EMILY MACDONALD–KORTH

Speed, Precision, and a Lighter Load: Metigo MAP 3.0, a Great Advancement in Condition Mapping for Large-Scale Projects

ABSTRACT

Graphic documentation refers to data recorded using pictorial representation over a photograph or drawing of a work of art. The optimal graphic documentation method would incorporate three major functions: digital imaging, mapping, and area quantification tools. Metigo MAP, a digital condition mapping program, is a combination of image processing and computer-aided design. Metigo MAP is comparable to other digital graphic documentation programs, but the comprehensive functionality, compatibility, price, and free annual updates set it apart.

The paper includes the following sections: Introduction to graphic documentation and related software; Introduction to Metigo MAP; Metigo MAP workflow; Metigo MAP Case Study 1: Fengguo Temple, China; Metigo MAP Case Study 2: Yuan Dynasty murals in Beijing, China; Metigo MAP Case Study 3: Metigo MAP as a measuring tool; Graphic documentation software comparison and commentary; and Graphic Documentation Methods Comparison Table; Conclusions.

INTRODUCTION TO GRAPHIC DOCUMENTATION AND RELATED SOFTWARE:

Graphic documentation refers to data recorded using pictorial representation over a photograph or drawing of a work of art; the image of the work of art is called the base map. Graphic documentation is an important phase of conservation because it allows the conservator to accurately document works of art and their condition and aids in making estimates for treatment. The optimal graphic documentation method would incorporate three major functions: digital imaging, mapping, and area quantification tools. Digital imaging (a digital base map and the ability to manipulate the image appearance) allows the user workflow to be more efficient and more flexible than is possible using non-digital means. With digital imaging, the user can create a map inside a computer application, adjust the image to make it easier to use, and facilitate importing and exporting the file between other applications. Mapping means to precisely record surface or structural features on a base map and is the core requirement of any graphic documentation method. Area quantification tools enhance the value of any graphic documentation method, allowing the user to accurately describe how much of each condition or class is present and aiding in comparative condition studies and treatment estimates.

The traditional method of on-site condition diagramming uses colored pencils on paper prints or markers on sheet protectors; however, the paper method is not efficient. The paper method and its diagramming techniques are easy to learn, but because the base map is not digital, area quantification is not possible and the maps cannot be used in peripheral applications unless they are converted to a digital file by being redrawn into another program or digitally scanned. Storage of paper maps is also an issue; the maps can become cumbersome, especially for large-scale projects. Digital imaging programs, such as Adobe Photoshop and Illustrator, have offered new methods and approaches for graphic documentation. Adobe imaging programs work well for mapping but are of limited use for quantification; making measurements and calculations within the programs is difficult. The design program, AutoCAD (CAD, Computer-Aided Design) works well for making graphic maps using digital images and for making to-scale diagrams. CAD requires a large investment of time and energy to learn how to use the complicated software but is commonly used for large-scale projects.

The shortcomings of these other methods led to the creation of Metigo MAP, a digital condition mapping program made by a German company named Fokus. Fokus is a preservation imaging firm that specializes in architectural photogrammetry and building surveys. Metigo MAP was designed for use by conservators of art and architecture, archaeologists, preservationists, and for other large- and small-scale condition assessment projects. Metigo MAP is a combination of image processing and computer-aided design and applies only the most useful functions for conservators from Adobe Photoshop and CAD. Metigo MAP allows users to create rectified to-scale images of the art object, architectural surface, or site and then to use the images to digitally draw highly detailed maps that indicate the location and extent of the various condition issues with visual designations, while also recording and calculating accurate surface area measurements of each condition issue. With Metigo MAP, the user makes the map directly in the computer by drawing the map on the image within the software while examining the artwork; this makes the documentation process faster by eliminating any intermediate steps. Metigo MAP is widely used in Europe; the scope of use has recently spread to other continents. Two institutions in China now use Metigo MAP, and a few institutions in the United States are using the software as well.

Metigo MAP workflow:

First, the user takes digital images of the work of art or architecture and then loads the images into the Metigo MAP software.

From there the user can rectify the images to make them straight and true-to-scale. For example, if the photographer cannot stand far enough away from the artwork to take the picture perpendicularly, the picture must be taken at an angle, and the result is a distorted image. The rectification function in Metigo MAP solves this common problem for large-scale projects: the distorted image is loaded into the software, the exact measurements collected on-site are entered into the software, and the software rectifies the image to be the correct format. After rectification, the software knows the actual dimensions of the artwork, and the location of every point on the artwork; by moving the cursor around the base image, the software gives the user the exact coordinates of any location on the image.

The user can process or adjust the images to improve sharpness, contrast, or brightness. Subtle color differences can be made more pronounced and easier to see for mapping by using the image processing settings.

From there, the user can create a map by making several categories of condition phenomena, called classes, each with a graphic representation on the map, and then organize the classes into groups. Each class or group of classes can be applied to the image in layers. For example, the user could make groups such as paint and ground, surface coatings, and restoration, and classes that fall under each group like flaking, blanching, and retouching, then view either the entire group or an individual class over the base map in the software. The list of groups, classes, and graphic representations do not have to be recreated for every project. The user can save the list in Metigo MAP as a template, creating a list that can grown, and choose only what is needed from the list for each project.

Because the image is rectified and true-to-scale, the program can calculate the total area or length of each class using the area quantification functions. This function can help, for example, in understanding the severity of each type of degradation phenomena. The area mapping function can also help in making accurate estimates for treatment.

When a map is completed, the user can design and insert a legend, and then the maps with all or a selection of layers can be exported as tiff files to be used in other programs or printed out. All the quantification data collected from area and length mapping can be exported into an Excel file for further use.

Metigo MAP Case Study 1: Fengguo Temple, China

The Art Conservation Department of the University of Delaware (UD) was invited by Tsinghua University of Beijing, a school famous for its architectural history program, to collaborate on an examination and condition reporting project at one of China's great cultural treasures, the Fengguo Temple, located in Yixian County, Liaoning Province, a rural region of northeastern China. Fengguo is a Buddhist temple, and was built between the 11th and 12th centuries during the Liao dynasty and is an exceptional and rare example of early traditional Chinese timber-frame construction. The temple holds an outstanding collection of polychromy which includes seven 30-foot, polychrome Buddha statues, painted architectural elements, and Buddhist murals most likely dating from

the Yuan dynasty during the 12th century. Led by Dr. Susan Buck (Winterthur/University of Delaware Program in Art Conservation) and Dr. Liu Chang (Tsinghua University), the team included graduate and undergraduate students from both universities. The UD team examined the condition of the wall paintings while Tsinghua University examined the temple architecture using 3D laser scanning.

The goal of the project was to examine the murals and write a report about the materials, techniques, degradation, and preservation concerns; the team decided to use Metigo MAP for the first time on the Fengguo Temple project. The interior of the temple has four walls covered in Yuan dynasty Buddhist murals which include 18 seated Buddha figures and two attendants. The murals were in poor condition; there was extensive loss in the paint and ground layers, cracking, and water damage, among other condition issues. Because there was not enough time to make condition maps for all twenty murals during the two-week on-site phase of the project, three of twenty Yuan dynasty murals were examined and mapped to represent the condition of the twenty murals overall.

The team used flashlights, handheld magnification tools, and ultraviolet light to examine the murals and identify the condition phenomena, and Metigo MAP to record the condition information. Classes with visual representation for each of the condition issues were created in Metigo MAP, and then mapped, one class at a time, in two-person teams. Each two-person team consisted of an examiner, or a person examining the mural at close range and outlining condition issues using a pointing device (e.g. a laser pointer), and an operator, a person with a computer who operates the software and creates the maps. Metigo MAP can also be used by an unaccompanied user who is positioned close to the mural while accessing a computer. On the Fengguo Temple project, optical mouse pens were used for more accurate control during mapping. However, the best way to use Metigo MAP is to directly map onto a tablet pc, using a stylus on the screen.

Maps made at the Fengguo Temple show condition phenomena plainly, because visual representations of classes are brightly colored compared to those on the base map. For example, by looking at a large wall, two very similar mural segments may appear to be in similar condition, but when a map is made with distinct and brightly contrasted colors that indicate individual classes, the condition differences can be more clearly and quickly understood.   In conjunction with the total area and total length data output features in Metigo MAP, these

condition differences can be described with an actual number in addition to a graphic representation.

Metigo MAP Case Study 2: Yuan Dynasty murals in Beijing, China

The same University of Delaware student team that examined and documented the Fengguo Temple (Case Study 1) had the opportunity to examine and map another Yuan Dynasty mural using Metigo MAP; the mural was located in a collection in Beijing. The mural was approximately 20 meters long and 3.5 meters high. The room that housed the mural was not deep enough to take a picture of the entire mural, and there were columns blocking areas of the mural. Professional photographers at the site took high-resolution images of the mural in overlapping sections, and at angles.   The collection that owns the Yuan Dynasty mural wanted to see the mural in one continuous image, something no one had ever seen.

A useful function of Metigo MAP beyond rectification is tiling, or lining up separate images next to each other to make one larger image. The UD team used the tiling function in Metigo MAP to digitally reassemble the Yuan Dynasty mural. The mural was cut apart at some point, probably to facilitate removal from the original location, then reassembled and installed in the current location. The de-installation involved cutting the mural; this resulted in visible seams on the mural surface creating block-like segments.   To tile the photographs of the mural together, the mural segments were measured in situ according to the area included in each hi-resolution photo, using the seams as measuring points. Next, the high-resolution images were loaded into Metigo MAP and rectified based on the exact measurements taken on-site. Because the rectification process makes all the images true-to-scale, the pictures can line up perfectly if the measurements are accurate. The rectified images were layered one by one within Metigo MAP and tiled by aligning the seams and imagery. The result is a continuous image of the mural, dead-on and unobstructed, and visible in entirety for the first time.

Metigo MAP Case Study 3: Metigo MAP as a measuring tool
The author used Metigo MAP as a measuring device on a project for the Getty Conservation Institute, where the main type of documentation is photography. Using the area quantification functions of Metigo MAP, photodocumentation can be converted into numerical data. The experiment involved the testing of anti-graffiti coatings; a selection of coatings was applied over an outdoor test mural at the Getty Center in a

location concealed from public view. Graffiti materials were applied over the anti-graffiti coatings, then removed, to test the functionality of each anti-graffiti coating. One photograph was taken after the graffiti material was applied, and one was taken after the graffiti material was removed. After the removal process, some residual graffiti was left behind, and Metigo MAP was used to quantify the amount of residual graffiti.

By rectifying the photograph of the experimental mural section using measurements taken at the site, Metigo MAP computes the actual dimensions of the mural section and every point in that mural section. By using polygon and magic wand selection tools (like those in Adobe Photoshop), and marking the areas of residual graffiti material on the image, the total area of the digitally selected graffiti material becomes quantified and produces a number to use for comparative data. Using Metigo MAP as a measuring tool allowed an actual number to be used to compare results, rather than visual analysis alone; these numbers represent one of several parameters used to evaluate each coating.

Graphic documentation software comparison and commentary:

The Graphic Documentation Methods Comparison Table (see Table 1) lists graphic documentation methods used in conservation and the significant characteristics of each method. The table includes previously discussed methods such as: paper maps, Adobe Photoshop and Illustrator, AutoCAD, and Metigo MAP. Two other programs are included in the table that have not yet been discussed: AutoCAD LT, a drafting a design version of CAD that does not include 3D functionality but does include all the 2D mapping functions of CAD, and MonuMap, made by Kubit, which works only within AutoCAD and was designed to streamline the otherwise complicated mapping process.

As mentioned above, the three most important functions for an optimal graphic documentation method include: mapping, digital imaging, and area quantification tools. All methods listed in the table allow for mapping, and all but the paper method use a digital base map and have some image processing functions. All methods, except the paper method, include rectification and quantification functions, although Adobe Photoshop and Illustrator are lacking in this area. The table also lists the compatibility of each method with AutoCAD, because AutoCAD is widely used, and it is likely that CAD

compatibility will be a requirement for maps of large-scale projects. Metigo MAP is fully compatible with AutoCAD, and Monumap is inherently compatible because is runs inside AutoCAD; AutoCAD and AutoCAD LT are also naturally compatible.

The learning curve for graphic documentation methods can be steep, but through trial and error, the use of an instruction manual, lessons with a teacher, or all of the above, it is possible to learn each method listed. The final column on the table lists the approximate costs of each method or piece of software. Paper mapping involves minimal costs; Adobe Creative Suite 5 which includes Photoshop and Illustrator is approximately $1000; AutoCAD is about $3500; AutoCAD LT is about $1000; Metigo MAP is approximately $2200 (or 1500 EUR), and Monumap costs $2095 plus the cost of AutoCAD.

Conclusions

In summary, Metigo MAP has several favorable features and only two obvious drawbacks. Metigo MAP allows for easy graphic mapping on a digital base map, with image processing capabilities, image rectification, and area and length quantification functions. Metigo MAP is fully compatible with AutoCAD and is relatively easy to use. Metigo MAP is not inexpensive, but the purchase price includes free annual updates, while other programs require yearly fees to keep the software current. The first drawback of Metigo MAP is the instruction manual; originally written in German, it can be difficult to use. The second drawback is that the image processing capabilities in Metigo MAP do not include white balancing. No piece of software can be considered a stand-alone conservation program without the ability to white balance images for truly accurate color representation.

Finally, Metigo MAP software is an improvement over non-digital methods of condition mapping. Because the information goes directly into the computer as the work is examined, the software allows for greater accuracy and specificity in condition reporting and surface area measurement, and the system requires minimal storage space and hardly any extra hardware. Metigo MAP is comparable to other digital graphic documentation programs, but the comprehensive functionality, compatibility, price, and free annual updates set it apart.

Graphic Documentation Methods Comparison Table						
Software	Mapping	Digital Imaging and Processing	Image Rectification and Quantification	AutoCAD Compatible	Ease of Use	Price
Hand-Drawn Paper Maps	Yes	No	No	No	Easy	Inexpensive
Adobe Photoshop and Illustrator	Yes	Yes	Yes, limited	No, only as a base map	Easy/ Moderate	CS5 Suite ~$1000
AutoCAD	Yes	Yes	Yes	Yes	Difficult	~$3500
AutoCAD LT	Yes	Yes	Yes	Yes	Moderate/ Difficult	~$1000
Metigo MAP	Yes	Yes	Yes	Yes, limited	Moderate	~$2200
Monumap (within AutoCAD)	Yes	Yes, in AutoCAD	Yes	Yes	Moderate	~2095 + AutoCAD or AutoCAD LT

Table 1. The Graphic Documentation Methods Comparison Table lists graphic documentation methods used in conservation and the significant characteristics of each method.

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Author

Emily MacDonald-Korth
Graduate Fellow, Winterthur/University of Delaware Program in Art Conservation
Graduate Intern, Getty Conservation Institute
1200 Getty Center Drive, Los Angeles, CA 90049
E-mail: emacdonaldkorth@getty.edu

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