



"The 5th Scientific Expedition of the Lublin University of Technology to the Central Asia"

August 15-28, 2021 (Uzbekistan, Tashkent/Chirchik)

Scientific seminar: "Documenting the tangible cultural heritage using digital technology and 3D scanning" *Plan*

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Presentations:

Time, min.	Title, authors, presenting author
10	Seminar opening Prof. Dilbar Mukhamedova (NUU)
20	Project and portal "3D Digital Silk Road" Dr. Elżbieta Miłoś, Dr. Mariusz Dzieńkowski
20	3D scanning of Emir Bukhara's costume – the methodology and its results Prof. Jerzy Montusiewicz
20	Documenting the geometry of large architectural monuments using 3D scanning – the case of the dome of the Golden Mosque of the Tillya-Kori Madrasah in Samarkand Prof. Marek Miłoś
20	Structure from Motion technology to create 3D models Dr. Marcin Barszcz, Dr. Krzysztof Dziedzic
	<i>Discussion</i>

Abstracts

Project and portal "3D Digital Silk Road"

The aim of this presentation is to present the project "3D Digital Silk Road" financed by the Polish National Agency for Academic Exchange (NAWA) under the programme "International Academic Partnership". One of the results of this project is the Internet Portal "3D Digital Silk Road" (<http://silkroad3d.com/>). The portal and its structure are also presented in details.



3D scanning of Emir Bukhara's costume – the methodology and its results

Historical costumes are part of cultural heritage. Unlike architectural monuments, they are very fragile, which exacerbates the problems of their protection and popularisation. A big help in this can be the digitisation of their appearance, preferably using modern techniques of three-dimensional representation (3D). It will be presented the results of the search for examples and methodologies of implementing 3D scanning of exhibited historical clothes as well as the attendant problems. From a review of scientific literature it turns out that so far practically no one in the world has made any methodical attempts at scanning historical clothes using structured-light 3D scanners (SLS) and developing an appropriate methodology. All the methods of creating 3D models of clothes so far have used photogrammetry and 3D modelling software. Therefore, an innovative approach was proposed to the problem of creating 3D models of exhibited historical clothes through their digitalisation by means of a 3D scanner using structural light technology. A proposal for the methodology of this process and concrete examples of its implementation and results are presented.

The problems related to the scanning of 3D historical clothes are also indicated, as well as a proposal how to solve them or minimise their impact. The implementation of the methodology is presented on the example of scanning elements of the Emir of Bukhara's costume (Uzbekistan) from the end of the 19th century, consisting of the gown, turban and shoes. Moreover, the way of using 3D models and information technologies to popularise cultural heritage in the space of digital resources is also discussed.

Documenting the geometry of large architectural monuments using 3D scanning – the case of the dome of the Golden Mosque of the Tillya-Kori Madrasah in Samarkand

The Tillya-Kori Madrasah is one of three Muslim schools surrounding Registan Square, a jewel of Central Asia's and the Silk Road's material cultural heritage. In the Tillya-Kori madrasa, built according to the architectural assumptions of the Timurids, as in every religious university, there is a mosque. It is built on a square plan and covered with a double-shell dome on a circular plan.

During the preparations for the reconstruction of the outer layer of the dome, documentation work was carried out on the inner layer of the dome, consisting of 3D scanning with a terrestrial laser scanner. The developed 3D models of the internal geometry of the dome, being an example of digital documentation of architectural objects, allowed for its accurate measurements. The main result of the works was proving the thesis that the building subsides unevenly under the excessive weight of the outer dome. This confirmed the necessity to reconstruct the outer layer of the dome in order to reduce its weight. The building subsidence parameters were measured by measuring the geometry of the lower layer of the internal dome – the highest horizontal layer in the discontinuous double-shell dome accessible from inside the building.

It will be presented the process of 3D scanning of the interior of the Golden Mosque and processing its results, the tools and software used, as well as the final results. An additional outcome of the work on digital documentation of the object was the development of a digital 3D model of the interior of the Golden Mosque for the purpose of disseminating information about the monument and making it available digitally in the form of a digital 3D model.

Structure from Motion technology to create 3D models

In the era of the global pandemic caused by the COVID-19 virus, 3D digitisation of selected museum artefacts is becoming more and more frequent practice, but the vast majority is performed by specialised teams. The speech presents the results of comparative studies of 3D digital models of the



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same museum artefacts from the Silk Road area generated by two completely different technologies: Structure from Motion (SfM)—a method belonging to the so-called low-cost technologies—and by Structured-light 3D Scanning (3D SLS). Moreover, procedural differences in data acquisition and their processing to generate three-dimensional models are presented. Models built using a point cloud were created from data collected in the Afrasiyab museum in Samarkand (Uzbekistan) during “The 1st Scientific Expedition of the Lublin University of Technology to Central Asia” in 2017. Photos for creating 3D models in SfM technology were taken during a virtual expedition carried out under the “3D Digital Silk Road” program in 2021. The obtained results show that the quality of the 3D models generated with SfM differs from the models from the technology (3D SLS), but they may be placed in the galleries of the virtual museum. The obtained models from SfM do not have information about their size, which means that they are not fully suitable for archiving purposes of cultural heritage, unlike the models from SLS.