ArchaeoTek Canada

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Bio / Archaeological Techniques and Research Center

INTENSIVE DIGITAL CURATION & APPLICATIONS IN CLOSE-RANGE PHOTOGRAMMETRY WORKSHOP

Summer 2022
Deva, Hunedoara County, Transylvania, Romania
Odorheiu Secuiesc, Harghita County, Transylvania, Romania

SYLLABUS

ArchaeoTek / BioArch Canada

This year, the Photogrammetry training is offered in two different sessions:

Session 1: June 5 — June 11, 2022
Session 2: August 7 — August 13, 2022

Web Site: https://www.archaeotek-archaeology.org/photogrammetry

Application Form: https://www.archaeotek-archaeology.org/application-excavation-and-gpr

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Program Fees and Costs:
- Photogrammetry Applications Workshop (standalone): $1295 per 5-day session

Maximum Number of Participants Per Session: 5

INTENSIVE DIGITAL CURATION & APPLICATIONS IN CLOSE-RANGE PHOTOGRAMMETRY WORKSHOP

I. Introduction

Our Intensive Digital Curation and Applications in Close-Range Photogrammetry Workshop is an intensive 5-day training program in photogrammetric survey, data acquisition, analysis, and presentation with an emphasis on digital curation of archaeological material. Taking place in Transylvania, Romania at one of two fantastic museums (Haaz Reszo Muzeum or Muzeul Civilizaţiei Dacice şi Romane), the program is designed to offer to participants training in a set of skills which are rapidly finding applications in the cultural heritage sector, but also in other fields such as architecture, engineering, manufacturing, video game design, and law enforcement to name a few. Our participants will acquire over the five-day training the necessary practical and analytical skills necessary to properly incorporate photogrammetric applications into their pre-existing career toolbox.

Visual Data Acquisition is an extremely broad term which contains methods such as photogrammetry, reflectance transformation imagery, 3D scanning, LiDAR, aerial reconnaissance, and others with practical applications in archaeology and cultural heritage management, forensics, manufacturing and engineering, and media. Field experience with these techniques on real artifacts and in a real setting is an exceptionally useful and lucrative skill to acquire, but due to the novelty of many of the acquisition methods the sources for training are few, expensive, and unfocused. These educational opportunities that do exist tend to understate the complexity of the world and the objects that can be captured and do not tend to provide the training necessary to adapt to the object, scene, or terrain that is being visualized. In contrast, this workshop provides a full set of technical, theoretical, and practical skills for close-range photogrammetry with a focus on applications in archaeology and the cultural heritage sector. As such, it offers thorough training for field work, processing, analysis, interpretation, and presentation of ancient artifacts of various sizes and materials in an accessible and professional way. Hands-on experience in archaeological photogrammetric applications is essential, but difficult to acquire.

This workshop will address the basic principles of optics and photography as they apply to photogrammetry and digital curation. We will focus on the practical aspects of data collection and the preparation for collection environments which, while immediately applicable to archaeology and the cultural heritage sector, have applications in other fields as well. By the end of the workshop, participants will be able to acquire the visual data necessary to produce 3D models, process that data into 3D models, perform an analysis of that data, interpret that data, and present that information in an accessible format. Through a combination of lectures, data collection, data processing, and data analysis, this workshop provides all the necessary training for our graduating participants to be able to produce accurate, publishable results, fully understand the limitations of different visual data acquisition methods, and to analyze the results in a useful way. The culmination of the workshop will include the production and publication of a digital museum exhibition as a demonstration of the skills learned during the workshop.

II. Course Aims and Outcomes

i. Aims

Upon completion of this workshop, participants will have the necessary skills and knowledge to plan a proper photography environment for a variety of archaeological materials, properly collect visual data, process that visual data into a 3D model, and interpret and synthesize that data into a narrative to be published as a digital exhibition. This process will present a variety of physical challenges, like working on a diverse set of artifacts ranging in size, size, and material, as well as technical and theoretical challenges such as overcoming obstacles in the physics of optics. The whole experience is intended to be intensive and collaborative, with a focus on experiential learning and application of collection, processing, and interpretation methods of real artifacts under real life research conditions. Participants will work directly with our instructors in small groups of 4-5 to gain fluency and proficiency with the equipment and software of a Digital Curation project. At the end of each session, the data will be synthesized into a digital museum exhibition and full professional report.

ii. System and Analytical Training

Our participants will learn to operate DSLR cameras, namely the cameras in the Canon Rebel series, in a variety of configurations for the purposes of collecting the photographic data necessary to collect the information required to produce a 3D model. Each participant will be collecting, processing, and interpreting their own data with their own camera on loan to them by the project instructor. The participants will also have the opportunity to learn other visual data acquisition systems such as light detection and ranging (LiDAR) and reflectance transformation imagery (RTI).

Concurrently, our participants will be trained in using Agisoft's Metashape, a stand-alone software that performs photogrammetric processing of digital images and generates 3D spatial data to be used in GIS applications, cultural heritage documentation, and visual effects production, among others. They will also be trained in MeshLab, Blender, Helicon Remote and Helicon Focus, among others, as a means of thoroughly processing 3D models and data for publication purposes.

The adaptive and all-inclusive approach of the equipment combined with the intensive hands-on, data oriented and results driven focus of the workshop, as well as the low participant:instructor ratio is guaranteed to provide a thorough understanding of methods of visual data acquisition of the highest quality, both in terms of data generation and analysis, and professional deployment and research.

iii. Applications and Case Studies

The workshop is conducted at one of two partner museums in the heart of Transylvania - the Haaz Reszo Muzeum and Muzeul Civilizaţiei Dacice şi Romane. Both of these museums offer a unique setting in which the common problems of data collection and interpretation at the museum level are presented at recognizable, but manageable levels. As a result, these museums are ideal

locations for all types of visual data acquisition methods, including the primary focus of this workshop of photogrammetry, as well as the secondary focuses of other methods like RTI and LiDAR.

In terms of practical applications, the equipment we deploy during the workshop is the equipment of choice in cultural heritage management, balancing the rigorous and full-bodied analytical powers with user-friendliness and cost-effectiveness, making the skills acquired accessible even following the project.

iv. Specific Learning Outcomes

We aim to provide contextualized information about the technical and practical aspects of visual data acquisition focused on archaeological and cultural applications but widely applicable in other disciplines. After a comprehensive introduction to the equipment, software, and collection procedures, we will conduct intensive surveys on artifacts of a variety of materials (metal, bone, ceramic, and lithic), of a variety of sizes at one of two museums in Romania. This data will be processed, analyzed, and interpreted to produce an exhibition which will be accessible to not only insiders in the project, but to the general public. In addition to providing hands-on experience with a suite new and innovative, not to mention highly useful, technologies, we will have supplemental discussions and readings on more advanced visual data acquisition and digital curation topics and specific applications. At its core, the workshop is designed to provide an engaging environment for the acquisition of the fully transferable and marketable skills associated with a variety of methods of visual data acquisition and digital curation.

The course will equip participants with the skills and experience to:

- **Complete photogrammetric projects from conceptualization through completion**
  - Identify and understand how to use various types of equipment required for collecting visual data
  - Understand which pieces of equipment can or should be substituted or adapted to the artifact or scene to be captured
  - Proficiency operating cameras, lighting systems, 3D scanners, and software
  - Understand how to properly collect visual data for 3D processing

- **Properly understand the limitations of photogrammetry and how to overcome them through physical or digital means**
  - Understand how to manually perform the proper equipment calibrations adapting the object in question
  - Optimize visual data through physical manipulations of the depth of field, light, scale, and references
  - Understand the balance between data quantity and data quality necessary to produce publishable models

- Understand and perform post-processing to remove unwanted data and aberrations
- Perform meaningful photogrammetric post-processing and interpretations

III. Format and Procedures

This workshop is structured as an intensive five-day digital curation training course conducted in one of two museums in Romania. For processing data and compiling results, it is necessary for participants to bring a laptop. The software can be installed on Windows, macOS, or Linus, but works best with laptops with a high speed multi core CPU (6+ cores, 3 GHz+ recommended). Due to the nature of the work and software licensing, most data processing will take place in the lab. Even if you do not have a laptop capable of running the software, a laptop will likely be necessary to complete and review readings and work on the final presentation. Please contact the directors if you have computing concerns.

Participants will be housed at hotels in double or triple occupancy for the duration of the workshop. Breakfast and dinner, Monday to Friday (inclusive) will be provided for each workshop session. Meals will consist of traditional Romanian cuisine and can be prepared to accommodate vegetarian diets. The small size of our workshop teams, maximum 5 per session, is designed to provide extensive personalized instruction and the ability to tailor the workshop to the interests of participants. Local transportation to the museums will be provided.

The workshop is meant to be an intensive program, maximizing the integration of theory, method, and experiential knowledge/skill. As such, each day will contain 7-9h of workshop related activities. The tentative daily schedule — for more details, see Course Schedule below — is as follows (*subject to change):*

- 7:30AM: Breakfast
- 8-8:30AM: Beginning of morning lectures, museum collection, or processing
- 12:30PM: Lunch
- 1:30PM: Beginning of afternoon lectures, museum collection, or processing
- 5:30PM (or later, as needed): End of work day
- 7:30PM: Dinner

Please note that the basic 1:1 Photogrammetry Intensive Workshop offered by the Center for Digital Archaeology (CoDA) for **4 HOURS of in-person instruction** and only **60 MINUTES of related lectures** is currently priced at **$1100 for the course ALONE** and does not include room and board for the in-person instruction, nor do they include instruction in other methods of digital curation.

IV. Participation Assumptions

This workshop focuses on extensive skill acquisition rather than academic progression. However, in registering for the course, it is assumed that participants will be engaged, interested, and active in the workshop. All workshop activities are mandatory. A substantial degree of personal responsibility and initiative is expected and required from all participants to complete readings, prepare for discussions, and acquire the skills offered in the workshop. All acquired skills and enjoyment of this workshop are directly proportional to the effort and attention participants invest. It is assumed that participants will fully engage in all aspects of the workshop.

Once accepted to the program, a set of articles and a list of introductory videos will be provided to participants. It is absolutely essential that participants are fully versed in this prerequisite information prior to their arrival to the workshop.

You must be able to sit or stand for extended periods of time. Flashing lights as well as contrasting light and dark patterns are sometimes necessary in data collection and may trigger people who are photosensitive.

Participants are encouraged to share their particular interests with the instructors, who will do their best to personalize the workshop and maximize the acquisition of relevant knowledge and skills.

All participants are expected to behave respectfully at all times towards the staff, other participants and local people. All participants are required to abide by the rules and regulations of the workshop as well as Romanian laws. Disrespectful and/or disruptive behavior will not be tolerated.

V. Course Schedule (subject to change)

Readings will be provided to participants before their arrival in Romania. Readings should be completed as prerequisites and reviewed before the day they are listed. A manual for Agisoft's Metashape will also be made available upon arrival in Romania. Additional reference materials containing specific technical details will also be provided for the interested participant and future reference. Each workshop session will conclude with a presentation and report of the session's findings in a professional-like environment.

The program includes, for each session, approximately:

- 10-15h lecture, seminar, or discussion
- 10-15h on-site at the museum collecting data
- 15-20h in the lab processing and analyzing data

DAY	TOPICS (AM)	TOPICS (PM)	READINGS
1	**General Lectures** Lecture(s): 4hrs	**Equipment Checks** Lecture(s): 2hrs Lab: 2hrs	1. Howland 2014 2. Drap 2003 3. Gajski 2016
2	**General Photogrammetry (Monuments and Facades)** Lecture(s): 1hr On-Site: 1.5hrs Lab: 2hrs	**Spatial Photogrammetry (Rooms and Scenes)** Lecture(s): 1hr On-Site: 1.5hrs Lab: 2hrs	4. Wallace 2017 5. Balletti 2015 6. Doležal 2019
3	**Macrophotogrammetry (Small Artifacts)** Lecture(s): 1hr On-Site: 1.5hrs Lab: 2hrs	**Other Spatial Science Systems (RTI, Handheld 3D Structured Light Scanner)** Lecture(s): 1hr On-Site: 1.5hrs Lab: 2hrs	7. O'Driscoll 2018 8. McCuistion 2019 9. Mendonca 1992
4	**Museology and Digital Curation** Lecture(s): 3hrs Lab: 1.5hr	**Individual Project** Lecture(s): 30m On-Site: 2hr Lab: 2hr	10. Sapirstein 2016 11. McCarthy 2014 12. Bitelli 2000
5	**Group Project** Lecture(s): 1hr On-Site: 3.5hrs	**Group Project** Lecture(s): On-Site: 1hr (if necessary) Lab: 3-4hrs	

VI. Required Readings (provided)

1. Howland, Matthew D., Falko Kuester, and Thomas E. Levy. "Photogrammetry in the field: Documenting, recording, and presenting archaeology." *Mediterranean Archaeology and Archaeometry* 14.4 (2014): 101-108.

2. Drap, Pierre, et al. "Laser Scanning and close range photogrammetry: Towards a single measuring tool dedicated to architecture and archaeology." *CIPA XIXth International Symposium*. 2003.

3. Gajski, D., A. Solter, and M. Gašparović. "Applications of macro photogrammetry in archaeology." *International Archives of the Photogrammetry, Remote Sensing and Spatial Information Sciences* 5 (2016).

4. Wallace, Colin Allan Bruce. "Retrospective photogrammetry in Greek archaeology." *Studies in Digital Heritage* 1.2 (2017): 607-626.

5. Balletti, Caterina, et al. "Underwater Photogrammetry and 3D Reconstruction of Marble Cargos Shipwreck." *International Archives of the Photogrammetry, Remote Sensing & Spatial Information Sciences* (2015).

6. Doležal, Milan, et al. "Understanding underwater Photogrammetry for Maritime Archaeology through Immersive Virtual Reality." *International Archives of the Photogrammetry, Remote Sensing & Spatial Information Sciences* (2019).

7. O'Driscoll, James. "Landscape applications of photogrammetry using unmanned aerial vehicles." *Journal of Archaeological Science: Reports* 22 (2018): 32-44.

8. McCuistion, Ashley, David A. Brown, and Thane Harpole. "Archaeology in the Palm of Your Hand: Using Photogrammetry and 3-D Printing to Record and Recreate Excavations at Fairfield Plantation." *Historical Archaeology* 53.3 (2019): 762-770.

9. Mendonca, Francisco Jaime Bezerra. "Combination close-range photogrammetry and digital processing in archaeology." *ISPRS International archives of photogrammetry and remote sensing* 29 (1992): 130-133.

10. Sapirstein, Philip. "Accurate measurement with photogrammetry at large sites." *Journal of Archaeological Science* 66 (2016): 137-145.

11. McCarthy, John. "Multi-image photogrammetry as a practical tool for cultural heritage survey and community engagement." *Journal of Archaeological Science* 43 (2014): 175-185

12. Bitelli, Gabriele, Maria Alessandra Tini, and Luca Vittuari. "Close-range photogrammetry, virtual reality and their integration in archaeology." *Proceedings of XIXth Congress of International Archives of photogrammetry and remote sensing*. 2000.

VII. Selected Bibliography

General References

Mikhail, Edward M., James S. Bethel, and J. Chris McGlone. "Introduction to modern photogrammetry." *New York* 19 (2001).

Linder, Wilfried. *Digital photogrammetry*. Vol. 1. Berlin: Springer, 2009.

Baltsavias, Emmanuel P. "A comparison between photogrammetry and laser scanning." *ISPRS Journal of photogrammetry and Remote Sensing* 54.2-3 (1999): 83-94.

Thompson, Morris M., et al., eds. *Manual of photogrammetry*. Vol. 1. Falls Church, VA: American Society of Photogrammetry, 1966.

Kraus, Karl. *Photogrammetry: geometry from images and laser scans*. Vol. 1. Walter de Gruyter, 2007.

Engineering References

Hampel, Uwe, and Hans-Gerd Maas. "Application of digital photogrammetry for measuring deformation and cracks during load tests in civil engineering material testing." *Optical 3-D Measurement Techniques VI* 2 (2003): 80-88.

Tangelder, Johan WH, et al. "CAD- Based Photogrammetry for Reverse Engineering of Industrial Installations." *Computer- Aided Civil and Infrastructure Engineering* 18.4 (2003): 264-274.

Ermes, Pierre. "Constraints in CAD models for reverse engineering using photogrammetry." *International Archives of Photogrammetry and Remote Sensing* 33.B5/1; PART 5 (2000): 215-221.

Cooper, M. A. R. "Analytical photogrammetry in engineering: three feasibility studies." *The Photogrammetric Record* 9.53 (1979): 601-619.

Archaeology References

Kaufman, John, Allan EW Rennie, and Morag Clement. "Single camera photogrammetry for reverse engineering and fabrication of ancient and modern artifacts." *Procedia CIRP* 36 (2015): 223-229.

Anderson, Richard C. "Photogrammetry: the pros and cons for archaeology." *World Archaeology* 14.2 (1982): 200-205.

Reindel, M., and A. Gruen. "The Nasca-Palpa Project: A cooperative approach of archaeology, archaeometery and photogrammetry." *Recording, Modeling and Visualization of Cultural Heritage; Baltsavias, E., Gruen, A., van Gool, L., Pateraki, M., Eds* (2005): 21-32.

Forensics and Law Enforcement

Thali, Michael J., et al. "3D surface and body documentation in forensic medicine: 3-D/CAD Photogrammetry merged with 3D radiological scanning." *Journal of forensic sciences* 48.6 (2003): 1356-1365.

Lynnerup, Niels, and Jens Vedel. "Person identification by gait analysis and photogrammetry." *Journal of Forensic science* 50.1 (2005): JFS2004054-7.

Leipner, Anja, et al. "3D mug shot—3D head models from photogrammetry for forensic identification." *Forensic science international* 300 (2019): 6-12.

Koller, Stephanie, et al. "Using virtual reality for forensic examinations of injuries." *Forensic science international* 295 (2019): 30-35.

Design References

Szwoch, Mariusz, A. L. Kaczmarek, and Dariusz Bartoszewski. "STERIO-reconstruction of 3D scenery for video games using stereo-photogrammetry." *Computer Game Innovations in Monograph of the Lodz University of Technology, Lodz University of Technology* (2017).

Dhanda, Abhijit, et al. "Recreating cultural heritage environments for VR using photogrammetry." *Int. Arch. Photogramm. Remote Sens. Spat. Inf. Sci* 42 (2019): 305-310