MAURIZIO FORTE

MR. FORTE: Thank you. So I would like to discuss in short some important topics concerning the definition of virtual heritage. To me virtual heritage is a digital dynamic information that is derived from a physical site or intangible activities heritage, whatever is not just monument territorial landscape. The breach between world and virtual heritage is constituted principally by the information process. So it means that ontology of information is much more important than the technological aspect, because it concerned a cross-cultural and interdisciplinary transmission. In this sense, virtual heritage can be said to be an ontology of cultural heritage.

Continuing to discuss the topics, interpretation and communication are dynamic processes, and this dynamic activity, I think, is really, really fundamentally (inaudible) reconstruction of the ancient world. And the reconstruction depends on dynamic part of the top-down approach. What do we compare by mental map for example and what we learn in the cybernetic space like virtual heritage systems, mincing the ecological approach. I follow the philosophy of Gregory Bates (phonetic) and so I mean the difference, the way we learn.

So if we increase the difference between us and the ecosystem we can learn more, we can increase the faculty of learning. And the difference passes throughout the interaction and feedback of the user. So in the feedback there is a – the core of the informational process. Again, the scientific knowledge in communication has to be integrated in an interdisciplinary simulation process and more than represent a complexity of relations. I like to use the definition of relationships coming from the Gibson ecology, so it means affordance, IT means the way to perceive an object, an activity, and the way we perceive the ecosystem, the world. And finally, knowledge of communication and perception though the pipeline of virtual heritage.

I think that if we don't discuss deeply in terms of epistemological approach of the beginning of the process, we can start the technological reconstruction or processing.

One of the focus of our activity is the contextualization of information, like you have the – you said you have discussed it before. In archeology is one of the crucial parts of the fieldwork. But first of all we live in an ecosystem, so the landscape, the environment are the final but the most important phase of the communication process.

I have collected here some key layers in the reconstruction processing. The ancient landscape, the archeological landscape, the mental maps and I'm trying to use some neologism, the mindscapes. So the perception of landscape through places, spaces, mental maps, and minds. So the final processing, the final aim is the reconstruction of the mindscape. I know it's quite utopistic but it's the core because we live in the first. We live in the archeological landscape. The archeological landscape is part of the contemporary world. Secondly, we would like to reconstruct the ancient world, but the ancient world is intangible.

So we know that we can know about it, about that through relationships, through feedback, through a dynamic process of information. For example, here you can see different ontology of the same landscape; it concerns the archeological park of Appiantica in the south part of Rome. And here is part of that three-dimensional website. It's a stimulation process, it's not – not yet the ancient landscape reconstructed. It's – the GIS in this case, the 3D information in this case is the first past of a very long, very long pipeline.

And I'll give you another very short and I think practical example of ontology of a monument. I mean a monument like a living organism constituted by different ontologies. This is the view of the Nymphaeum of Egeria, in Rome, 2nd century AD, in a very important old print of Piranesi, 18th century. It's interesting, it's a – it's an important viewpoint but is not yet a monument. This is the monument in 2003 and it is the nymphaeum but it is really hard to identify it as a nymphaeum. What is a nymphaeum? What is a monument? What kind of monument can it identify?

This is the same monument after laser-scanning activity. It means to use a spotlight of 2 millimeters and taking a million points for represented. It is the reality, it's not the reality. It's not the monument. It's another ontology of the monument. I won't try to continue. This is the reconstruction of the same nymphaeum like we assume it was in the 2nd centaury AD. It is the monument; no, it is a possible stimulation of this monument re-contextualized in the ancient world.

So the factor – the key factor here is the transparency of the data through the reconstruction. The feedback, the validation process, there are a lot of factors. They're just spatial information. How much is accurated? So the technologies can change the detail, can change, of course, the capacity to understand the monument. But if we don't have a new methodological approach in investigating, recreating, and acting inside the digital ecosystem, I think we don't reconstruct anything.

Again – so another important question, how do we interpret and reconstruct spatial data in archeology? It's very important because we know we are in a very – it is a spatial discipline. This is a reconstruction – a possible reconstruction of the Ethiopian landscape in the 1st century AD in Aksum.

And again, through virtual museum, how do we reconstruct or re-contextualize information. I tell you, this is the Scrovegni Chapel of Giotto in Padua. You trust me? I don't know, because it seems a very strange building. But this is a cybernetic map. It's the ontology of the monument I tell you. And again this is the reconstruction of the monument in virtual reality. Of course it's a still image here – still picture. So we have no capacity now to interact. So the information is dynamic again, is – in this – in that strange code, I call the cybernetic space.

Again, what – how I can describe this pipeline. I think creating an information processing, connecting knowledge and communication through the interaction. It's important to not separate the two domains; otherwise the risk is to lose information

through the processing. We have to discuss of course now about technologies so in – I think that every week, every day we can have new challenges, technological challenges. But if we don't know how they produce different formats, different archives, and different ontologies we can't represent data.

In archeology for example, a very innovative aspect was and is the level of detail, the accuracy, in comparison with the past. Now we have model – we have an accuracy of few millimeters, or microns in comparison with the past. We can focus landscape. We have geospatial special information of a few centimeters by GPS. And – but are we really have able to have a free accessibility to all obvious information? I tried to describe what we do, what we – our lab do, so that you can understand much better how the same kind of information can be processed from the fieldwork, from the archeological fieldwork until the final communication process, virtual reality. Because it's a very long pathway, but it is really interesting to understand what happens in that box.

I am in Tambo Colorado here in Peru, an Inca site, we have the differential GPS, a very strange antenna you see, over the backpack. Or here we are in Ethiopia in plateau of Aksum, we have another micro-topography relief by GPS, and we use portable instruments like PDA computer connected with GIS so that in the real time we can have the map. So it was very interesting to work with the students on that because they can – or they could really understand in real time what they were doing, what they were mapping. What these – the sense of place and not just a space of landscape.

And this map of Tambo Colorado – Tambo Colorado is a very important Inca site and near the coast of Peru and this survey and this map was created in 5 days, is an important factor, so to create information and map in very few – in a very short time.

And this information was useful, it's just an example v for comparing all their data we have new maps. You see the different orientation, there are many archeo-astronomical studies on Tambo Colorado based on wrong maps. So the technology is in this case simple, really cheap but really useful for re-contextualizing the site with the correct orientation. You see there is 15 degrees of difference for example.

Or like in this case the use of GPS – differential GPS for creating a micro-digital elevation model. The elevation factor in this case, with the detail of a few centimeters, can identify we've all excavating a Roman villa in the inside of the red square, you can, see in this slide, for example.

And over here in Aksum, walking – so walking with the backpack and the GPS system and the same time you can collect thousands of data in the same way because – why? Because the world has not the same level of maps, there are no available maps in Ethiopia for ecological – good ecological fieldwork. So as soon as we work with technologies like GPS – differential GPS, in this case we create the same-time maps. And the – I'm sorry – and again, the same 3D, digital audition model of the plateau of Aksum, Bieta Ghiorghis, and so this is the survey we are organizing in Tambo Colorado,

we have the University of Berkeley through a joint research project between the two institutions, or inventing a new way of mapping.

Inventing of course in some ways like here in Rome, because we don't have a – we didn't have here a detailed map of Grottarossa. We've used a balloon here and differential GPS taking – so that in this way we've – in the same time, sorry, we have put some targets over the Via Flaminia, this – the ancient Roman road. And in a very short time we have collected an orthophoto mosaic of the site.

It wasn't mapped, unfortunately, and – but was really interesting because of the resolution in particularly of – of the photo mosaic. So we have 1 centimeter of our resolution here, so that you can use this roster data as basis of your reconstruction for example.

Or like here very cheap way to construct kite, like here in Tambo with the students. That was very interesting because every student was able to use 10 kinds of different technologies. So laser scanner, kite, remote sensing, GIS, PDA computer, GPS, and so on. This is the digital camera over the kite.

And here is the result of the orthophoto mosaic of Tambo Colorado, a very simple way to take a map in very few days.

There are – of course in the technological world, there are very much more expensive instruments and tools like laser scanner. We have – this is the case of long-range laser scanner. The category is time of flight for architectural survey of – sorry, this is the case of a laser scanner long range in an Egyptian tomb in Luxor.

And this is a close range, we have a resolution of a few microns inside the Inca palace of Tambo, to give you an idea of an accuracy 0.008 millimeter. This is this archeological site of Tambo, we have the Inca palace in the south part of the site. And here is one of the first model we have the reprocessed by laser scanner. Typically laser scanner produces a lot of clouds of points. You need to convert points in measure – in geometry.

So it's a very long processing. I would like to tell you that as soon as you have a model you don't have the geometry, so that you need an extra time in lab for post-processing. So it seems to have used that technology but it needs a lot of big effort for processing data after. So this is the result of a computer graph reconstruction made by one of my Ph.D. students in Tambo.

And another kind of interesting and cheap technology is photo modeling. So the use of – it's the photogrammetric techniques using calibrated digital cameras. This is the case of a palace, Tell Mozan in Syria, dating the third millennium before Christ. In archeology, unfortunately, until today most part of the sites, I think 85 percent probably don't have maps, don't have 3D models, and they have a very poor survey and relief.

It's really important because before starting reconstruction we have – we should have a very detailed documentation and scientific documentation. From my point of view it's

quite useless to reconstruct without a long processing of documentation from the field. This is – on the left is the picture of the site, the palace, the clouds of points, the first processing and you find the results on the right side.

Another interesting result of photo modeling made by students here in Rome, in Malborghetto is along the Via Flaminia Antica in the northeast part of Rome. And here we have the site, and on the opposite side you have the virtual model made by photo modeling software. This is the – it's not yet a reconstruction; this is the contemporary archeological visibility of the site, o the re-contextualization of the site in the contemporary landscape.

We have used also computer vision throughout a European project called EPOCH and because of the collaboration of University of Leuven. It's very interesting techniques and also accurated but interesting for creating 3D models in a very short time, we have a server and client system, so processed by the Web and the result is the 3D documentation during the excavation or during the field work in 3D.

Of course I don't spend so many words about technical details. If you need more information, please tell me.

This is the Maya site of Edzna reconstructed in 2 hours of work during a training session in a course organized by UNESCO in Mexico.

Summarizing the first part of the presentation, I think I put in red some key words concerning what we have done. So the data have been collected for use of different technologies, laser scanning, for example, photogrammetry, photomodeling, GPS, remote sensing, GIS and so on. The subsequent processing evolves the input of the data into 3D and creating a virtual space which presents the data in geospatial form. That's another important key point.

And let me now conclude with the case study where we are working on, because it's connecting the virtual museum with the data processing with virtual reality. So this activity is, I think, concerning three different important approaches.

The first one is multi-user domain – a collaborative environment where multiple users in virtual reality can interact each other. Secondly the virtual storytelling – you told that before the importance of involving student people in storytelling, the narrative approach and say that virtual reality is a way to communicate so that the combination, we think, of narrative techniques like movies in 3D with free interaction, navigation, is a very important aspect to increase the understanding.

The core – sorry, the final goal of the project is concerning, I think four main ontologies – a printed book, for example, and the representation of the Villa of Livia. The Villa of Livia – Livia was the wife of the Emperor Augustus, in the second life and here in the virtual museum, this virtual museum will be open this December.

So it's very concrete way, if you have chances to touch this – to taste this installation and through the web GIS on – like you see here in the very – in a large-scale image.

So – sorry, I'm not very familiar with this. GIS maps, VRGIS, VR landscape, there are many different integrated approaches in the same proposal, in the same project, and here for example – and you see on the left side the archeological landscape and on the right side the ancient landscape of Via Flaminia.

We have collected thousands of data concerning plants, environmental information, soils, maps, geological information, and so on. The focus, I repeat again, is always the environmental reconstruction, the ecological approach. We live in the environment, so it's so important that if you want to re-contextualize ancient worlds, we have to start from the environment, not just the anthropological factors.

Look, this is the simulation of the ancient Roman landscape. It is a simulation. The simulation factor is the most important factor and concerning the relationship between the Roman villa in – for example and the most important one, the Villa of Livia in the landscape. So I go faster because there is, I think, 5 minutes?

Five minutes, okay. This is – for example, is the superimposition of the older relief – older map with the new ones and here look at the difficulty of accessibility. If you visited the villa now you have this bad coverage, so you can't understand – you can't contextualize the spatial relationship of the villa.

So I give an example, different techniques, photomodeling, laser scanning for optimizing measures. The differences between the perception of the same wall after the optimization and before the optimization of polygons, clouds of points. And now if you – another additional chance could be, okay, I fly over the villa. You can't see anything because of the coverage, so the villa again is hidden from the landscape.

So I give you an example of some works concerning 3D graphic libraries. Hybrid models through the landscape, the some rooms – it's a work in process – it's a work in progress so – and I want to conclude with 2 minutes of movie in 3D graphic library.

We have classified thousands of architectural elements in planimetries, shapes and architectural comparison between different sites because to validate the reconstruction you need a top-down approach as well, right, so you have to compare different pattern; plants, environmental information, animals as well.

Okay, I stop here, and I would like to show you 2 minutes of movie or 1 minute, if I have time and let me show you – the first one is concerning the walking-over of the avatar in – no, the other one, okay, this. So for example – this is an example of 3D interaction where – what I call an affordance.

An affordance is a relationship between the avatars. The avatar is moved by the user, so the avatar walks through the landscape like in this case – yes, please, okay. In the same

time this landscape changes. So the first attempt that we have done is to transform the architectural elements of the villa in a transparent way, so that the user, the observer is able to identify what is reconstructed, what is not; what is perceivable and what is not perceivable; what is contextualized and what is not.

So it's a very long process but I think it remains, in the future, to calculate, to validate how detailed, how accurated, how valid, is the reconstruction. Because I insist again, it is a simulation process. The more the difference I increase, the more I enhance the interaction between users.

Please mind that we have four users with a different avatar, so that they have a – even an imitation feedback from the other users, so that you can learn through yourself, through your avatar, through the other avatars.

And okay, we can conclude with the last movie in – 30 seconds, 10 seconds, you decide, okay. And just for giving example, this is our lab, so it's not yet a virtual museum. We are constructing the virtual museum in a room in the Roman National Museum in front of Termini Station, so 300 meters far from the Termini Station in Rome.

So this is an example of a multi-user domain, so there are – the virtual environment is available for four users. And in the virtual museum we have a system, stereoscopic and immersive, for example, a class of people, or a class of students, 25 people, looking to a video display, and four users interacting each other with an installation.

So there are different experiences. The most experience by virtual reality crystallizes for the collective interaction and a one-to-one virtual reality interaction, like in this case through the avatar and through the joystick.

The interface is very simple but the amount of data inside the system are very accurate. Every thing is in geospatial information, so you can calculate millimeters, you can calculate surface volume, or 3D geographic coordinates, because everything is in the landscape.

You can compare the landscape through the time and through the four architectural Roman faces of the ancient Villa of Livia. I've – I conclude. Thank you very much.