

Module 10
Digitizing 3D Collections for Museums
Technical Workshop 2:
Image Based Approaches to Documenting 3D Collections
January 27, 2022

CAPTIONING PROVIDED BY:
CAPTIONACCESS
support@captionaccess.com
<http://www.captionaccess.com/>

* * * * *

This is being provided in a rough-draft format. Communication Access Realtime Translation (CART) is provided in order to facilitate communication accessibility and may not be a totally verbatim record of the proceedings

* * * * *

DAN YAEGER:

Hello everyone, wherever you are. Welcome to the digital empowerment project on digitizing 3D collections and museums. The digital empowerment Project is a nationwide initiative organized by six US regional museum associations dedicated to providing free self-paced training resources based on digital media and technology for museums.

This series is made possible by funding from the Institute of Museum and Library services. We are delighted to have you with us here today. My name is Dan Yaeger and I'm the executive director and host for the spinal module of the series.

Before we get started, I would like to acknowledge the places which we gather. In this era of digital music -- meetings, it is important to reflect on the land we each occupy and honor the Indigenous people who call it home. I'm speaking to you from Massachusetts, the historical homelands of the Massachusett people.

Let us honor elders past and present as well as future generations. We are the digital empowerment project team recognize that our organizations and those of our members were founded within a call in a society that excluded many people throughout the United States and beyond. We ask you to reflect on the place where you reside and work and respect the diversity of cultures and experiences that form the richness of our world and our profession. Thank you.

Now, for just a few housekeeping notes before we introduce today's presenter. First, I would like to acknowledge today's ASL interpreter who will be on the left side of your screen, and let you know that captioning is embedded in a box just below the YouTube player on our website with controls to adjust your experience.

Following today's program, we ask you to complete a short survey and give us feedback. We will throw up a link in the chat stream and email it to those who registered. We would appreciate it if you helped us improve our work.

We encourage you to post questions for our presentation today that will be addressed at the end of the presentation. Please type them in the chat and we will get there as much as time allows. We may not be able to get to all questions during the live session, so we have set up a community form for raising questions and connecting with your fellow practitioners on the museum hub website.

If you are looking for help, create a login and a member of the community will get back to you. Now I will introduce today's speaker for module 10 tech workshop, image-based approaches to documenting 3D collections.

Carla Schroer is cofounder and Director of Cultural Heritage Imaging, a nonprofit corporation based in San Francisco that contributes to scientific research. Carla leads training programs at CHI along with working on field capture projects which reflects caption imaging and photogrammetry. She also leads CHI's software development activities.

Carla spent 20 years in the commercial software industry managing and directing a wide range of software development projects. Carla, thanks for being with us.

CARLA SCHROER:

[Martin Lum was supposed to be part of] the presentation today but is not able to join us due to a health issue. Also my colleague Mark Mudge because the work I'm presenting is really the work of all of us.

I want to start by saying the time here in San Francisco, California, the traditional home of the Ramaytush Ohlone people. We pay our respects to them, their elders, past present and future who call this place their home.

Cultural Heritage Imaging is a nonprofit corporation, and we believe that the treasures of humanity are worth saving.

We are in our 20th year now. Really, the big idea of our work, which fits directly with what I will talk about today, is about the ideas around how digital cultural heritage can be documented and the tools that are available for this are widely adopted around the world by cultural heritage practitioners, museums, libraries, historic sites, archeologists and so forth.

But also by cultural communities directly, and by citizens and scholars. We really believe that cultural communities should be able to take control of their own documentation needs and therefore their own cultural narrative.

We believe that information that is widely sourced helps everybody and creates a better world of knowledge coming from lots of places, not just wealthy institutions. When we are doing documentation work, we have to think beyond our immediate needs beyond what we might be using it for today, but also how we will archive that digital information to make it available for others to make it available to use and reuse. I will talk about some approaches we take for that last part as we go through today.

I want to start, because I know this is really targeted at small museums, with some ideas for some simple and low-cost things that can be done to deal with spaces and 3D objects.

The simplest and most inexpensive things should be various approaches that use a series of images that are just stitched together. In this case, there is no geometry. And what I mean by that is that there is no coordinate system, there is no X, Y, Z position in space. They are just a set of images on software that understands the relationship of the images so you can kind of move around.

Let me show you a couple of examples. I think we have all seen panoramas. Here's one in San Francisco that I just found on the web. I didn't make this one. We can kind of spin around and get a feel for where we are.

You can see that there are some distortion and perspective issues as I move around here. That is because there is no geometry, there is only the images.

Another option is we can turn this in on itself, and we can put an object on a turntable and then we can spin it around and zoom in and out.

This is a simple way if you have a 3D object to be able to share the object and let people see the backside of it and so forth. Particularly in the collection space may be where they can never see that. This is a simple case of just a single pass on a turntable. You have a single pass and you take a set of images.

There are more complex ways to do this. What we call a multi row. These are often called object movies. In this case, I turn the object all the way around. In this case, these are just images that have a relationship to each other. There is no actual 3D, there is no geometry. This means I cannot measure it, there are other limitations to what I do.

But as an easy way to share information, as a visualization, this could be an easy to use tool. These are inexpensive, there are lots of software packages that can put this information together, and you can convey more information than you can from a single photo.

The disadvantage is there are distortion and perspective issues. You do not have any geometry, as I have said, and that means you cannot measure things. You have no accurate measurement.

Also, some of the tools produced proprietary formats. That would make it difficult in terms of the longevity of the data.

What I want to mostly talk about is the area where our organization works, which is computational photography. We are taking a sequence of images and using computer algorithms to extract information across that sequence of images, and generating new forms of digital representations that are not possible from a single picture by themselves and contain additional information.

There is a large family of things that are considered computational photography. The ones that we focus on, and that I will be presenting today are reflectance transformation imaging or RTI, and photogrammetry.

Let me start with an RTI, and I think the easiest thing is for me to just give you an example. This is a Greek kylix from the Johns Hopkins archeological Museum. And in the picture, there is Sanchita Balochandran, and she is an archeologist and also a conservator.

I will zoom in here, and we can see some details. With an RTI, what we have is both shape and color information. We have that only from a single camera point of view. We cannot spin the object around. But from that single point of view, we can really light from any direction and employ mathematical enhancements that allow us to see details that we cannot see with the naked eye.

This can be really really valuable for looking at fine surface details, inscriptions and so forth. In this case, Sanchita's project is very interested in the original designs on these Greek pieces, that were painted in with slip before they would have then been painted over.

She could see under the microscope, evidence of these original drawings, but under the microscope, she saw such a small area that she couldn't put together the whole thing. So right here, you can see along the back here, the figure was drawn in even though the design was likely intended to always have the shield, the background was drawn in. By applying this mathematical enhancement, looking at a shape with no color - because our eyes tend to follow color making it hard to see things - you can see the original design.

What is happening with an RTI is we have a camera in a fixed position, a subject in a fixed position, and we take a sequence of images with light in different known positions around the subject. Then, in software, we can synthesize that into an RTI. Special viewing environments know then how to do the relighting on the mathematical equations. It is a 2D image, it is pixel based. But it contains 3D information about the shape.

This is based on information that came out of HP labs in 2001. It can be actually quite inexpensive in terms of equipment to do this. We can use a regular camera and a tripod. We figure out the light position based on a reflection on a reflective sphere that we can put in the image, and there is software that can figure that out.

Here is a basic example of an RTI set up. I have a camera pointing down, we are actually firing the camera from a computer, but there are various ways to fire the camera. This is my colleague, Marlon who is holding a string to keep my distance the same. And then I take different images with light in different positions around the subject.

So it can be pretty straightforward to do and the software is open source. Here is a set up for a vertical subject. The main thing is we have to get spheres into the image. Here it is in a gallery. In this case, we are just shooting the small area of this panel right here, and we put the light, the flash on a pole so we can get it up higher around the subject.

A couple more quick examples. This is from the Smithsonian natural history Museum collection. It is a Mississippian culture chipped maze. This is from the RTI. We can start to see the edge, and when I look at this mathematical enhancement, you can see that all of the details of that surface, all of the touches on retouch is there can be viewed, which can be really helpful for researchers, but also for people who just want to understand how these things were made.

Here is another example of a Japanese woodblock print from the fine arts Museum of San Francisco. Here, in this image that came out of the RTI, I have got the color at the bottom, and then here, again, with no color in just the surface shape. We can see all of the details of the embossing and the design that was in the woodblock.

This technique is really flexible. We can do it on really large subjects. This is an inscription that we shot at the El Morro national Monument. It is about a meter and 1/2 wide, you can see us using a larger light, and the string is on a stick so that we can control it.

Here's a couple of images from that RTI where we had Native American rock art and an inscription from 1606 in this same location. Here is some information that we can see from the RTI.

On the other end, we can take this all the way down under a microscope and look at very small subjects. Here we are back at John Hopkins, and we image this very small intaglio gem. It is less than a centimeter wide. Here are some images from the RTI, you can see as we move the light bringing out different details like the sculptural elements in the hair, and here, we are bringing up details in the hand.

So this is a great technique that can help you if you are trying to analyze a surface and show surface details. Conservatives use this quite a bit. The software is free. It is available from our website along with instructional videos and so forth.

Now I want to talk a little bit about photogrammetry. For photogrammetry, our goal is to create a 3D digital surface, a digital object that replicates our actual subject as close as we can in shape and color.

We also, going back to this archiving idea, want to think about how we are creating our photographic imaging sets. We want them to be independent of the specific software we are using. We want to follow good practices so that that set of images could be reused by somebody else and could be understood by somebody else. And can also be preserved for future generations.

If we follow good practice, our data can be qualitatively and quantitatively evaluated.

I want to show you a couple examples of this. The examples I'm showing are all directly from the photogrammetry software, I will be showing you that in photogrammetry software. But we did not do any smoothing or whole filling or hand editing.

It is important to understand that frequently, when you see three models presented, a lot has been done to them before you see them. If you just want to have enjoyment of the subject, that is perfectly fine, but if you want to use that data for research, or for conservation or tracking change or so forth, then you really need to understand what has been done to the data so that you can use it correctly.

My first example is a replica of an Olmec head at San Francisco City College. We use this as part of a training class. You can see there is a tree that limits the ability to get around the subject. Let's look at the model.

This is a dense cloud, it is a point cloud which means it is a set of points in space, each point has a coordinate, and X, Y, Z position in space and a color associated with it. In this case, I have 68 million points in this model.

In the photogrammetry software, we can turn on the cameras. What I'm seeing now is every blue rectangle here is showing the position of a camera that was used to shoot this. It was a training class, we had a lot of people with some overlaps. It is a little bit overshoot, it could probably be done with less images and still get the same quality.

Note around the top here, there is a place where the images are up high and they drop down right here. That is because of that tree. We couldn't get the camera over here, but we still got a really good result.

I will turn the cameras off now. This is my point cloud. From that, we can create a wireframe or a mesh. In this case, the mesh is so big that I have to zoom in pretty far for you to see the triangles.

There are more triangles where I have a swift change in surface, and less in smoother areas. The thing about doing photogrammetry, particularly if it is done properly and I have used calibrated scale bars in the scene, I can measure.

I see, for example, how deep is the site? How far is it from here to here? I measure this is 2.9 cm. So I rotate this around and measure any aspect of the surface that might be interesting to me. So that can be super valuable. Across the eye 48 cm.

The other thing, I share this with pictures on it. The texture map. The thing is that when you see 3D models presented, almost all of the time, what you are looking at is a model that has a texture map on it. Even if the model was created from a laser scanner, there are photos generally taken with a camera, sometimes other methods for getting the surface, and then that texture map is laid on top of the geometry.

The texture map can hide a lot of problems in the actual geometry. It has the virtue of I scaled down the geometry and have much less actual geometry, put the pictures on it and then it looks really good and carries a lot of detail. But I may not have enough actual measurable geometry for whatever my purposes are.

The point here is really that whenever you are doing imaging, whenever you do documentation, you really need to ask yourself why am I doing this? Who is it for? Who will use this data? What information is important to them?

Because if you do not understand that, you cannot choose the right methodology and you cannot produce the right kinds of results. In fact, we go so far as to say that if you cannot answer those questions, you shouldn't be doing it. You should go back and figure out why you are doing it.

I just want to point out that when you start to look at 3D data, you may be saying mass of data, data that is covering up problems, and you may not. Learning to understand what you're saying and how to ask the right questions is a good skill to have.

The next example I want to show you is from the Library of Congress. This is also photogrammetry training that we did there shortly before everything shuts down.

This is 12 century Romanesque binding, and here I am back in the photogrammetry software. You can see I rotate this all the way around. Let me back out and show you the cameras, the pictures. We put it on a turntable and shorted all the way around, and turned it over, and then we took some extra pictures over the top using handheld so that we got the whole subject. We can put that together in the software.

I will turn the cameras off. Here is the front of the book, and the same thing. I can measure in this. This is the point cloud. In this case, I have 19 million points. But this is all measurable. If I wanted to go, for example, to the solid model and ask how big is one of these little punchlines here? I measure that. From here to here. In this case it is 6.17 mm. The closer I am on the surface, the more detail I have.

Which also means the higher precision I get in my measurements. Which means I have to understand the precision of the model. Not just the resolution of the model, but when we start doing these digital representations, in addition to the resolution, we also need to understand the precision. The precision is the question of whether or not the things are in the right place.

I have a high-resolution model that has a lot of bumps on the surface, and the points are not in the right place. So understanding the precision and the resolution of the model or of the needs of your audience, who you are doing it for, is going to help you approach this the right way, and apply the right techniques.

You can do photogrammetry without a lot of equipment. If I was working outdoors, we recommend a digital SLR, because to do this properly you have to lock everything down. Yes, he can do it with the phone, but you will not get the same kind of precision that she would get with a digital SLR. These are calibrated scale bars and with just that set of equipment, we are also using a wide lens here.

With just a set of equipment we can do rock art, the olmec head, if we're working indoors in a studio we are going to need some lighting to light out objects but it can be done without a lot of equipment. In order to get the high quality results we have been talking about, we need to follow a set of rules about how the images are collected, and how our camera is set up. If we do that, that will allow us to get very high precision, low uncertainty data for the results that we can actually quantify and talk about.

If we follow that set of rules, we can get 3D and actually correct 2D outputs, we can quantify the measurement, and we can create repeatable, reliable images that can be preserved for others to use and to reproduce our work.

Sometimes, when we go out into the world and to conferences and things, we hear people give the advice that you just take a lot of pictures. Take a lot of pictures. The software is so good, you just throw the images in the software and you get a model and it looks great.

It's true. You can take a lot of pictures and get something that looks good. Maybe that is ok depending on what your purpose is. If you do this, your results can have significant and unknowable embedded route measurement areas. We cannot figure out what the error is. It is no longer quantifiable.

If you just take a lot of pictures and that data might be appropriate to make something that spins around on your website or can be grossly measured, but if you really want to use the data for tracking change, for conservation activities, before and after, for research purposes, then you probably shouldn't apply that approach.

So you really need to follow the set of rules so that you are getting high quality data. I want to show one more example. This is a model that we created, and I am showing it to you in sketchfab. This is essentially YouTube for 3D models. Anybody can put 3D models there. You

can see all kinds of models from things that people made up out of their heads to things that are empirically captured like this, to rings in between.

There are lots of dragons and bugs and robots, but also museums that have things there. This is a fun project because this trunk was found in the Netherlands, and it is at least a couple hundred years old, and it contained locked, undelivered letters. There is a whole research team that has been working on it, and we were in the Netherlands for a conference and asked to come and image this to add to the work that they are doing. It is on display in a museum in The Hague.

We worked with them and we shut it and got good measurable data all the way around. In this case, we also did some additional imaging. We didn't do 3D on the inside because we had one day to get done as much as we could and had to bring all our own equipment and so forth. We just took photos of the rest of it to help document it. We did a couple RTI's of some wax seals that were on it and some good close up macro photography of that.

The reason I included this example is it is a case where we did multiple techniques to really capture all the information that was of interest to the folks we were working with, and that fit the time and budget that we had. We had one day on-site in the museum to shoot it, the 3D model was the highest priority, and then we did some additional documentation. You can mix-and-match these techniques to meet your needs.

We have resources on our website, and some of the rules that I was talking about before, rule-based imaging, there are instructional based videos on our photogrammetry page.

The capture method is independent of the software. It doesn't matter what software you use, if you follow good photogrammetric practice, you will get a good set of images that will work for a variety of software packages.

The software we use at this point is commercial software. We use Agisoft Metashape Pro. There is open software, but we think soon there will be more available in that space.

Now I want to take a minute and talk about what we mean when we say scientific imaging, what makes data reliable and reusable, how do we think about the reuse and longevity of our data and not just having cool things spinning around on our websites?

First, let's talk about the scientific method for a moment. At its core, the scientific method is really about a couple of things. One is that the original data, you have to have empirical data. That original data has to be available for others to look at. In our case, we are talking about images.

If we are producing a 3D model, and RTI, a multispectral output, we have to keep track of what we did and share with people how we process that data in order to show the result. In other

words, we cannot just show the result, we have to show how we got there and that enables people to review our work, replicate our work and so forth.

This core idea is really behind the digital lab notebook software that we have been working on for a long time. The 1.0 release is coming out in the next few weeks, and this is open source software that has had some NEH funding. The digital lab notebook is a toolkit for collecting and managing metadata about computational photography based imaging.

We are testing a release candidate right now, and we expect to be out in the next two or three weeks.

We are fortunate in that we have had funding from the National Endowment for the humanities to do the most recent work on the tool, though over time, we have had a variety of prototypes and use cases and user input to help us get here.

The core design principles here, one, open source was critical because we wanted wide adoption and we wanted people to add to the software. We wanted it to be easy to use and just follow a sort of natural language use and the way that you would enter information in a database. We are photographers at the end of the day, so we really wanted to not spend all our time doing metadata. Part of why metadata is not done very well is because it takes a lot of time and people don't like to do it.

So the idea is that you enter information once, and you make it really easy to reuse the data so that you can start creating templates and so forth of your usual practices, and it makes it very easy to collect information as you go. It is a flexible system, so you can enter as much or as little information as you like. It is not yet translated to other languages, but the software itself is internationalized so that it can be translated. What we produce in terms of metadata from the software is something called linked data or link to open data that is mapped to the cydoc conceptual reference model, which is a semantic ontology.

Here is what is really cool: you don't have to know anything about what I just said in order to use the software. It does this for you completely under the hood. And this is the direction that metadata is going, particularly in Europe. Getty has projects in this area, Mahlon has been funding projects in this area. Congress is starting to look at it. In the US, we don't see as much adoption, but we expect this to be a direction that continues to pick up.

But the system will also produce Dublin court records, letorecord and a human, readable report. See you still have information that is readable even if your organization is not yet doing the linked data.

The other thing is, we can enter a lot of the information before we do the image capture or the image processing. We can create these template kits of equipment and stuff like that that makes it really easy when we are actually doing the imaging. Finally, in the new tool, in the 1.0 version, we have something called the archiver that will automatically create a submission information

packet or SIP in a couple of formats. What that does is it takes all of my images, my results, my work products, my metadata, it wraps them up into a zip file, it puts them in manifests, it puts checks so that I hand this to her repository and they can manage this data for the long term, which is really huge, because tons of the kind of things I have been showing you have been produced all over the place, and the librarians of the world are freaking out about what to do with all this data and how to manage it, because especially for research purposes, they really have to understand the data for it to be valuable.

Again, it's about how we collect and manage data about digital representations through their whole lifecycle. We support, right now, RTI, photogrammetry, multispectral imaging and documentary image sets. In that category of documentary image sets could be panoramas, object movies, focal stacked images or just images that document something.

The system is really set up around the idea of photo sets, it is very flexible within this environment. Why does this matter? In addition to creating data that can be preserved, we think there is another key reason why this is so important, which is the idea of democratizing technology. What we mean by that is really enabling anyone that has the skills to collect documentation to contribute their work to the world's knowledge.

What we see today is that so many people rely on the authority of who produces the data, rather than the reliability or authenticity of the data itself. We see that in terms of, "I trust this data because it came from the Smithsonian, the British Museum, MIT, Pick your favorite world-class institution. As opposed to understanding the data and letting it speak for itself.

Good data is good data, not so great data is not so great data, and I figure that out by looking at the data rather than who it came from.

We think that by doing that, it really allows anybody to produce high quality work and let that work stand toe to toe with work from the most authoritative sources.

We have had a lot of folks involved in the project. Our primary partner is the center for cultural informatics at the Institute of computer science in Heraklion Crete and we have had funding from various sources for ideas that became the software.

I want to show a quick example to drive home why this information is so important. If somebody gives me a photograph, just a photograph, and I want to use it for research, what do I need to know about that photograph in order to rely on it for my work? It would be great if I had the original photo, if I had the camera data, what the settings were in the camera, assuming that the person shot raw and converted it, what were those conversions, and how is the data processed?

Especially if I want to measure something, was distortion correction applied. And the key one is sharpening. Let's take that further. Here is Pan-American unity by Diego Rivera. There is some

sharpening, and you cannot see that. That is kind of my point. This could happen and you might not notice it.

If I zoom in here and apply a little bit of sharpening, and now a lot of sharpening, hopefully you can see that. A little bit. A lot.

What is happening is the sharpening is changing the pixels. I create artifacts on the surface that don't actually exist on the real-world subject. This is just one photograph. If I am building an RTI, then the software is actually looking pixel by pixel across that stack of images to calculate RTI data. If I'm doing photogrammetry, the software is working on a subpixel level to understand how everything aligns and works correctly. If I have sharpened the images, I produce artifacts that do not exist in the real world that could confuse a researcher trying to use the data and make them think an inscription is that that isn't or something like that.

So understanding the data is a critical part if you care about longevity. The last example that I want to close with is a Maori canoe sale that is at the British Museum. There is a research project that is happening out of New Zealand by a group of Maori weaving experts and researchers. It is funded by the Marsden fund.

We were asked to come to London, to the British Museum, we worked with a couple of the weaving experts, the Maori researchers, and we did high-resolution photogrammetry of the whole sail, both sides. And also some RTI's of some small details. That picture was of setting up to shoot it.

We produce this model of the sale. This is an example of why it really helps to understand who you are doing the work for and what they need to know. The researchers who are weavers really wanted to understand how the weaving was done, this particular sale is over 200 years old. It is the only known example of this type of sale that exists in the world.

It has 13 panels that are joined together. And it has a series of holes that are in it. And the holes are carried through the joints. This is a lost way of weaving that they are trying to understand and re-create. Our imaging needed to have enough detail to show them exactly where the strands are going through the whole sail.

Here is another area of it. This also gives us an incredible conservation record at the state this was in at the time. We can see how the strands are beginning to fray, and there has even been a little bit of conservation in certain areas.

What we produced allowed the research team to zoom in and out and look at every strand of this sale and carry it through and see how the weaving was done.

This is an image from the RTI. In addition to photogrammetry of the whole sail, both sides, also the weavers chose certain areas and asked us to do an RTI of the small area so that we had additional information there. You can see through one of these joins how the strands came

through. You can also see why we had to do it on each side, front and back, because it looks different.

Understanding your audience, why you are doing it, what information you need, will help you understand what the right approach is. Obviously, you have to meet your budget and so forth. There are many tools for you to choose from.

I want to end there. Here are some ways that you can find us and get in touch with us. I want to note that we also run a form site. CHI forms, for people that are adopting reflective transformation imaging and photogrammetry. And the digital form notebook, so that's a good place to go if the original materials and get you far enough in your work.

Finally, here is my contact information, and Marlin's as well, and the website of our organization. Thank you.

DAN YAEGER:

Thank you, that was terrific. Very interesting and great examples. We have a few questions here from our chat. Just to remind everybody it is time for Q&A, so drop your questions in the chapter and I will relay them to Carla.

One of the questions we had is regarding the digital apps notebook that you mentioned. Can you give us an example of ways it was useful internally and for the public. It might be following up on that last example, who is using those examples that you have shown? Can the public tune into that or is it primarily a research/academic tool?

CARLA SCHROER:

Let's start with the DLN specifically. We are about to release 1.0. Even though we have worked on it and the ideas forward for a long time, we had some early prototypes, we did a beta version of their tools a couple years ago, so we are about to release 1.0.

We have had a number of advisors who have used it for pilot projects, it is not being used at scale but we hope that picks up. University of Texas at Austin in archeology applied to documentation they did on site of a dig last summer. There is a group in Indianapolis that has used it. We have worked quite a bit with the Smithsonian digitization team and they have provided a lot of feedback on the tool but haven't adopted it directly yet. But they have been looking at it.

You asked a broader question about the documentation in general. It really varies. Our organization focuses a lot on training and consulting and helping people adopt the tools for themselves. There are all kinds of reasons why people want to do this stuff. Some of the material is absolutely being shared and is public. Some are for research, and maybe there is a goal to publish it later, or lo-res versions are published and high-res isn't available.

So it really varies.

DAN YAEGER:

The project, notebook, once it is underway, that is open to anybody and... How do they access that? Is it through you? Or the Smithsonian?

CARLA SCHROER:

It is open source software. It is free. There will be a GitHub site for people who want to work on the source code, and the executables that are ready to run and an installer and everything will be on our website. We have a downloads area of our website and you can find the RTI software info and photogrammetry stuff.

Right now, the beta of the DLN is up. So wait a couple of weeks and 1.0 will be available. There are links for instructional videos, user guides, all that kind of stuff.

DAN YAEGER:

Cool. And relevant to that, one of our team is wondering if there are tutorials or guides for getting started with photogrammetry on your website or elsewhere? I suspect the answer is yes, and about the deal and is eventually.

CARLA SCHROER:

Yes. I have a document that I will provide to you guys that we can put in your forms as well that have links for different kinds of resources. So we have a technology area of our website and in the photogrammetry page there, there is a description of some of the stuff that I have talked about, and there are links out to instructional videos on photogrammetry capture.

We have a vimeo channel for photogrammetry and one for DL and. It is all linked out from our website.

DAN YAEGER:

Great question here. What kinds of projects should smaller museums undertake and when should they think about doing it out of house, outsourcing it? In-house versus out of house. I saw that you go to museums a lot to do this work, but what kind of things could we do just on our own?

CARLA SCHROER:

You can do all of it on your own. But you have to invest a little bit in some equipment, and then you also have to invest some time in learning to do it. So that is going to vary across museums, whether there is staff that is appropriate to do that. I realize that small museums can be harder.

We did a training program a few years ago where we specifically targeted smaller museums, and we held out a certain number of seats for people from small museums. A lot of the ones that came were small museums that were in universities so they tended to have access to a little bit more equipment and things to make things work.

I think it again goes back to your purpose. Why are you doing it? Who is it for? Are just some good photographs good enough? Is a spinning object movie good enough for your purpose of sharing some important objects that were telling a story? Museums are often trying to tell stories. How do I illustrate my story? You.

There are some very inexpensive ways you can do that. Sometimes you have a really special object. Maybe you can get a grant to do research on it, like the sail that we were invited to do. That group of people is not going to learn how to do that. They got a research grant and they paid us to come and image it.

I would say those are some of the trade-offs. I think it comes up a lot, can I do this with my phone? Cameras in phones are getting better and better, there is no doubt about that. It goes back to fit for purpose. Why am I doing it? Who is it for? Some pictures I shot with my phone might be good enough. There are apps you can put on your phone that you will make -- that make 3D models. They are not going to be super tight like what I just showed you. Maybe that is ok. It goes back to who you are doing it for and why you are doing it whether or not that kind of approach gets what you need.

If it is about making people aware about what is in your museum, and helping tell stories about objects in your collection, then you may not need these scientific types of results. That is a discussion that you should be having about who you are doing it for and why. I think the biggest mistake that we see people make, and this often comes not from the staff, but from higher up in museums, this idea that... Especially bigger museums... We have to have a 3D strategy and make 3D, and then it will meet all these needs. I will have a cool thing for my website and meet conservation needs and so forth.

Well, not necessarily, right? (Laughs) It depends on your budget and your approach. I think it is a mistake to think there is one thing you can do to meet all the needs. So understanding your goals there will help you make the right choices, and obviously then, the budget and the amount of time that it takes are dependent on those choices.

DAN YAEGER:

What drives the budget. This number of questions here about the number of images you need to make sure the object is taken care of. Is the size of the object also at play here and the relative ease of photographing on the like?

CARLA SCHROER:

It totally varies. It depends on the level of resolution that you need, and it depends on the complexity of the object, not the size so much.

If I have a sculpture, an Asian sculpture with eight arms, and I get around all those arms I get detail in them, that will take way more time and photos than if I have something shaped more like the olmec head where I get around it and have the detail that I need. Size is one factor, but

The needed resolution, the needed precision and also the complexity of the object are going to impact that.

Or something like an Asian sculpture with a lot of arms, maybe just an object movie makes sense. Now somebody can spin it around, they can zoom in and out, they get a sense of what this object is. Particularly, we see in museums a lot where they are like, "This is always on display but nobody can ever see the back of it." Something as simple as an object movie can help people see that kind of result.

If you are talking about RTI, we do around 50 images per RTI. RTI will be used primarily for situations where we need to really find surface details. So something like a faded inscription, trying to read a signature that is very hard to read, before and after treatment for conservation, rock art is a good example. There are a variety of reasons why RTI is a great solution, and we are talking 35 – 50 images for each RTI, each camera position. That is what we are shooting.

DAN YAEGER:

One of these questions is one of my questions, the file sizes must be humongous!

CARLA SCHROER:

Get over it, space is cheap.

DAN YAEGER:

Ultimately, you have to have enough computation power.

CARLA SCHROER:

The RTI's don't take a lot of computer power, and things like the object movies don't take a lot of computer power. The 3D work to do the high rest of the time during does take more computer power. There are services that you can have where you shoot the images, and they can do the processing on bigger systems. So that is a possibility. You probably want to do some initial work yourself just to get a feel for it. There are ways to get it done.

The costs are coming down on a lot of that kind of work. But yes, from an archiving perspective, you can produce a large set of images that have a fairly big footprint, but we have worked with various library groups, we have had partners on certain projects where there is a longevity of the data, and you want them to do the archive for a project, so pay a fee to deposit stuff with them, or maybe they will show certain stuff for free.

The costs of that keep coming down.

DAN YAEGER:

Put on your futurist hat here. Where do you see this going? There's a question about drone technology and how photogrammetry will work in the future. Do they blend together technologically at some point or do they now? What is happening in the upcoming generation?

CARLA SCHROER:

A lot of the things you just said can already be done or at least in the research labs if they are not out there all the time. Just to set the stage for a couple things looking back in time. Photogrammetry, the idea of taking overlapping photographs and using them for measurement goes back to the 1850s. It is not a new idea.

The first photogrammetric society was in Prussia in the 1870s. So photogrammetry from airplanes with metric calibrated cameras was done a little bit in World War I, heavily in World War II. In the 70s and 80s it was done to create topo maps. And it has really been since the 2000's that the ability to do close range photogrammetry and not have to pre-calibrate everything and use expensive care has become more and more accessible. Laser scanning systems have been around since the late 1980s, and they do what they do, and there hasn't been a huge change in laser scanning systems other than the stuff that is going on for self-driving cars.

So there are quick systems that do low-resolution but can track what is happening. So if you look at the lidar that is in iPhone 13 Pro, you cannot really scan directly with that. It is low-resolution. The primary purpose for putting it in there is for augmented reality.

So if you have a situation where you point your camera and move it around that you want to see something placed in that scene, the 3D model or other things that you are placing on the screen, the camera can't keep track of where you are. And Google and Apple and other companies are taking advantage of all the research that has been happening around self-driving cars to do that kind of stuff.

There are some apps that can use the lidar along with photos to help produce three models and scanning, has it been smooth, have holes been filled, what has been happening to this? I see something that looks good but from a research perspective I have no ability to quantify or understand what I'm looking at.

One of the reasons that we have focused on computational photography is that that is an area where there is a huge amount of research. There is a lot of work that is happening in computer vision and computer graphics around photography based imaging.

We are seeing getting more more data out of image sets. Getting better precisions out of data, and ways that people are starting to combine these different techniques. We do sometimes do RTI with photogrammetry, you can register one to the other. We cannot fully integrated, but that could happen in the future.

Cameras are a great tool, so get one and learn how to use it and you can do more and more stuff with it.

DAN YAEGER:

One last question before we let you go. This is a high-level question. It seems to me that climate change, we are recognizing it as an existential problem, a lot of museum collections and facilities, especially these heritage landscapes. What role do you see this computational photography playing in terms of just possibly cataloging things that are at risk?

Is there something that should be encouraged to really prioritize things that are at risk because of sea level rising or flooding or whatever the case might be that might be lost?

CARLA SCHROER:

Absolutely. I didn't talk about that in this presentation because we were focused on small museums, but that is a big driver for our work and a big driver for why we think it is important to train lots of people to do this for themselves because we need lots of people to do this. To understand the trade-offs and get high quality data, and also think about archiving and long-term reuse of the data. Climate change is a huge motivator for us to work in this space.

It was just announced last week that we were awarded a grant to do training with three Indigenous communities. One is on the Pasamaquati tribe in Northeast in Maine, one is the Aleutian and Privilege Island Association based in Anchorage and one is [spelling] Wapaa in Hawaii. Part of why we are working with these three groups, they have all come to us about training, but they are all coastal and very much impacted by rising sea levels.

So the goal of this program is to buy some equipment for them and due to trainings plus online consulting to really get a program going to create a sustainable community of practice around high quality documentation of their cultural material.

Who knows why this got funded, because there is no guarantee, but I think that one of the compelling reasons to fund this project was because of the impact of climate change to the specific communities.

DAN YAEGER:

Awesome. Thank you very much, Carla. Very grateful for your comments, of course thank you all for being with us here today. Please remember to fill out an evaluation form and use the community form space and museum-hub.org.

Hopefully we'll see you next week for our final webinar presented by Harry Abramson of direct dimensions. Be well, everyone, and we will see you next week. Take care.