different computer graphics and thus get access to different files to get to different levels of information

For me, it is possible to still be dealing with actual science, to use different tools and new medias to prepare a data base that will be used by very different people that are not only tourists, but also kids or even colleagues. We can thus make the choice to pass information through very different media to very different people, while at the same time not having to fear the choices we would have to make, to show only one aspect, while rejecting another, of the complex reality we are dealing with. Computer graphics are definitely not just a gadget for hollywood special effects. They can become a major tool to generate, and analyze complex scientific databases and to pass the gathered information in its whole complexity but through entertaining media to the wider audience we are working for, the public. They thus find a natural ground of application in archaeology and heritage based research.