3D Information Techniques in Research, Restoration and Popularisation of Uzbekistan's Cultural Heritage – Case Studies from the Polish-Uzbek Cooperation

Prof. Marek MIŁOSZ, Prof. Jerzy MONTUSIEWICZ, Dr. Jacek KĘSIK, Dr. Elżbieta MIŁOSZ
Lublin University of Technology, Department of Computer Science, Poland
Rahim KAYUMOV
Samarkand State University, Scientific-Practical Museum-Laboratory, Uzbekistan

m.milosz@pollub.pl

Agenda

- Digital technologies in culture heritage
- Cooperation between Lublin University of Technology (LUT) and different cultural organisations in Uzbekistan
- Cooperation results – the case studies:
  - Sher-Dor Madrasah mosaic
  - Virtual Afrasiyab musem
  - The dome of the Golden Mosque of the Tillya-Kori Madrasah
  - Internet portal: „3D Digital Silk Road”

Digital technologies in culture heritage

- Digital technologies development:
  - the development of digitization systems, as well as the possibility of storing and sharing information -> **preservation, protection, and restauration**
  - the possibility of wide reception of digital information by the whole of society -> **wide dissemination**
- Digitization of cultural heritage facilities began with the era of digital photography and techniques using various 2D scanners. With the development of technology, it has extended a third dimension to **3D technology**, using various techniques and tools (HW & SW)

Sher-Dor Medrese mosaic

На Регистане спасают... тигров

23:17 23 Декабрь 2018 Культура (/ru/post/category/culture) 92 0

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Determination of ceramic tile colour surface areas on the medieval Sher-Dor Madrasah mosaic in Samarkand – Problems and solutions

Marek Milosz *, Elzbieta Milosz, Jerzy Montusiewicz

Lublin University of Technology, 38D Nadbystrzycka Str., 20 618, Lublin, Poland

1. Introduction

Over the centuries, many architectural objects of various cultures and styles have been decorated with mosaics (Fazio, 2008), i.e. decorations made of small elements of different colours and textures. The elements of

University of Technology proposed a method using IT achievements: a combination of 3D scanning technology (Kęsik et al., 2019) with photogrammetry (Kraus, 2007).

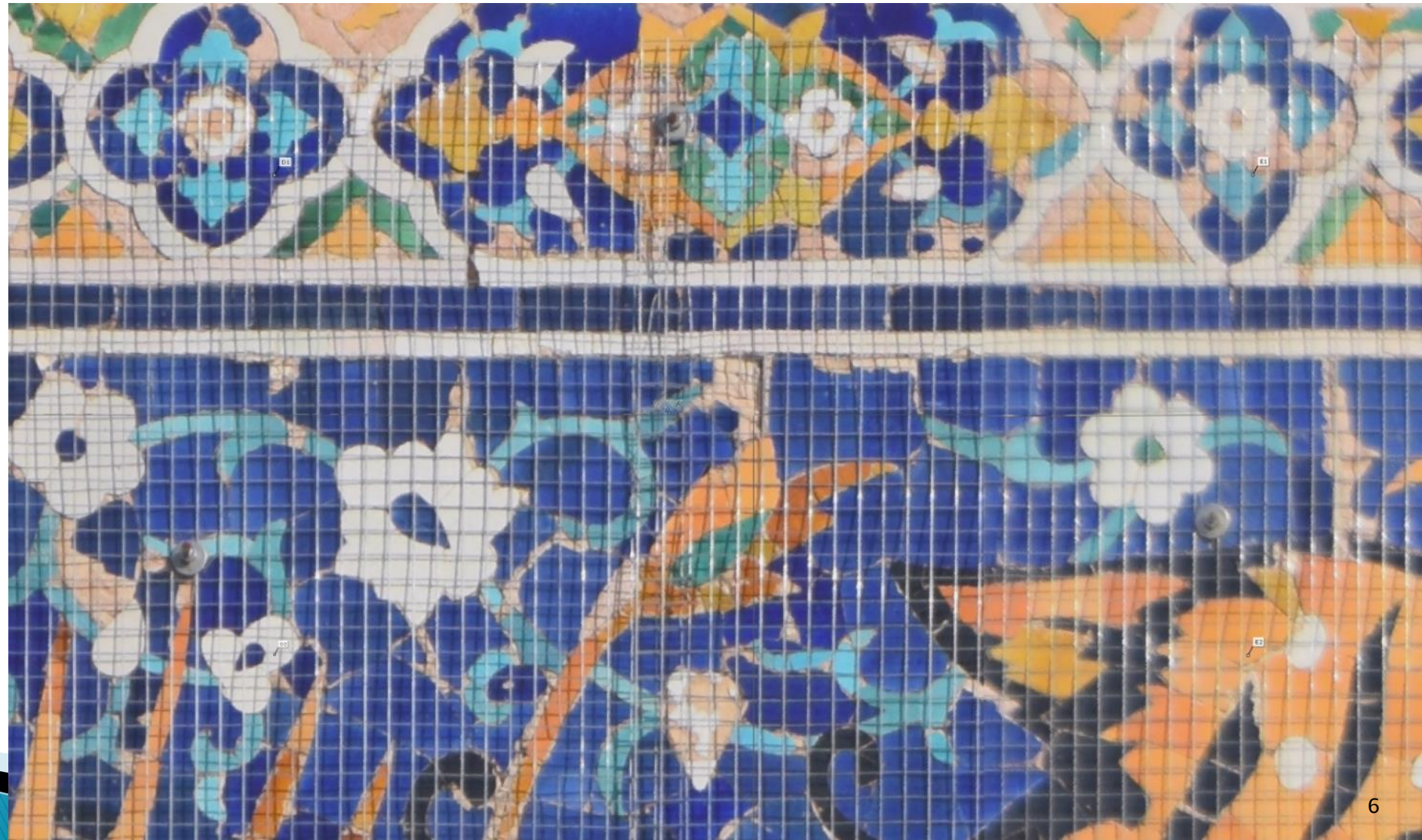
The portal containing the mosaic was scanned with a laser 3D Faro X330 scanner with an accuracy of 1 mm. The scanner has a built-in digital

Laser 3D Scanning Sher-Dor Medrese mosaic

- Accuracy: 1-2 mm

Sher-Dor Medrese mosaic – problems

- Big area: +100 sq. m
- Big numbers of deffects and repairs
- Metal mesh

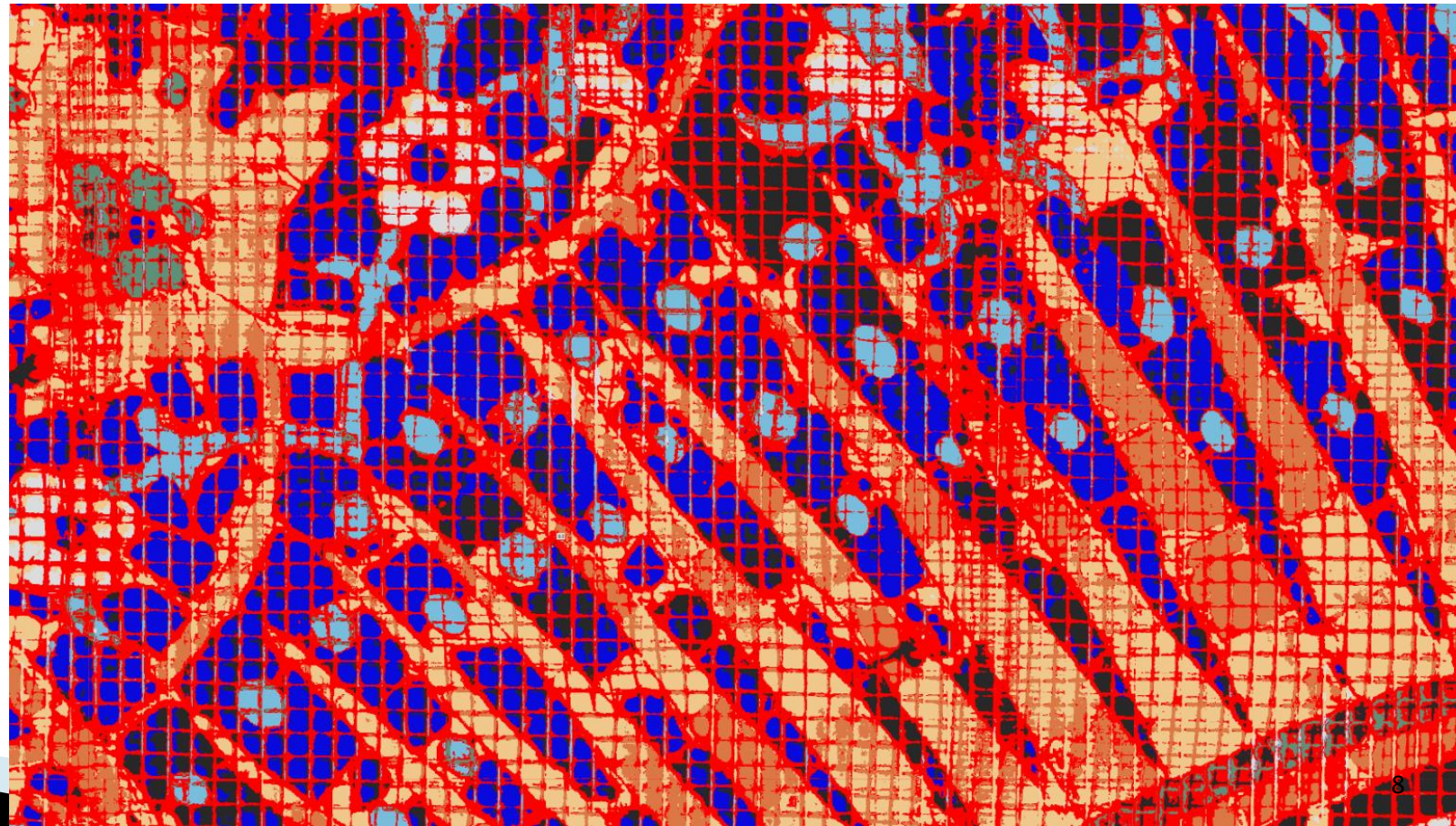


Template for the renovation of the medieval Sher-Dor Medrese mosaic – solution

Determination of ceramic tile colors surface areas on the Sher-Dor Medrese mosaic (1)

- Problem: colours classification
- Solution – designing and developing special software using AI

red colour – not recognised areas



Determination of ceramic tile colors surface areas on the Sher-Dor Medrese mosaic (2)

Colors on REGISTON mosaic Sher-Dor

Colour	R	G	B	% of area	Aera, m^2
blue	120	190	22	11,806%	12,207
navy blue	10	10	220	23,506%	24,305
white	220	220	220	20,019%	20,700
black	40	40	40	7,463%	7,717
light brown	240	200	140	23,107%	23,893
brown	220	120	70	11,039%	11,414
green	94	145	120	3,017%	3,119
light pink	240	180	166	0,044%	0,046
			Total:	100,000%	103,389

Estimation based on over 70% of the area.
Rest of area: mesh, joints, repairs, defects, ...

Virtual Afrasiyab musem

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Virtual and interactive museum of archaeological artefacts from Afrasiyab – An ancient city on the silk road

Marek Milosz *, Stanisław Skulimowski, Jacek Kęsik, Jerzy Montusiewicz

Lublin University of Technology, 38D Nadbystrzycka Str., 20618, Lublin, Poland

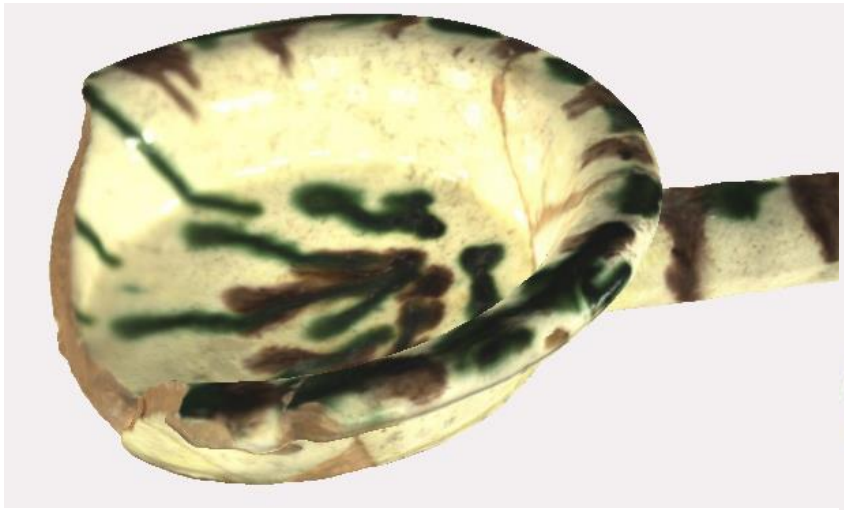
1. Introduction

Information Technology (IT) is developing very rapidly, both in the area of technical devices, software and information transfer capabilities, i.e. computer networks. They offer new and ever more accessible possibilities of their use.

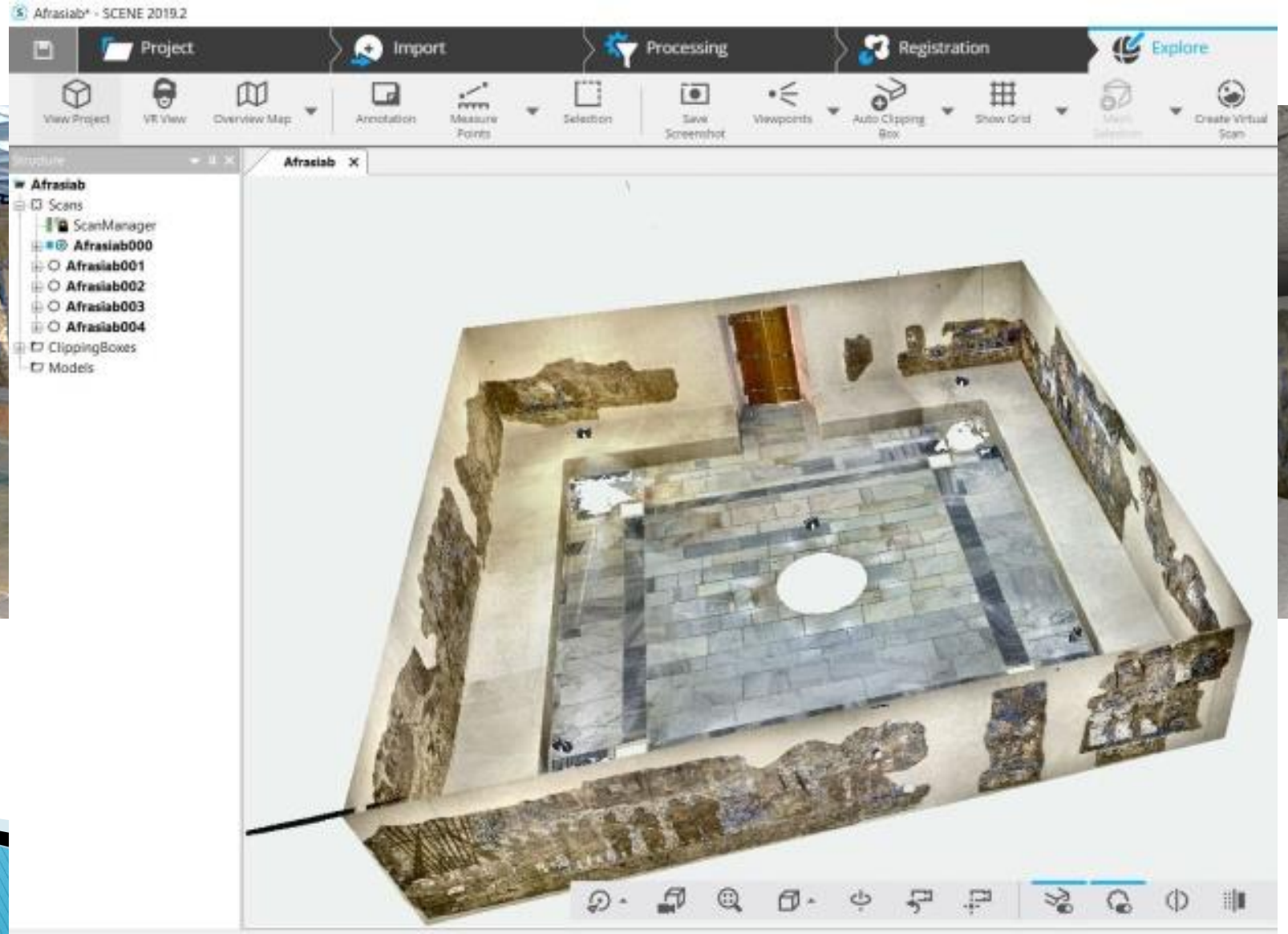
The wide availability of computer devices with high computing capabilities (e.g. modern smartphones) and data transmission networks results in IT applications in more and more areas of social activity. (Skamantzari et al., 2017), the Palatine in Rome (Pescarin et al., 2018), the Hagia Sophia in Istanbul (Döker and Kirlangiçoğlu, 2018), the Jinsha Archaeological Site Museum in China (Hu et al., 2017), the Ian Potter Museum of Art in Parkville, Australia (Waters, 2019) or the Correr Museum in Venice (Berto and Salemi, 2019). These processes, as well as the threats that flow from them, are well described (Yu-Chang et al., 2012). Further development of technology has resulted in the majority of citizens having in their pockets a digital device with high processing power connected to a broadband data network. This creates entirely new

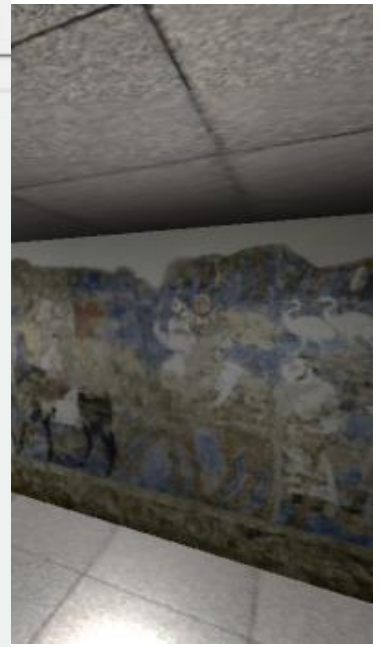
3D artifact scanning – structured light scanner

3D models



Hall of Ambassadors scanning and postprocessing





Virtual museum: "Acient Afrasiyab"

Golden Mosque of the Tillya-Kori Madrasah

САМАРКАНДСКИЙ ВЕСТНИК

Главные Политика Экономика Культура Н

Проведена 3D-оцифровка Тилля-кори

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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

Jacek Kęsik [a], Marek Milosz [a,*], Jerzy Montusiewicz [a], Khonkul Samarov [b]

[a] Lublin University of Technology, Lublin, Poland
[b] Museum Registan Ensemble, Samarkand, Uzbekistan

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ABSTRACT

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 madrassa, 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.

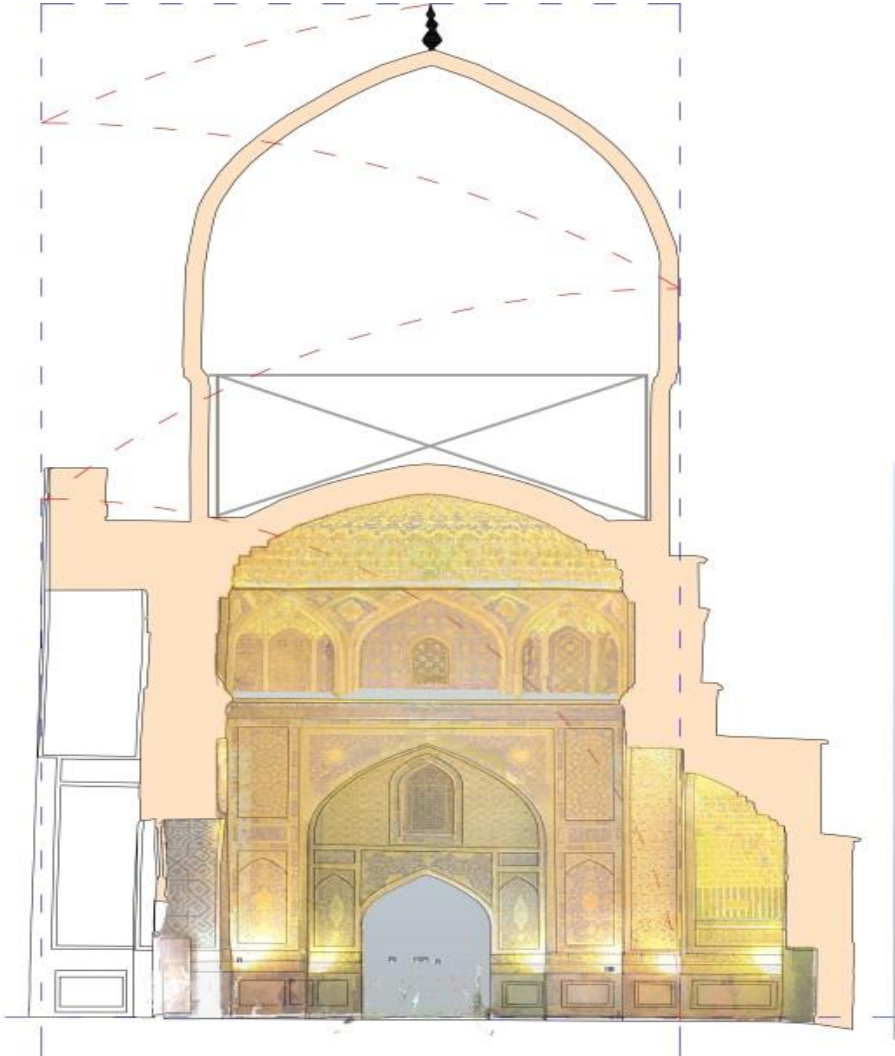
During the preparations for the reconstruction of the outer layer of the dome, documentation work was carried out on the inner layer of the dome, consisting of 3D scanning with a terrestrial laser scanner. The developed 3D models of the internal geometry of the dome, being an example of digital documentation of architectural objects, allowed for its accurate measurements. The main result of the works was proving the thesis that the building

3D scanning of the interior of the Golden Mosque

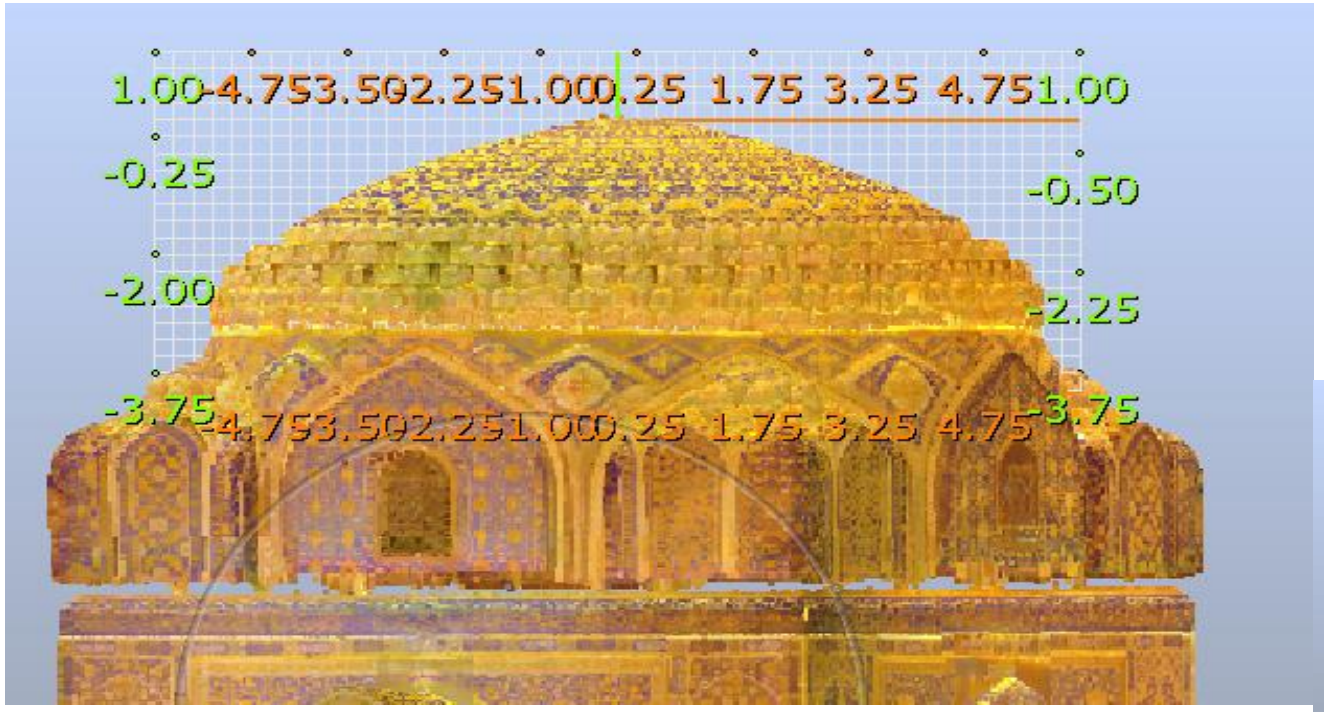
- June 2018
- 2nd Scientific Expedition of the Lublin University of Technology to Central Asia

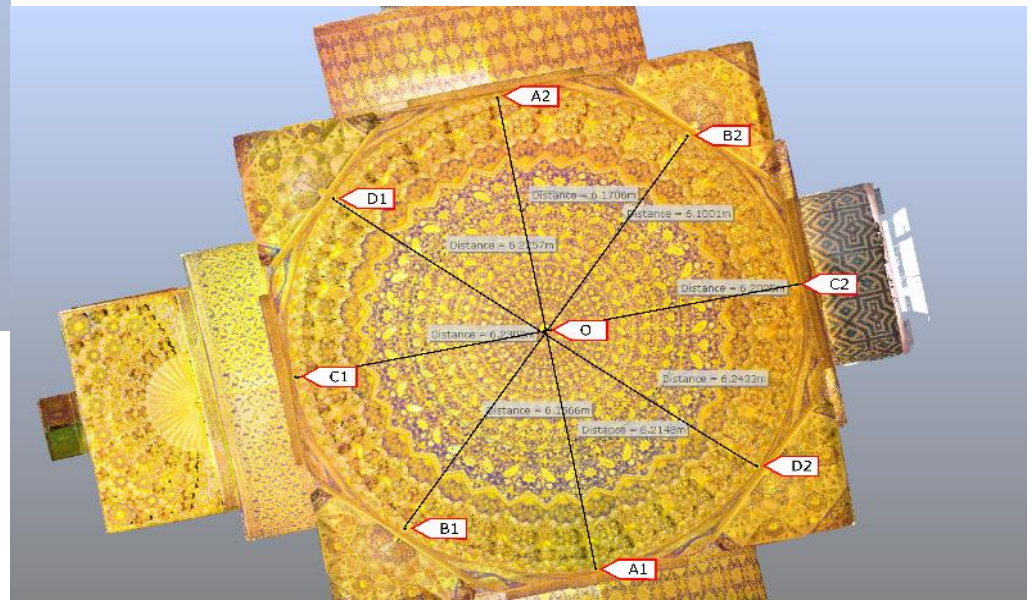
3D scanning of the Golden Mosque – scanning results

- Raw and cleaned data – cloud of points
- 3D mesh model
- It is the Golden Mosque digital documentation



Geometric measurements of the internal dome





Deviation from the horizontal

- Diameter of the base of the inner dome = **10.75 m**
- The inclination of the base of the inner dome is not less than **23.12 cm**
- Error of measurement: **0.1 %**

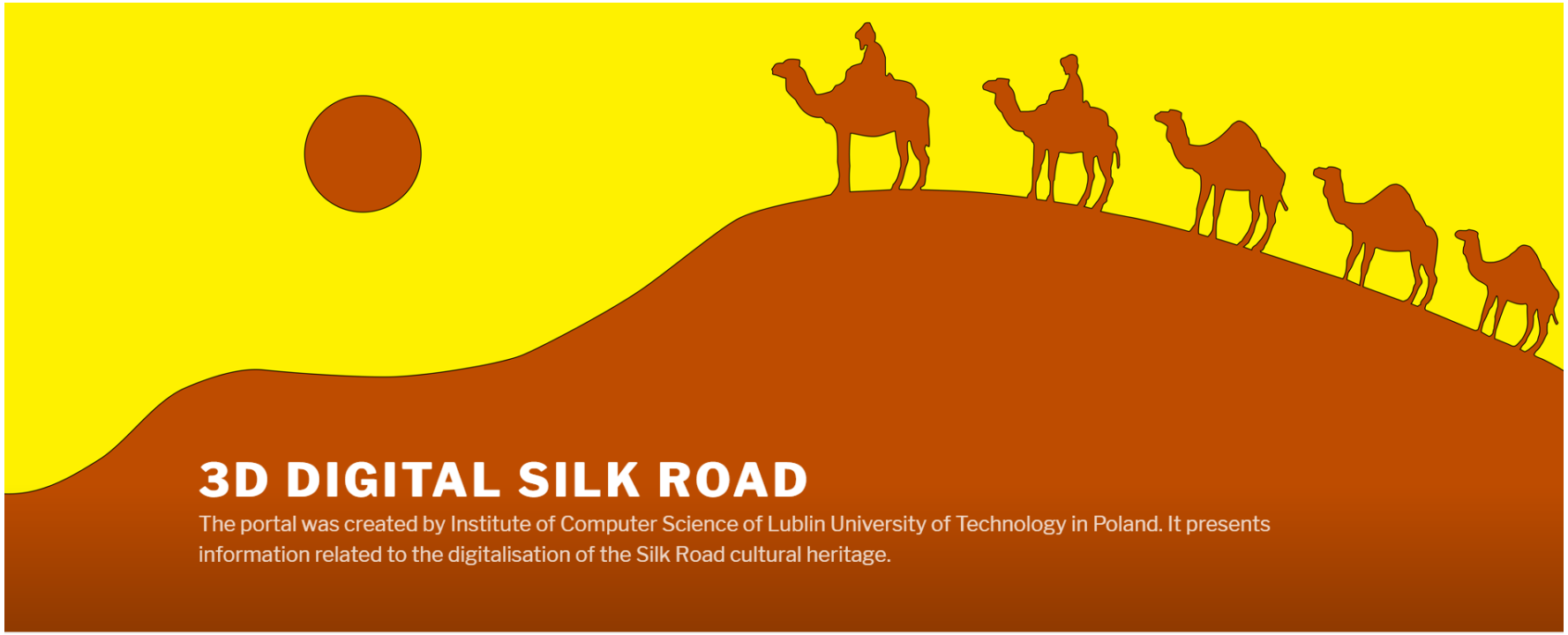
June 2018

May 2019

August 2019

– 75–80 t

Portal ”3D Digital Silk Road” – the result of cooperation



SilkRoad3D.com

Portal ”3D Digital Silk Road” – aims

- Promotion of the cultural heritage of the Silk Road in new digital media – ICT (Internet, 3Dimension, Virtual Reality)
- Collection of data about historical monuments in one place
- Showing the achievements of Lublin University of Technology (LUT) and its Partners

New project

- **„3D Digital Silk Road – digitization of the Silk Road heritage in Uzbekistan”**
- Background: result of the previous cooperation and partners activities
- Founded by: The Polish National Agency for Academic Exchange (NAWA)
- Budget: +250 000 EUR
- Partners:
  - Lublin University of Technology (Poland)
  - National University of Uzbekistan
  - Samarkand State University
  - Chirchik State Pedagogical Institute
  - Urgench State University

Project results on:
SilkRoad3D.com

Thank you

We invite you to cooperation

m.milosz@pollub.pl