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Content

The use of 3D photogrammetry in analysing the Roman epigraphic monuments: a case study from Kremna village, southwestern Serbia

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This paper explores the efficacy of different open-source software tools in analysing 3D photogrammetric models of Roman epigraphic monuments. The study, conducted on four monuments from Kremna, Serbia, reveals that advanced software processing significantly enhances the visibility of reliefs and inscriptions, making it possible to record previously unreadable text. A key result is the identification of 27 new letters on one altar, showcasing the method's potential for further epigraphic research. The results show that, at this moment, the most suitable software visualization tool for recovering lost inscriptions is depth mapping in Blender software. The research illustrates the value of 3D modelling for archaeological interpretation and permanent digital preservation of endangered epigraphic monuments.

Keywords: *3D epigraphy, photogrammetry, Roman epigraphy*

Introduction

This paper is the result of research conducted on selected Roman monuments from the village of Kremna in southwestern Serbia, with the aim of determining the possibilities of applying photogrammetric 3D models to uncover lost inscriptions on epigraphic monuments.

As an easy and free form of documentation, 3D photogrammetry is becoming more prevalent in archaeological practice (Al-Ruzouq 2012: 97; Magnani et al. 2020: 2). In recent years, a number of papers (Landes et al. 2013; Calisi 2016; Brutto 2018) on registering various anomalies on artefacts using a series of vizualisations on 3D models were published. It has been shown that, among other things, processing 3D models of epigraphic monuments can result in recording parts of inscriptions, otherwise illegible by traditional epigraphic methods. This is a method that has only recently emerged, as most 3D model software did not have the necessary tools for such analyses until a few years ago. Additionally, computers with powerful processors capable of handling large datasets have only recently become more widely available, including other necessary performance aspects such as graphics cards or RAM capacity. Considering this is a very young field of research, a comprehensive study comparing the success of different software and visualization tools for these purposes has not yet been conducted. This paper will attempt to do just that. With the aim to determine the effectiveness of each visualization tool, the results obtained by different open-source software will be compared. At the same time, this paper will emphasize the importance of 3D modelling for preservation of cultural heritage, especially when it is not properly protected and threatened by environmental factors.

Materials

The Kremna basin is rich in archaeological remains from the Roman period. In addition to a temporary military camp at the site of Trgovište, the remains of Roman funerary monuments, altars, and stone sculptures are scattered around the village, on at least five sites. They have been dated to the II and III centuries, with medieval monuments also recorded at some sites. Despite their large number, only a few of these monuments can provide significant epigraphic data. They are very poorly preserved and have been increasingly affected by external factors over time. With that in mind, four monuments with visible inscription fields, with or without legible letters were selected to be analysed.

The first analysed monument was a funerary stele from the site of Crkvine-Misajlovići (Fig. 1a). It was first described in 1986, when a part of the inscription was recorded: *D(is) M(anibus) Aurel(ius) Cut[ius vi]xit annos R.. D* (Mandić 2015: 207). The same description also mentions dolphin reliefs found alongside the rosette in the middle part of the upper field. The central part of the monument, i.e., the inscription field, is bordered by columns with decorated capitals. The monument has been significantly damaged in previous decades, and today, not a single letter of the inscription is visible, nor are the dolphins in the upper field. At the bottom of the inscription field, the monument is broken in width. In the lower field, reliefs of two confronted hippocamps are visible, and the base is also preserved.

The site Crkvina is located in the hamlet of Rodalji-Čulići. It is a place where minor excavations were conducted in 2004, during which the altar (Fig. 1b) was cleaned and placed at today's position. Report from the excavations mentions that it is a small ancient altar, from which only the letter C in the lower zone of the inscription field can be read (Lj. Mandić, from an unpublished report on field excavations in 2005, the National Museum of Užice).

The third analysed monument (Fig. 1c) is a spolia, built into a modern fountain opposite to Moljković Han (Zotović 1973: 16), and it is known to have been transferred from the site at the Stamenić cemetery (Mandić 2015: 207). Due to the way it was secondarily used, this funerary monument is only partially visible, with the entire lower half of the inscription field and one side today lying below the ground. On this monument, reliefs of the god Attis are visible on both sides, and above them, as well as above the inscription field, relief garlands with rosettes are depicted (Vulić 1941-48: 246). Today, no letters are discernible in the inscription field.

The last monument is a votive altar (Fig. 1d), registered at the Erić cemetery site. It is a limestone altar dedicated to the god Jupiter. During archaeological reconnaissance conducted in 2021, a partially readable inscription was recorded: *I(ovi) O(ptimo) M(aximo) ANVS ROO M* (V. Mihajlović, from an unpublished report from a systematic survey in 2021).

Methodological framework

The process of photographing the monuments from the village of Kremna was preceded by planning all phases of the research, following the steps previously described by Marin-Buzon (Marin-Buzon et al. 2021: 2-3). DSLR camera Canon EOS 700D, a 18-megapixel with EF-S 18-55mm f/3.5-5.6 IS STM lens was used for creating the photographs of all four monuments.

The photographing of the monuments was carried out in September 2022. Only cloudy days were chosen for shooting, as it was important to neutralize shadows on the surface of the monuments. Before photographing, it was necessary to remove vegetation, clean the monument, and, in the case of the stele from Misajlovići, remove rainwater that had accumulated on the inscription field. The ranging pole and markers were placed around each monument, and the distances between them were measured in order to obtain the necessary measurements for scaling the model. All photos were captured in RAW format. Since the shooting conditions were dependent on the external light, aperture was set to *f*/4.5, with ISO 100 for all the monuments, while the exposure of 1/200 seconds was used for photographing the monument built into Moljković fountain and one from Crkvina site and 1/160 seconds exposure was used for the altar from Erić cemetery and stele from Crkvine-Misajlovići. While it would also be purposeful to increase the f-number to achieve a greater depth of field, it was decided to reduce the f-value at the expense of shorter exposure and smaller ISO, in order to assure the photos do

Figures 1a–1d. The present state of the monuments from Kremna village (Photo by: A. Bandović and P. Đerković).

not contain too much noise or are not blurry. Since the photos were not taken in controlled lab conditions, the distance between the camera and the object could not be fixed, but was approximately 80cm for all the monuments. With such settings, DoF (Depth of Field) value comes to around 1.5cm, which is much more than the actual depth of the letters on the flat surface of the monument. However, it is still a very small value, so it was important to use a manual focus and check the photos during shooting.

In recent years, mobile phones with increasingly advanced cameras have been produced. They can provide photos of very high resolution, and a series of performances have made photography faster and easier. The latest generation of iPhone phones even contains a laser scanner, which, along with accompanying software, provides very precise 3D models (Luetzenburg 2021: 2-7). For this reason, all mentioned monuments from the village of Kremna were photographed one additional time, using an iPhone 12 with a 12-megapixel camera, with the aim to illustrate that the method may achieve sufficient success with photos obtained using a mobile phone. DSLR cameras have a significantly larger sensor and the possibility of changing lenses, offering a wide range of possibilities, while mobile phones boast increasingly advanced cameras that provide fast high resolution shooting, recent studies have shown that both can yield comparable results when used properly (Fawzy 2019;

Sahala Samosir & Riyadi 2020; Saif & Alshibani 2022; Patonis 2024). The iPhone photos were taken in automatic mode, with aperture values varying between *f*/1.6 and *f*/2.8, and between 1/800 and 1/200 seconds for exposure, while ISO speed was 32 for all the monuments.

The photographs were inserted into the *Metashape* software for creating 3D models, which is commonly used by archaeologists (Lehoczky & Abdurakhmonov 2021: 9). After aligning the photos, high quality textured models were obtained, with each model containing around 30 million points. A total of 8 models – 4 obtained by DSLR camera and 4 by iPhone camera – were derived and imported in other software. In order to apply different visualizations on their surfaces, four software were used: *Metashape*, *MeshLab*, *CloudCompare* and *Blender*.

The first visualization was creating a digital elevation model (DEM) in the *Metashape* program. This is a simple process used to represent heights on the model by assigning colors on a predetermined scale. Although digital elevation models are most commonly used in archaeology for displaying altitudes during the creation of 3D relief models (Kokalj et al. 2013: 100), they can also be used in the analysis of artifacts. In our case, it was decided to use a planar projection, which allows the user to establish the basic plane in relation to which the height of points on the model will be measured. Ideally, *Metashape* will thus create an elevation model so that the surface of the inscription area is marked with one shade, while irregularities, such as inscribed letters and reliefs, will have different values on a predetermined spectrum of colors.

The second software used was *MeshLab* (Cignoni et al. 2008), which allows 3 different visualization techniques suitable for the aims of this research. The first technique involves adjusting the light source's position to illuminate the monument from different angles, which is not possible in natural conditions, thereby enhancing shading and aiding inscription readability. The second visualization used in *MeshLab* is depth mapping, which is achieved by simultaneously moving the *Zmax* and *Zmin* bars, which denote the boundary values on the Z axis, i.e., the values in the depth of the 3D model. In this way, the software will assign a value of 0 to a certain minimum height, marked with black, while the maximum height will be marked as white, having the value 1. In that way, all points located between the two Z axes will be assigned values expressed in shades of gray, depending on their distance from the axes. While analysing the monuments from the village of Kremna, it was important to place the two axes as close to each other as possible and in close proximity to the inscription area or reliefs. In this way, the very surface of the monument receives the maximum value, while the deepest possible dent receives the minimum one. In other words, the deeper the symbol on the monument is carved in relation to the surface of the inscription area, the lighter it will appear. In addition to the two options mentioned, there is a third useful visualization in *MeshLab*, which, as research on a medieval inscription from western France has shown (Vergne et al. 2018), can provide good results in the analysis of damaged inscriptions. It is called Radiance Scaling (Vergne et al. 2010) and allows the recognition of shapes through shadows and radiance of objects, achieved by differences in the intensity of illumination on convex and concave parts of the object.

CloudCompare (Sautier et al. 2020) was also used for visualizations of the heights of photographed monuments. It is necessary to set a plane against which coloring will be performed, after which it is also possible to choose the type of coloring. The method of creating height ramps in this software is fairly similar to DEM in *Metashape*.

The *Blender* software (Simonds 2013) interface involves inserting functions, in the form of windows, which can later be connected to achieve the desired visualization (Ferdani et al. 2020: 15). Similar to the *MeshLab* program, the process of representing depths is based on establishing two Z axes, values 1 and 0, which can be moved in the Color ramp window.

Results

1. Funerary stele, Crkvine-Misajlovići

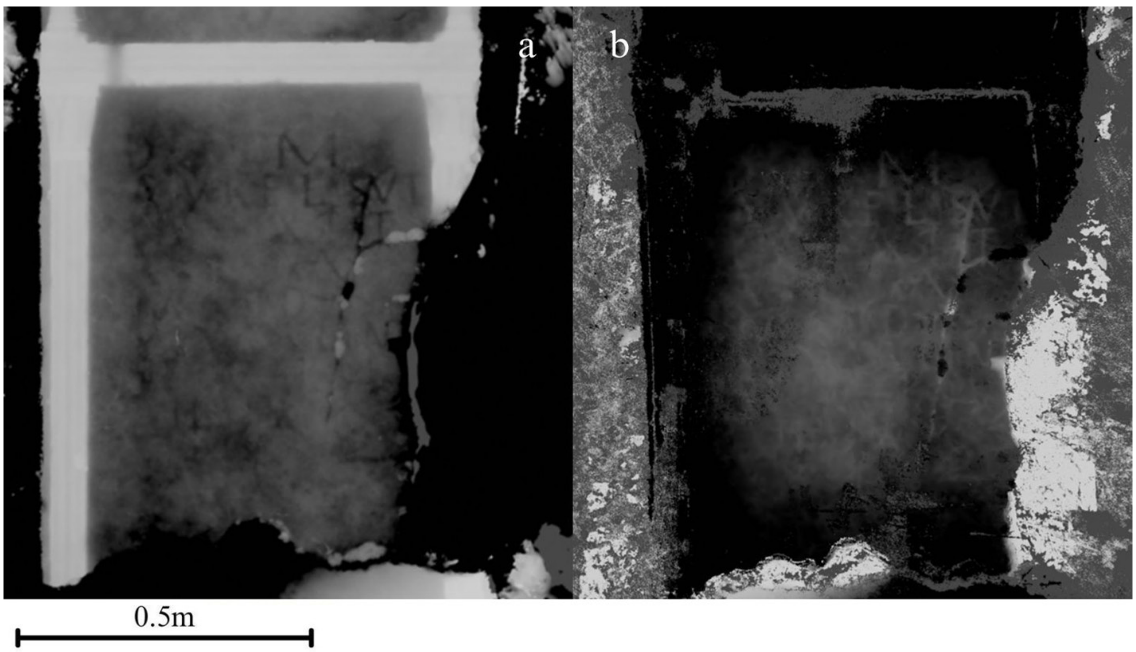
While analysing the, today invisible inscription on the funerary stele from Misajlovići, it was possible to reveal several letters, especially in the upper part of the epigraphic field. DEM analysis in *Metashape* software allowed recording 20 letters (Tab. 1), in the case of DSLR derived photos, and 15 letters on the model created by using an iPhone camera. While artificial manipulation of light source in *MeshLab* software did not result in a significant number of recorded letters, height maps in the same software allowed the reading of as many as 19 letters. Radiance scaling in *MeshLab* also resulted in a significant number of recognizable letters, with Gray Descriptor providing better results than Lit Sphere Radiance Scaling. Analysis conducted in *CloudCompare* proved to be imprecise, since it was not possible to record a single letter on either model. However, processing the models

software visualization	stela, Crkvine - Misajlovići		altar, Crkvina Rodalji - Čulići		funerary monument, Moljkovića česma		altar, Erić cemetery	
	DSLR camera	iPhone camera	DSLR camera	iPhone camera	DSLR camera	iPhone camera	DSLR camera	iPhone camera
Metashape – DEM	20	15	13	13	1	1	9	8
MeshLab – Artificial moving of the light source	3	1	4	4	0	0	8	8
MeshLab – Depth maps	19	12	27	24	2	0	20	19
MeshLab – Radiance scaling (Gray Descriptor)	18	14	25	24	2	1	15	15
MeshLab – Radiance scaling (Lit Sphere Radiance Scaling)	18	8	25	24	3	0	15	15
CloudCompare – Height Ramp	0	0	0	1	0	0	4	4
Blender – Depth maps	21	15	28	27	3	2	21	16
Readable today	0		1		0		11	
Readable in the past	20		1		0		/	

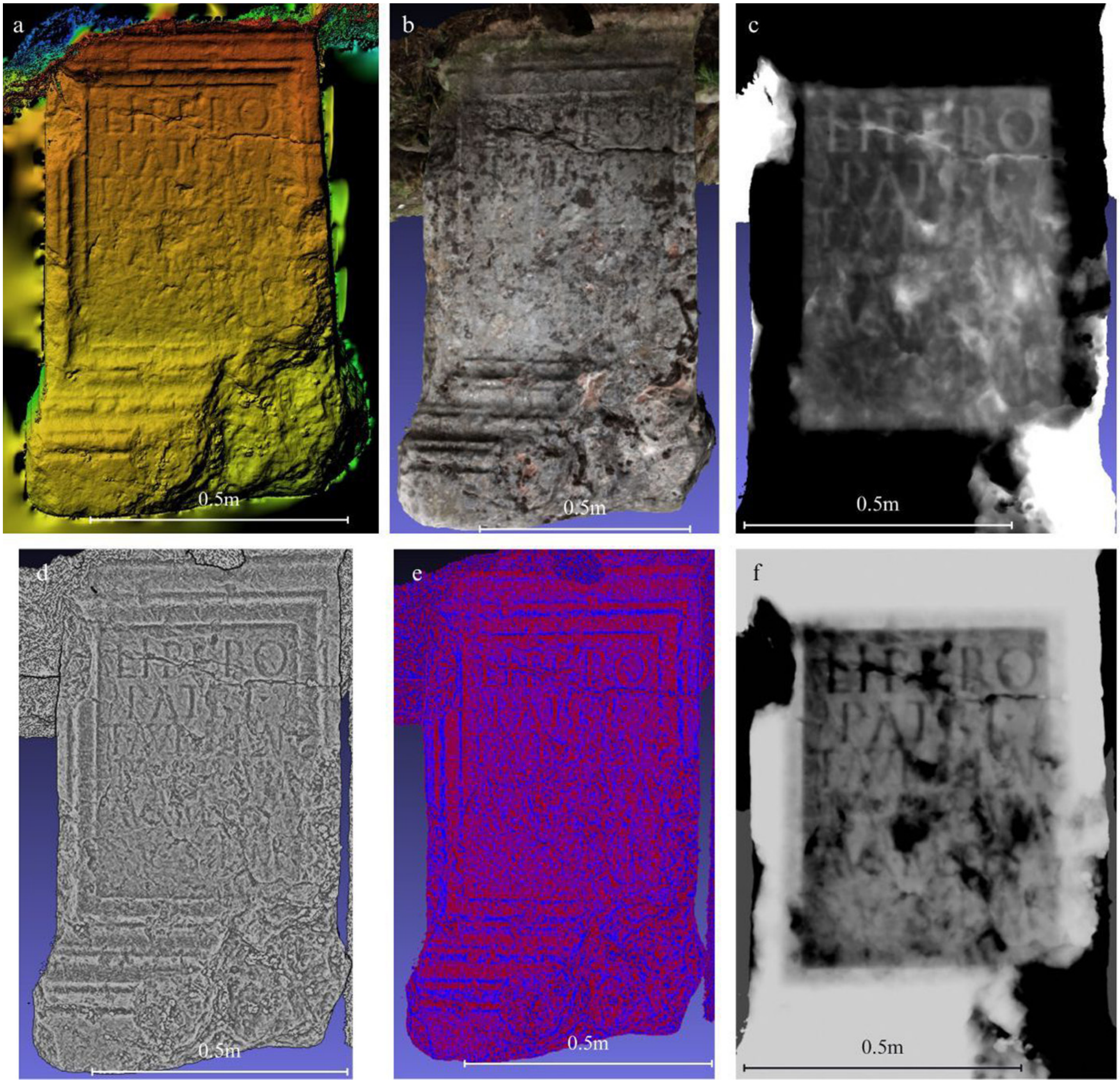
Table 1: Number of observed letters per monument, depending on the applied software visualization and the type of sensor used

in *Blender* gave the best results, with 21 recorded letters on DSLR-derived model (Fig. 2a), and 15 in the case of iPhone camera (Fig. 2b). This means that it was possible to detect the following letters: D M AVREL CVT...XIT...XN..... DT.....D.NS.....M...

By analysing the digital elevation models of the stele from the Misajlovići hamlet in the *Metashape* software, an animal figure resembling a dolphin was observed in the upper left corner of the monument (Fig. 4c). In both models, the rosette in the center of the upper field is clearly visible, together with the columns with capitals and the hippocampi reliefs in the lower field (Fig. 4d).



Figures 2a–2b. Funerary stele from Crkvine-Misajlovići, depth maps in Blender, from DSLR (a) and iPhone photos (b).



Figures 3a – 3f: The comparison of different visualizations on DSLR-derived model of the altar from Crkvina site in the hamlet of Rodalji-Čulići: (a) DEM in Metashape, (b) artificial moving of the light source in MeshLab, (c) depth maps in MeshLab, (d) Gray Descriptor radiance scaling in MeshLab, (e) Lit Sphere radiance scaling in MeshLab, (f) depth maps in Blender.

On both models, analysis conducted using the *MeshLab* software, artificial manipulation of light source allowed better detection of hippocampi in the lower field, especially when it comes to the model derived from photos taken with the DSLR camera, while the dolphin figure in the upper field corner is barely discernible. Regarding the analysis of height maps in the *MeshLab* software, all the mentioned reliefs are clearly visible. Radiance scaling, in the case of both types of visualizations, also allowed for the detection of all figural elements and the columns on this stele. Analysis of this monument's model in the *CloudCompare* software did not give the desired results, as most of the elements on this monument could not be observed. Processing the models in the *Blender* software gave results similar to those provided by *MeshLab*. Regarding relief representations, both models clearly show the rosette and dolphin motif in the upper field, as well as hippocampi in the lower field.

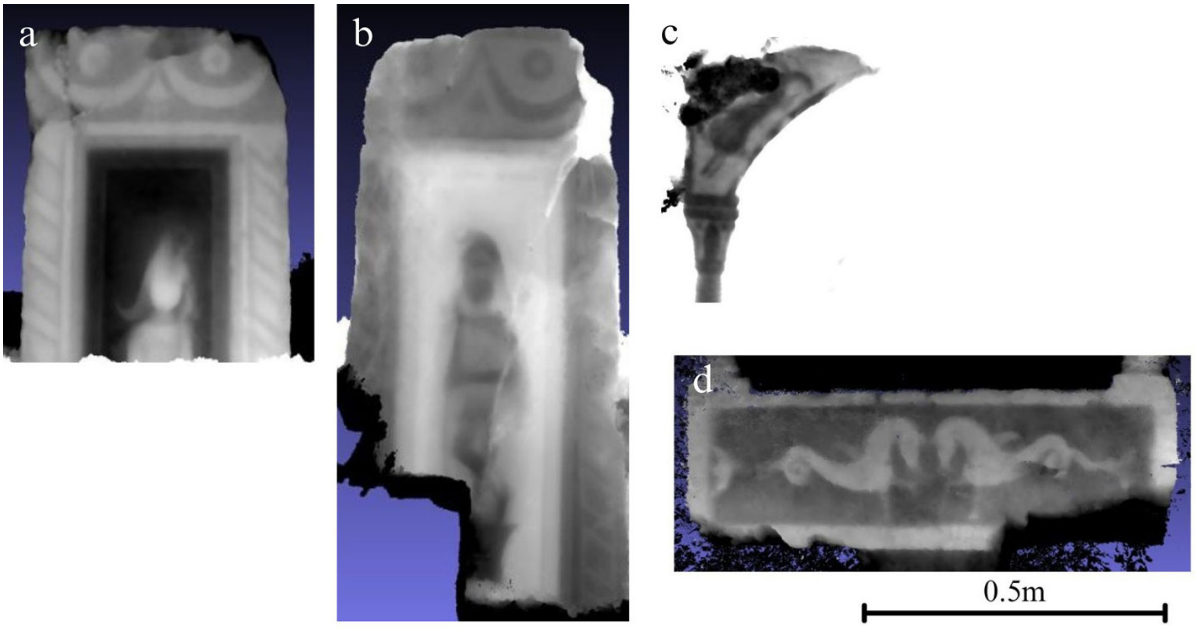


Figure 4: The reliefs visible using Metashape depth maps from DSLR photos on funerary monument from Moljkovića česma (a, b) and stela, Crkvine – Misajlovići (c, d).

2. Monument from the Crkvina site in the hamlet of Rodalji-Čulići

While analysing this, until now barely legible monument, it was noticed that the newly recorded letters were incorrectly oriented, which leads to the conclusion that the monument was placed upside down. This meant that during further processing, the model of the monument from the Crkvina site had to be rotated 180 degrees, in order to read the inscription. The creation of DEM in the *Metashape* software made it possible to see part of the inscription on this monument and in the case of both created models (Fig. 3a) it is possible to read 13 letters. Artificial manipulation of light source in *MeshLab* only resulted in 4 visible letters (Fig. 3b), but height mapping (Fig. 3c) and radiance scaling (Fig. 3d and 3e) in the software enabled much better results. While the same cannot be said in case of *CloudCompare* processing, analysis conducted in *Blender* resulted in the highest number of readable letters – 28 in the case of using the DSLR photos (Fig. 3f) and 27 for the iPhone photographs. Thus, it is possible to read almost the whole epigraphic text: LIBERO PATRI°. T°AVI...AN M...V.. AVR°M... S°V°S°L°M .

3. Tombstone built into the Moljković fountain

Due to the fact that today only a part of the inscription field is located above the ground, results of the analysis of the tombstone built into the Moljković fountain are limited. While DEM analysis in *Metashape* allowed recording a single letter on both produced models, depth maps and radiance scaling in *MeshLab* gave slightly better results on the 3D model created by photos from a DSLR camera (Tab. 1). However, by artificially moving the light source in the software, it was impossible to detect a single letter, which is also the case with height ramps in *CloudCompare*. Again, height mapping in *Blender* gave the best results, enabling 3 letters to be read on the DSLR-derived model. Those letters are: D M .N/M... Since the figure of god Attis on both sides of the monument was visible to the naked eye, most of the used visualizations only enabled a better view of the relief, and the same can be said for the garland reliefs in the upper parts of the monument (Fig. 4a, 4b).

4. Altar from the Erić cemetery

The only monument where today there are some letters visible with a naked eye was the altar from Erić cemetery (Tab. 1). DEM analysis in *Metashape* software, artificial moving of the light source in *MeshLab* and height ramps in *CloudCompare* all resulted in smaller amounts of recorded letters than already mentioned in the previous archaeological report (V. Mihajlović, from an unpublished report from systematic survey in 2021). However, height mapping in *MeshLab* allowed recording 20 letters, in the case of DSLR photos, and 19 letters on the model created by using an iPhone camera. Among all visualizations applied to the model derived from mobile phone photos, depth maps in *MeshLab* gave the best results, which is the only example where *Blender* has not been able to provide the most complete results. Radiance scaling in *MeshLab* resulted in 15 recorded symbols in all cases. Once again, the best results overall were provided by *Blender*, with 21 letters recorded on DSLR model: IOM .T.RD°CS(?) ...ANVS N..IROO VSLM.

Discussion

The issue of recording and interpreting epigraphic monuments can, at least partially, be addressed through the creation of 3D models for archaeological purposes. This approach facilitates an objective and precise documentation, analysis, conservation, and presentation of archaeological material (Vergne et al. 2018: 6). The results of this study underline the necessity of generating 3D models of epigraphic monuments and other archaeological findings, particularly concerning artifacts made of perishable materials or those inadequately protected and presented. The documentation and permanent conservation of epigraphic monuments can be achieved by 3D models, as they offer a relatively quick, cost-effective, and straightforward means to permanently document artifacts such as epigraphic monuments. The production of 3D models of the monuments from Kremna was of particular significance, given their composition of easily degradable limestone, which should under no circumstances be exposed to environmental factors. Their notably poor state of preservation has been known since the late 19th century (Vulić 1941-48: 248; Vulić & fon Premerstein 1900: 50-51), and only by 3D visualizations used in this paper was it possible to record previously invisible features.

The comparison of results depending on the used software tool was the primary focus of this study. Each used option in the mentioned software will be individually discussed at this point. In order to establish a criterion for the success of the results, the visualizations offering the highest number of recognized letters (Tab. 1) were simply marked as the best ones, with a separate focus on the visibility of relief images.

The primary advantage of using DEM in the *Metashape* software is the relatively straightforward execution of analyses, given that this program is most commonly used for creating 3D models in archaeology (Lehoczky & Abdurakhmonov 2021: 6). The elevation models provided sufficiently good results, particularly in terms of the number of observed letters on the stele from the Misajlovići hamlet, although fewer letters were observed in the case of other monuments. The success of analysing monuments through the creation of digital elevation models may depend on several factors, and it is important to note that this method is most commonly used for relief representation in terrain model creation (Kokalj et al. 2013: 100). The advantage of this method lies in providing a comprehensive view of all parts of the monument simultaneously, as it does not depend on the mutual distance of artificially placed axes, as is the case with depth mapping, and it is the software most widely used by the archaeological community.

Concerning the analyses in the *MeshLab* software, it is noticeable that artificial light source displacement did not deliver equally good results as other visualizations. Nevertheless, this by no means implies that this method is useless, given that all relief representations and symbols are significantly more recognizable when using this method. The next used option in the *MeshLab* software was depth mapping. This analysis allowed notably good results for all monuments, and in the case of the mobile phone model of the altar from the Erić cemetery, this visualization provided the highest number of observed letters. Generally speaking, of all the 7 applied visualizations, only the method based on the same principle executed in Blender software provided better results. The third visualization used in the *MeshLab* software, radiance scaling, provided expectedly good results that support earlier conclusions regarding the method's success (Vergne et al. 2018: 7). Although the method did not provide better results than depth mapping, this visualization can also be considered sufficiently detailed for registering damaged inscriptions. Gray Descriptor and Lit Sphere Radiance Scaling, in terms of their success, do not differ significantly, with an advantage of the latter option being the ability to choose desired colors for concaves and convexes. It is necessary to emphasize that, just like digital elevation models and shading methods in *MeshLab*, this method provides a comprehensive view of all parts of the monument simultaneously, which is particularly important for observing reliefs.

The *CloudCompare* program failed to provide sufficiently high-quality data regarding the registration of damaged inscriptions on epigraphic monuments. By applying the described analysis in this software, it was possible to read only a part of the already visible letters. On the other hand, this software tool allowed a slightly better perception of certain relief scenes, although other used software tools proved better for these purposes.

As already mentioned, in almost all cases, depth mapping in *Blender* software provided by far the best results. This is not surprising, considering that this method proved to be very effective in the case of analysing a Roman epigraphic monument from Spain (Andreu & Serrano 2019). On the sample of monuments from the Kremna village, depth maps provided the best results in 7 out of a total of 8 created models. Such a result confirms that, regardless of the choice of physical sensor for photographing, registering inscriptions on illegible or poorly legible epigraphic monuments is best achieved through depth mapping in *Blender* software. However, this by no means implies that only this program could be used for these purposes. Depth mapping and radiance scaling in *MeshLab* software provide nearly as good results, and it is a software with a much simpler interface. Additionally, the disadvantage of *Blender* is that depth mapping prevents simultaneous viewing of all relief representations on the monument, which is not the case with radiance scaling.

While DSLR photogrammetry resulted in models useful for further epigraphic analysis, the mobile phone camera was employed primarily to assess the speed and general utility of creating 3D models with widely used technology. This approach aimed to determine if mobile devices could serve as a valuable preliminary tool for quickly identifying potential inscriptions or features on monuments that warrant more in-depth photographic documentation. The results of this work indicate the existence of the inscriptions on the monuments, and resulted in their correct interpretation. The fast acquisition of photos offered by mobile phones therefore positions them as an effective method for initial site assessment, potentially indicating areas where detailed recording with professional-grade equipment would then be most beneficial. Additionally, precisely calibrated mobile setups can also result in comparable results (Saif & Alshibani 2022; Patonis 2024), and lately smartphones also have LiDAR technology (Antón et al. 2025), which is another direction for future research in the field of 3D epigraphy.

Even though the main aim of this paper was purely methodological, it is impossible to ignore the potential of the results for archaeological interpretation. By combining the results from this paper with the previous readings of the same monument (Mandić 2015: 206), it is possible to interpret the inscription on funerary stele from Misajlovići: *D(is) M(anibus) Aurel(ius) Sut- [- - -]xit [- - -]XN[-] [- - -]DT[- - -] [- - -]D[- - -]N S[- - -] [- - -]M[- - -].* Apart from that, the reliefs that are today unrecognizable were possible to detect, allowing us to capture them before further decay. The most interesting results are the ones regarding the monument from Crkvina in the hamlet of Rodalji-Čulići. Previous researchers could only recognize letter C in the lower part of the monument. However, even that reading was wrong, since the monument was placed upside down by archaeologists, which could be concluded only by the precise methodology used in this paper. After the conducted visualizations, it is now possible to reconstruct nearly the whole inscription: *Libero Patri• T. Aur(elius ?)[- - -]AN M[- - -]V[- - -] Aur(elius, -elia)·M[- - -] S•v(otum)•s(olverunt)•l(ibentes)•m(erito).* Only now can we conclude that this monument is an altar dedicated to Liber, Roman god of fertility, wine, winemaking and freedom (Imamović 1977: 160). As such, Liber was often referred to as *Deus Laetus*, that is, "the happy god" (Olujić 1990: 9). The inscriptions on the altars dedicated to him usually begin like our example, with the dedication Libero Patri. The number of votive monuments dedicated to Liber is quite numerous in Dalmatia, and a higher concentration of such monuments was also recorded in the provinces of Pannonia and Dacia (Olujić 1990: 10). Regarding the monument built into the Moljković fountain, it is now possible to record and interpret a small part of the, never before read inscription: *D(is) M(anibus) [- - -]M*. It is also possible to expand the previous interpretation of the altar from Erić cemetery: *I(ovi) O(ptimo) M(aximo) [- -]T[- - -]RD•CS(?) [- - -]anus N[- - - IIv]ir q(uin)q(uennalis) v(otum) s(olvit) l(ibens) m(erito).*

Conclusions

The findings from the analysis conducted in this paper unequivocally represent the success of three-dimensional photogrammetry in reading weathered, obscured, or faintly discernible epigraphic inscriptions or reliefs on architectural artifacts. Across all surveyed monuments, a substantially larger number of letters was documented compared to conventional techniques, with a notable discovery of 27 previously unnoticed characters. The results of this paper allowed us to record yet unknown archaeological and historical features of the Kremna basin, such as the presence of Liber's cult in this part of Roman Dalmatia. This outcome leads to the suggestion for further usage of the presented methodology, along with the integration of laser scanners and infrared thermography (IRT). Nonetheless, the advantage of 3D photogrammetry lies in its widespread accessibility. It was for these reasons that the described visualizations were examined on models derived from an iPhone camera.

Although outcomes may not match the quality of the results achieved via DSLR cameras, they notably outperform traditional methods of monument interpretation. The methodological framework of this study can serve future studies of 3D epigraphy, particularly in recovering lost inscriptions and reliefs.

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