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THREE-DIMENSIONAL MODELLING OF A BRIDGE BY INTEGRATING TERRESTRIAL AND AERIAL PHOTOGRAMMETRY APPLYING AN ADAPTED CAPTURE METHOD

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Abstract

Three-dimensional (3D) photogrammetric modelling is a contemporary remote sensing method for generating digital models with their specific appearance and texture, which are used in various areas of life. The modelling of complex geometry objects, such as masonry bridges, is not an easy task, because of their specific features (the presence of arches and various niches). This determines the choice of an adapted capture method according to the individual characteristics of the object. The paper presents research aimed at generating a highly accurate three-dimensional model of a bridge, by combining terrestrial and aerial photogrammetry. A low-cost unmanned aerial system (UAS) was used for capturing the upper side of the bridge. This significantly optimised capture time. But its capabilities do not allow to capture the bridge arches from the bottom upwards, nor to obtain an accurate model of the bridge railing. Because of this, a terrestrial survey was made with a digital camera, thus complementing the information required to generate a comprehensive model of the bridge. The integration of aerial and terrestrial capturing using low-cost cameras and systems, along with the application of modern algorithms for processing, allow to create precise, accurate, and detailed digital models. It is all very important for future conservation, restoration, adaptation, and socialisation of such type of objects which are monuments of culture.

Introduction

Cultural monuments and in general cultural wealth are of indisputable importance for the cultural identity of any society. The development of commonly accepted ways of managing cultural heritage and a cultural tourism strategy are major tasks faced by any country.

According to a number of recommendations and resolutions of the European Council, Europe needs to prepare commonly accepted ways of heritage management and, in view of sustainable development of cultural heritage, a strategy for cultural tourism. The sustainable progress of the cultural and natural heritage will be guaranteed by reaching the full capacity of the following three basic principles: economic and social development, and environmental protection. The cultural and natural heritage will be preserved and used as a factor of development at the local and regional level, when its physical integrity is preserved and when the message it carries is successfully relayed and assimilated by contemporary society [1].

Due to its strategic location and history, Bulgaria is rich in cultural monuments, some of which are still in use today – for example, masonry bridges. According to unofficial data, they amount to about 150 and their preservation, restoration, and use is of utmost significance. The potential presence of erosion, abrasion, landslide activities, and the anthropogenic factor are all prerequisites for the need for periodic activities related to the monitoring and restoration of such sites. Remote sensing, as a non-destructive method which in some cases requires the acquisition of images from low altitudes (in particular photogrammetry), provides promptness and necessary accuracy, ensuring the safety of the work process. The ability to establish methods for capturing, along with the creation and storage of high-precision models of these types of objects, would provide experts from different fields with exclusive opportunities to have data on the exact location of every detail of those sites and objects.

There is a range of studies related to the creation of 3D models of masonry bridges. Some of these are based on the application of entirely terrestrial photogrammetry. For example, in a study implemented in 2006, a virtual photogrammetric model of the Kapuagasi bridge was created. The bridge is located in Istanbul and has a length of 74.4 m. More than 30 stereo images were taken with a *Samsung Digimax 430* digital camera. 40 reference points were used. Photogrammetric processing was performed in the *Pictran-D* software environment and the generated bridge model was input in 3D Studio Max for texturing [2].

A test and subsequently a field study related to photogrammetric modeling of a bridge are presented. The captured images were used by the *PhotoModeler* custom software to measure bridge characteristics. A field surveying was also performed. Based on the comparison between photogrammetric and manual measurements, it can be said that photogrammetry provides sufficient accuracy and is a non-contact, inexpensive and practical method for creating three-dimensional geometric textured models [3].

A 2017 study presents the Meram Bridge in Turkey captured. The bridge is 29.5 m long and 4.5 m wide and has five arches along its length. The capture was performed with a *Canon PowerShot A2200* and a *Canon EOS 100D* digital cameras. 70 control points were used and subsequent photogrammetric mapping was performed in Photomodeler. Another type of software was also employed, namely Photoscan, and 6 reference points were used for georeferencing. According to the result of this research, both photogrammetric approaches are validated as a low-cost method for 3D modelling of a masonry arch bridge [4].

Terrestrial photogrammetry has been established to this day as low-cost, accurate, and fast methodology for 3D modelling of architectural objects and for extracting metric data about them. In some cases, terrestrial photogrammetric capture is more difficult due to factors, such as situational features of the object and its surroundings. Unmanned aerial systems (UAS) are an alternative to this.

In a study, carried out in Italy, a bridge of special architectural and historical value was investigated. It was captured by a quadcopter equipped with a Sony camera with a 21MP (5344 × 4016) CMOS sensor. Twelve control points were used for georeferencing. The photogrammetric processing was performed in the Agisoft Metashape software. The Rhinoceros software and several additional developments were also used to construct the geometry of individual bridge elements. The obtained results prove the potential of the method in projects related to three-dimensional modelling of masonry bridges to be used for their maintenance and restoration [5].

A test study was implemented in 2020 related to the investigation of cracking of concrete samples in laboratory conditions using UAV. Several digital three-dimensional texture models of these samples were created and after that edge detectors were used to detect cracks. The presented results of the laboratory tests show that very accurate results are obtained with an error of less than 1 mm [6].

Another research presents the creation of digital photogrammetric models of two bridges for their visual inspection. The *DJI Mavic 2 Pro* unmanned aerial system with a 20Mpix camera was used for the experiment. The data were processed in *Agisoft Metashape*. Both bridge models were validated by laser scanner surveying. After that, the obtained point clouds were compared. The validity of both photogrammetric models was verified. The obtained dense point clouds can be used as a basis in solving subsequent tasks and in analyses related to detecting bridge status and their periodic monitoring [7].

In some cases, the use of low-cost UAS poses a problem with digital cameras, mounted on their platforms. These cameras cannot capture the bridge's arches from bottom to top. This disadvantage can be solved by using images, obtained from terrestrial and aerial photogrammetry.

Until recently, simultaneous processing of terrestrial and aerial images was impossible. With the development of new software solutions and the *Structure from Motion* method, this obstacle has already been removed. This has generated the idea of collaboration between terrestrial and aerial photogrammetry, which allows the efficient construction of precise, detailed, textured three-dimensional models of various objects, including bridges. More flexibility, convenience, promptness, and completeness in their capture is thus provided.

To the best of our knowledge, a bridge of this size has not been captured in Bulgaria. But it can be borrowed from other captures abroad which actually prove that such a combination can be successfully used in photogrammetric surveying and modelling of this type of object.

A 2017 study proved the applicability of the collaboration between aerial and terrestrial photogrammetric surveying in the generation of a digital three-dimensional model of a bridge in Taiwan. It is consisted of three sections with an overall length of 60 meters, each 20 m wide and 8 m high. It consisted of three sections with an overall length of 60 m, each 20 m wide and 8 meters high. About 10 000 images were taken by a UAS equipped with a *SONY α7R2* digital camera. Some of the images were acquired by terrestrial photogrammetric surveying using a pole with a length of 2–8 m. All images were processed by Agisoft PhotoscanPro. The resulting root mean square error was less than 3 cm. The three-dimensional geometric model was subsequently used to identify cracks on the surface of the bridge [8].

Identical research related to the capture of the San Cono Roman bridge, located in the southern part of Italy, was carried out in 2019. A *Canon EOS 100D* digital camera with an 18 mm lens and a *Xiaomi Mi* unmanned aerial system with a 12.4 Mpx camera were used for this purpose. The photogrammetric processing was performed in the programming environment of the Russian *Agisoft PhotoScan* software. The resulting root mean square error of the model was 0.011m. The generated 3D model of the masonry bridge was successfully used for performing a structural analysis by specialised software and proves the capability of this methodology for generating 3D models of bridges [9].

In 2020, another research confirmed that the combination of aerial and terrestrial photogrammetry could be employed to create digital models necessary for the monitoring of concrete bridges and viaducts in Italy. In 2020, another research confirmed that the combination of aerial and terrestrial photogrammetry could be employed to create digital models for the monitoring of concrete bridges and viaducts in Italy. A visual inspection of a standard concrete overpass in L'Aquila was done. The resulting orthophotomosaic was used to perform an object-based analysis to identify and classify disturbed areas and shapes. The results have shown satisfactory identification of deteriorated areas. This allows to carry out easy and quick periodic inspections in order to evaluate the development of processes related to bridge faults and to plan activities to preserve the facility [10].

All these studies prove that remote sensing in particular photogrammetry is a method well-established in practice as a fast, inexpensive, and safe way to generate three-dimensional digital models with high accuracy and detail.

Method and data

The main purpose of the presented study is to establish sustainable methods for capturing and modelling types of objects like masonry bridges, using low-cost cameras and systems, as well as commercial data processing software, applying the "structure from motion" method. This method allows free placement of the capturing stations (projection centres), thus facilitating the performance of the task. This would contribute to an easier and cost-effective modelling of these objects across the territory of Bulgaria. It is important to note that these models can be used not only to preserve the cultural and historical heritage of the country, but also for the monitoring of such transport facilities.

Photogrammetric processing is related to the creation of a digital model of an object/surface or parts of it, which is applied in various spheres of life. This processing includes several stages. After the images are loaded in the software (the camera is assumed to be calibrated), correlation procedures are performed to detect the so-called connection points in the corresponding images. Based on stereophotogrammetric principles, 3D points in space are calculated and generated. The camera positions for the scheme are also calculated. Initially, a texture-free model is built, which is called a skeleton model (the object is represented as an irregular triangular network – a combination of vertices and edges). Subsequently, a texture of the object is also generated. Its quality depends on the characteristics of the camera (for example, the high spatial resolution of the camera provides a better-textured model). A photorealistic virtual 3D model of the object is obtained from these images [11].

Analytical processing methods are used in the fore-described procedures related to the creation of photorealistic three-dimensional models. They are essential for the calculation of the internal and external image orientation parameters. Thereafter, the relationship between image and object is established and the necessary information (coordinates and geometric elements) about the captured object is subsequently obtained.
Usually, the stages of orientation are as follows:

- Providing information about the object (control points, distances, geometric elements);
- Measuring of image points for orientation (image coordinates);
- Calculation of the internal and external orientation parameters;
- Object reconstruction from the oriented images (new points, geometric elements).

Depending on the method used and the application of the photogrammetric data, these steps are performed sequentially, concurrently, or iteratively [11].

The modern *Structure from Motion* (SfM) method allows simultaneous processing of images acquired at different distances from objects, at different capture angles, and at different focal lengths. This is a significant advantage over traditional photogrammetric methods, making it possible to simultaneously process aerial and terrestrial photogrammetric images taken with different cameras. It is most suited to processing images with a high degree of overlap that capture the full three-dimensional structure of the scene. The method differs fundamentally from conventional photogrammetry, in that the geometry of the scene along with the camera positions and orientation are solved simultaneously, using an iterative bundle adjustment procedure, based on a database of features automatically retrieved from a set of multiple overlapping images.

The *Structure from Motion* (SfM) method follows a certain sequence of processing activities. The first stage, after the images to be processed have been loaded comprises detecting identical points in all the overlapping images, applying the Scale Invariant Feature Transform (SIFT) algorithm. This algorithm allows linking individual images or their characteristic points. The images do not need to be in the same scale, i.e. they may be of different resolution. Then, the so-called bundle adjustment is carried out. This algorithm is based on multiple iterative procedures. At this stage, the parameters of inner and outer orientation, automatically retrieved from the overlapping images, are calculated. In addition, a sparse point cloud is created (the three-dimensional coordinates of the object are obtained in a random coordinate system based on the homological points, detected in the photographic images). Having obtained the geometry of the object, the creation of a dense point cloud commences. This includes calculating the respective 3D point for almost every pixel of the image. Afterwards, this may result in generating digital elevation models, digital terrain models, three-dimensional textural surfaces and ortho-rectified images (orthophoto mosaics) etc. [12]. This is precisely the reason why all stages of photogrammetric image processing can be performed fully automatically in modern software products, such as *Agisoft Metashape*, *Pix4D*, *Meshroom*, *Autodesk ReCap* and others, making them suitable for use by non-specialist users.

The object of interest is the "Humpback" Bridge, which is located in the town of Harmanli in the central southern part of Bulgaria (Fig. 1). This transport construction was built in 1585 to facilitate the crossing of the Olu Dere River for the *caravans* (the convoys of the day). Its length spans 109 m, and it is 6 m wide. It is known as the "Humpback" Bridge because of the tapering shape (resembling a kind of humpback) in the middle of its central arch. The bridge is with a large 22 m arch symmetrically flanked by two smaller ones in its main and longest part, and by another 6.3 m arch after the bend in the northern part.

Fig. 1. Location of the studied object

The facility is more than 400 years old and as an architectural work is a representative of the school of one of the most famous Ottoman architects - Mimar Sinan. He designed over 300 buildings throughout the empire, and the most famous ones in Bulgaria are the Banya Bashi Mosque in Sofia and the Kodja Dervish Mehmed Pasha Mosque (the present-day Church of the Holy Septuagints in Sofia).

This unusual, yet functional and aesthetic solution of urban planning demonstrates the high level of construction skills of its creators. The spanned distance of over 22 m is remarkable for the technical capabilities of the day.

Results

Photogrammetric capturing of the bridge

The location of the bridge is near the city marketplace and considering it might be busy and overpopulated at specific time zones, those were avoided when working on the project. In order to ensure monochromatic lighting and minimal shading of the areas of interest, the hours selected for work were early in the morning and late in the evening, i.e. when the Sun is low above the easterly or westerly horizon.

The aerial shots for the project are taken with a *DJI Mini 2* UAS. With its mere 249 grams, it is lightweight and powerful, and thanks to its intuitive and advanced functions, it offers complete freedom of flight. It has a 31-minutes battery life and five levels of wind resistance. It rises to 4000 meters above sea level. It supports up to 10km of HD video transmission to the controller. With a 12MP sensor along with 4K/30fps video and 3-axis motor stabilisation, it provides high quality footage [13].

The *DJI Mini 2* is controlled by an RC controller, which requires connecting a mobile device with the appropriate control software installed.

Map Pilot Pro software installed on an IPhone 13 Pro mobile device was used to create a plan mission. The application serves to plan and execute a flight along an optimal trajectory in order to create maps or three-dimensional models.

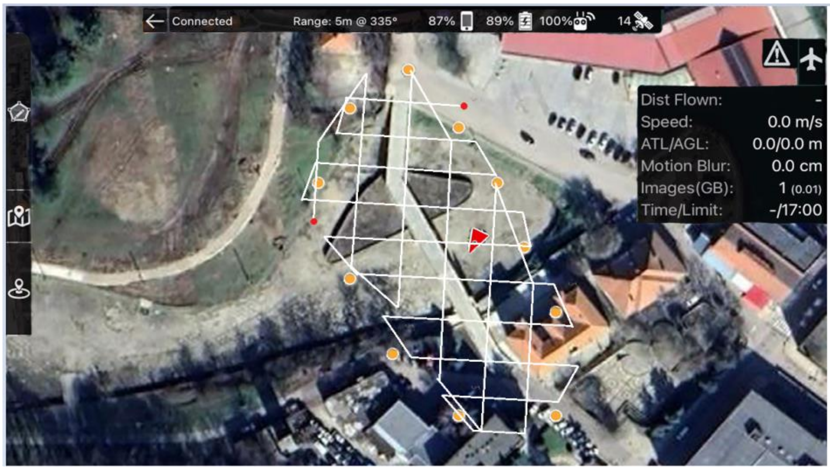

Fig. 2. Mission plan for the "Humpback" Bridge in Harmanli, prepared through the Map Pilot Pro software

Two flights at an altitude of 30 m have been executed with a 3D mode flight mission trajectory.

- Flight 1 produced 128 nadir images;
- Flight 2 produced 111 photos with a shooting axis tilted at 45^{o}.

The images were saved in .jpeg format. The total flight time was 44 minutes. Considering the technical specifications of the camera and the selected flying height, the resulting pixel size on the real object was Ground Simple Distance (GSD) = 2.4 cm.

Because of the complex structure of the object, its shooting with a UAV cannot be termed sufficient. As it is impossible to lift the optical axis above the horizon when shooting with a *DJI Mini 2* drone, to the low coverage of arches from their underside is very insufficient. After the aerial survey, an approach was taken to shoot the façades and the underside part of the arches with a digital camera. Additional photos of the railings and the walkway part of the bridge were also taken for better detailed description and in order to increase the quality of the model.

The shooting was performed with a *Nikon D90 SLR* camera with a *NIKKOR* lens. Its 12.3-megapixel DX-format *CMOS* sensor and *EXPEED* image processing system offer exceptional image quality with a wide ISO sensitivity range.

The eastern and western façades were captured with a perpendicular and tilted optical axis at a distance of about 15 m.

An individual approach was taken when shooting the arches and niches of the bridge. The images were taken with a perpendicular optical axis from one side to the other side of the main arch foundation across its width. Additionally, fan-shaped exposures were taken in a semi-circle, starting from one foundation, and reaching the other foundation of the arch.

The niches, symmetrically flanking the large arch on both sides, were photographed with opposite forward moves and at each station, exposures were made with the perpendicular camera axis inclined upwards.

The experiments have established that photographing the railings across the width with exposures only from one side of the bridge to the other did not give satisfactory results. Therefore, additional exposures were made in a circle, providing shots of part of the paving stones in order to produce a precise model of the bridge railings. This ensured that no information was missing from the model (no holes in the model). Fig. 3 is a schematic illustration of the shooting method.

The established capture approach can successfully be applied to the modelling of other masonry bridges with similar geometry.

Fig. 3. Visualisation of the exposure moments in terrestrial shooting

A total of 1012 images were obtained: 237 of the eastern façade, 161 of the western façade, 110 images of the underside of the arches, 471 of the pedestrian pavement and railings, and 33 photographs of the rhomboids symmetrically located around the main arch of the western façade of the bridge. The capturing of the façades was performed at a distance of 15 m, with a focal length of 18 mm, and a pixel size on the actual object GSD = 0.45 cm was obtained on the bridge façades.

Photogrammetric processing. Generating of a digital 3D model

Data processing was performed on an *Acer Swift 3 Ultrabook* with the following parameters: RAM - 8GB, Intel core i5 processor with a working frequency of 1.60GHz, NVIDIA GeForce MX 250 video card with 2GB of own memory and 4 GB of shared memory. The computer operating system was Windows 10 Professional, 64-bit.

The *Agisoft Metashape Version 1.8.4* software was used to process the terrestrial and aerial images.

A very important part is the selection of images to be used in the processing, as their quality determines the final results. Therefore, before starting the photogrammetric processing, it is necessary to review those carefully and select the most suitable ones. To create a three-dimensional model of the "Humpback" Bridge, a total of 1,251 terrestrial and aerial photographs were loaded and processed simultaneously into one Chunk.

Following the image assessment, a sparse cloud of points was created. The result of this processing step was a point cloud containing triangular positions of key points corresponding to the images. In many cases, UAVs are equipped with GPS/GNSS systems to measure external orientation parameters during the flight. In the presented case, the function for rough referencing of the model by camera coordinates was not selected. This was due to the technical parameters of the drone, specifically the lack of an RTK module and low positioning accuracy. The sparse point cloud was created at the high accuracy setting. This step took 3 hours and 4 minutes to process. The sparse cloud contains 2,304,529 points and can be seen in the figure below.

Fig. 4. Sparse point cloud

During the aerial survey of the bridge, 7 reference points were used for georeferencing the model. They were marked with square-shaped marks consisting of contrasting squares. Four of the marks were placed on the paving stones in the pedestrian part of the bridge, and three in the bed of the man-made pool underneath. Their coordinates were measured in the BGS 2005 coordinate system using a *CHCNAV i50* GPS receiver. Afterwards, through the *BGS Trans* programme, they were transformed into the WGS 84 zone 35 system in order to be employed in the project. Geodetic altitudes were used for georeferencing the model.

The next standard stage in photogrammetric processing is recognising these seven reference points in the images.

Agisoft Metashape Professional software uses markers to indicate the locations of points in the images. The position of markers is determined by their coordinates in the images. To determine the spatial coordinates of the reference points, it is necessary to measure their image (planar) coordinates on at least 2 images. Metashape supports two approaches to marker placement: manual and guided marker placement. Manual approach implies that the marker projections should be indicated manually on each image. It should be noted that incorrect projection markers affect accuracy of the model. Manual marker placement does not require 3D model and can be performed even before image alignment. In the guided approach marker projection is specified for a single image only. Metashape automatically projects the corresponding ray onto the model surface and calculates marker projections on the rest of the photos where marker is visible. Marker projections defined automatically on individual photos can be further refined manually. Guided marker placement usually speeds up the procedure of marker placement significantly and also reduces the chance of incorrect marker placement. It is recommended in most cases unless there are any specific reasons preventing this operation [14].

Guided marker placement was implemented in the presented study. After the reference points were recognised, the adjustment equation parameters were set, and optimisation was performed. The root mean square error (the absolute accuracy of the model) was 0.004 m.

A dense point cloud is created after the adjustment completed. Metashape software tends to produce extra dense point clouds which are of almost the same density, if not denser, as LIDAR point clouds. A dense point cloud can be edited and classified within Metashape environment and used as a basis for such processing stages as build Mesh, build DEM, build /generate orthomosaic. The software also allows to export/ exporting of point clouds in formats compatible with other software [14].

The "Humpback" Bridge dense point cloud, containing 141,068,817 points, was created at the high precision setting and can be seen in the Fig. 5 below. The processing of this step was performed within 13 hours and 33 minutes.

Fig. 5. Visualisation of the dense point cloud for the whole object

The next standard stage of the photogrammetric processing is creating a polygonal model (Mesh). If the model is already georeferenced, it is not necessary to place a limit on the area in which to create a Mesh model. The software automatically generates this with the necessary detail and in the correct geometry [14].

For the object of study, the Mesh model was created from the dense point cloud by selecting a high value for accuracy. The processing of this step was performed within 9 hours and 13 minutes. The resulting model contains 20,074,615 triangles and can be seen in the Fig. 6 below.

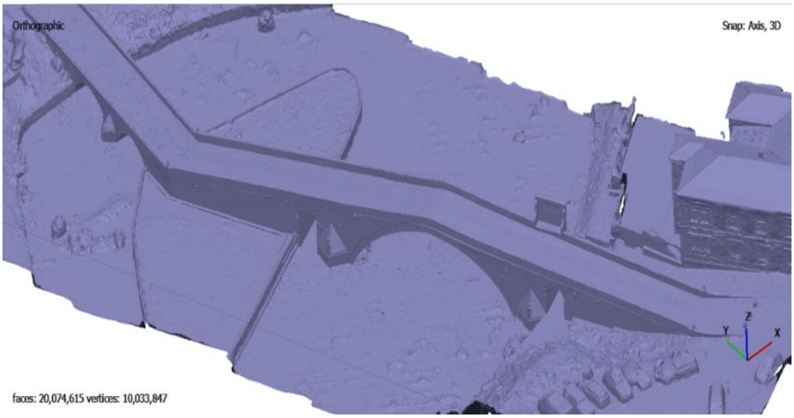

Fig. 6. Visualisation of the polygonal model (Mesh) of the bridge

The software offers a function for creating a three-dimensional textured model, which displays the geometric body in the full range of colours and textures.

Thereby, the object is actually recreated. The images are selected as output data, which allows building a colour texture map (diffuse map). The renderings below show the textured model of the bridge, as well as fragments of it.

A

B C D

Fig. 7. Visualisation of the created three-dimensional textured digital model of the "Humpback" Bridge and its fragments: (A) West façade; (B) Romboid on the left side of the large vault; (C) Lower side of the great arch; (D) North entrance

Conclusions

The generation of highly accurate 3D models, as an execution of already existing cultural monuments and other facilities is in itself a project for the conservation, restoration, adaptation, and socialisation of similar facilities.

The models of 3D digital visualisation can facilitate the communication, interpretation, and protection of traditional buildings and places which have gained significance for public heritage. Henceforth, cultural heritage can be interpreted in collaboration among residents, professionals, associated communities, and other stakeholders. 3D digital modelling can also provide new approaches for cultural heritage management. Digital modelling is not only used for data processing and visualisation of buildings which are cultural monuments, but also helps giving meaning and direction of cultural heritage management [15].

The technological development of the devices and systems used for collecting information and the commercialisation of modern software products are prerequisites for the application of photogrammetric methods in various areas of life, such as agriculture and forestry, ecology, archaeology, architecture, mining, and other engineering application areas. The various modern commercial software solutions for photogrammetric processing make it easy to choose a program for image processing, and simplified work environments make handling them easier and easier. The possibility of combined processing of terrestrial and aerial images using the *Structure from Motion* (SfM) algorithm as the basis of a range of modern software products, such as *Agisoft*, *Pix4D*, *PhotoModeler* and others, allows easier work with images obtained from different distance from the object, at different angels of capture, and at different focal length. This is a significant advantage over traditional photogrammetric methods.

The application of unmanned aerial systems for civil purposes has opened new horizons for photogrammetry. The possibility of obtaining images from positions that are inaccessible or hard to be accessed by an operator, as well as the speed of operation, increase the interest in this type of technique.

With such advantages as low-cost equipment, high accuracy, and detail close-range photogrammetry remains a desirable and preferred photogrammetric capture method.

The collaboration between terrestrial and aerial photogrammetry opens up unlimited possibilities specialist from different areas to survey, map, and make 3D models of facilities with complex geometry.

The "Humpback" Bridge is in its essence such an object, whereupon the use of different types of images obtained from terrestrial and aerial photogrammetry, as well as the proven shooting methodology, allow the creation of a three-dimensional model of the facility. This accurate and detailed model gives a comprehensive idea of the object and its physical properties like dimensions, heights, colours, texture. All of the above are very important when planning future activities related to the restoration and adaptation of the bridge.

The model has been handed over to the Municipality of Harmanli as a conceptual project for the conservation of the "Humpback" Bridge.

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ТРИИЗМЕРНО МОДЕЛИРАНЕ НА МОСТ ЧРЕЗ ИНТЕГРИРАНЕ НА ЗЕМНА И ВЪЗДУШНА ФОТОГРАМЕТРИЯ, ПРИЛАГАЙКИ АДАПТИРАН НАЧИН НА ЗАСНЕМАНЕ

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Резюме

Триизмерното фотограметрично моделиране е един съвременен дистанционен метод за изграждане на числени (цифрови) модели с присъщия им облик и текстура, които намират приложение в различни области от живота. Моделирането на обекти със сложна геометрия, такива като зидани мостове, е нелека задача поради специфичните им особености (в повечето случаи наличието на сводове и различни ниши), което предопределя и избора на адаптиран начин на заснемане спрямо индивидуалните характеристики на обекта. Статията представя изследване, целящо изграждането на високо точен триизмерен модел на мост, комбинирайки въздушно и земно заснемане. За заснемането на горната част на моста е използвана нискобюджетна безпилотна летателна система (БЛС), която значително оптимизира времето за заснемане. Но нейните възможности не позволяват заснемане на арките на моста отдолу нагоре, както и получаване на прецизен модел на перилата на моста. Поради това е извършено и наземно заснемане с цифров фотоапарат, което допълва необходимата информация за генерирането на цялостен модел на моста. Интегрирането на въздушно и земно заснемане, използвайки нискобюджетни апарати и системи, както и прилагането на съвременни алгоритми за обработка, позволяват създаването на автентични, точни и детайлни цифрови модели, което е от изключително значение при бъдеща консервация, реставрация, адаптация и социализация на такъв тип обекти - паметници на културата.