A310

Introduction to Digital Archaeology and Virtual Reality

Fall Semester 2019
ARCHLab
Mondays/Wednesdays, 11:00-12:40 AM

Course Instructor: Hüseyin Çınar Öztürk

Hours Available: Immediately after class or by appointment
Introduction to Digital Archaeology and Virtual Reality

1. Course Description

Archaeological methodology has been changing at a revolutionary pace throughout the last decade. Today old ways of recording and interpreting archaeological data are being replaced by digital and computational methods, and virtual reality has become a key component of archaeological projects and cultural heritage management (CHM) alike. The main aim of this course is for the student to develop a comprehensive understanding of the new possibilities offered by the most recent tools and methods in analyzing the past, as well as to acquire a practical skill set, which will be useful in both archaeological fieldwork and cultural heritage management projects.

Upon the successful completion of the course requirements by the end of the semester, students will have gained theoretical knowledge on and develop a deep familiarity with:

- archaeological databases and data management;
- tablet-based digital excavation recording systems, such as iDig;
- nondestructive methods of archaeological exploration and remote-sensing such as LIDAR, Ground Penetrating Radar, and Thermal Imaging;
- airborne imaging and its uses in archaeology;
- international digital archaeology case studies, such as Kaymakçı and Keros;
- the role of Geographical Information Systems (GIS) in archaeological research and interpretation of spatial data;
- online and digital publication of archaeological projects.
- the impact of archaeological sciences in modern analysis and interpretation of the past (e.g. aDNA studies, micromorphology, zooarchaeology, paleoethnobotany)

Students will also gain practical experience in 3D modeling and photogrammetry, which is fast becoming the norm on fieldwork projects. They will also have hands-on practice of spatial recording using a total station.

Upon the successful completion of the course requirements, they will be able to:

- create 3D models of excavation trenches or buildings;
- create 3D models of archaeological artifacts (statues, weapons, etc.);
- digitally record architecture using photogrammetry-based orthophotos;
- fly a drone and take aerial photos;
- set-up and use a Total Station for spatial recording;
- create orthomaps and DEMs (digital elevation models), using drone photographs.

This course requires no previous archaeological fieldwork experience; however, since it is designed as a higher-level archaeology class, a substantial level of archaeological, historical, or anthropological knowledge is expected.

2. Course Resources and Activities

Given the ever-changing nature of the subject matter, rather than a particular textbook, we will be using chapters and articles from recent and up-to-date publications and online sources. The state of the discipline is such that half of the reading list changes every year. The readings, lecture slides, and workflows/technical tutorials for the computer-based projects will be regularly posted on Moodle as PDFs.

For the computer-based projects, the students may choose to use the computers in the CYA ARCHLab or their own computers. For the 3D modeling assignments, they can use their own DSLR cameras, or a camera provided by CYA. At the end of the semester the instructor will have the three best models 3D-printed and
3. Course Requirements

a) **Large object / Area 3D modeling:** Using the tutorial provided, you will create a 3D model of a large object or an area, such as a statue, garbage bin, the interior of your room, a tombstone or memorial monument from a cemetery, your incredibly motionless friend’s body, the slope of a hill, an ancient wall from the Philopappos Hill, etc...

b) **Small object 3D modeling:** Using the tutorial provided, you will create a 3D model of a small object, such as a stone artifact or a piece of jewelry. As archaeological objects in museums cannot be photographed from all angles, neither would it be legal to do so without a permit, you will need to choose a modern object.

c) **2D digital recording of architectural features or trench sections:** The days of architectural illustrators using their plumb bobs and rulers have long gone. In this assignment, you will learn how to use photogrammetry-based orthophotos to create publication-quality 2D stone plan illustrations of architectural features or vertical trench sections.

d) **DEM and Orthomap:** The increasing quality of digital airborne imaging and the decreasing prices of drones revolutionized the archaeological practice. In this assignment, you will create digital elevation models (a fancy term, which simply means a 3D representation of a terrain’s surface) and mosaic orthomaps (aerial maps, corrected according to ground control points), using the photo-set provided.

e) **Grant Application:** You will write an official archaeological project grant application for a fictional excavation or survey project of yours. You will need to: i) come up with a methodology incorporating the knowledge you acquired in our course, ii) determine which advanced tools or techniques to utilize, iii) calculate your expenses, iv) justify your choices regarding the terrain, geology, topography, and history of the fictional research area, v) hopefully convince the grant committee, which consists of the instructor. No budget limits. (ca 2500 words)

f) **Final Exam:** Your knowledge on both technical (e.g. how do we use thermal imaging as a remote sensing tool in archaeology?) and theoretical/ethical (e.g. do digital methods and the pace and accuracy they provided prevent us from thinking deeply about fundamental issues?) aspects of the course will be assessed.

g) **Class participation:** The frequency and quality of the questions raised and contributions to in-class discussions and practice will determine your class participation grade.

4. Grading and Evaluation

Your grade for this course will be based on the following distribution:

<table>
<thead>
<tr>
<th>Assignment</th>
<th>%</th>
<th>Deadline</th>
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<tbody>
<tr>
<td>Large object / Area 3D modeling</td>
<td>15%</td>
<td>9 October</td>
</tr>
<tr>
<td>Small object 3D modeling</td>
<td>15%</td>
<td>23 October</td>
</tr>
<tr>
<td>2D architectural / trench section illustration</td>
<td>15%</td>
<td>4 November</td>
</tr>
<tr>
<td>DEM and orthomap</td>
<td>10%</td>
<td>4 December</td>
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Syllabus

Archaeological Project Grant Application 20%

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<thead>
<tr>
<th>Assignment</th>
<th>Weight</th>
<th>Due Date</th>
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<tbody>
<tr>
<td>Outline</td>
<td>20%</td>
<td>20 November</td>
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<tr>
<td>First Draft</td>
<td></td>
<td>4 December</td>
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<tr>
<td>Submission</td>
<td></td>
<td>11 December</td>
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<tr>
<td>Final Exam</td>
<td>20%</td>
<td>18 December</td>
</tr>
<tr>
<td>Class participation</td>
<td>5%</td>
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</tbody>
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- Students may choose to write a short research paper (2500 words) instead of the Archaeological Project Grant Application assignment.
- If you intend to upgrade the course to 400-level, one additional 3D model and a research paper (4000 words) will be required, in which case the Archaeological Project Grant Application assignment will become mandatory.
- For 5 pts. extra credit, which will be added to the Final Exam score, students may create an additional 3D model.

7) Use of Laptops and Tablets
In-class or on-site use of laptops and other devices is permitted if that facilitates course-related activities such as note-taking, looking up references, etc. Laptop or other device privileges will be suspended if there are indications that they are not being used for class-related work.

8) Attendance Policy
Only one unexcused absence will be allowed in accordance with the CYA policy. Further unexcused absences will lower your final grade. Please contact the Director of Academic Affairs in the case of an absence due to illness.

9) Accommodations for Students with Disabilities
If you are a registered (with your home institution) student with a disability and you are entitled to learning accommodation, please inform the Director of Academic Affairs and make sure that your school forwards the necessary documentation.

Class Schedule

1. 9.9 Introduction to Digital Archaeology
   Fundamental concepts
   Stratigraphy and fieldwork methodology
   The history of digital archaeology and introduction to course

2. 11.9 Basic Principles of Photography & 3D Modeling

3. 16.9 Photogrammetry I
   Introduction to photogrammetry
   Workflow for artifact/small object and large object/area photogrammetry
   Data Collection in Zooarchaeology: Incorporating Touch-Screen, Speech-Recognition, Barcodes, and GIS
   Guest Lecturer: Dr Flint Dibble
4. **23.9 Photogrammetry II**  
*Photogrammetry workflow review*  
Stratigraphical recording  
3D recording and field archaeology

5. **25.9 Remote Sensing in Archaeology**  
Geophysical Methods of Remote Sensing  
LIDAR  
Thermal Imaging  
Satellite Imagery  
Case studies

6. **30.9 The use of drones in archaeology I**  
History of aerial photography and archaeology  
Aerial imagery as a remote sensing tool  
Types of drones  
Case studies

7. **2.10 GIS and Spatial archaeology I**  
GIS and spatial recording in archaeology  
Spatial recording tools: theodolite, GPS, d-GPS, Total Station  
GIS software solutions: an overview

8. **7.10 GIS and Spatial archaeology II**  
GIS and Survey and Excavation Methodologies  
*Guest Lecturer – Dr Denitsa Nenova*

9. **9.10 Field Work I**  
Surveying with Total Station & analogue architectural drawing

10. **11.10 Field Work II**  
Surveying with Total Station & analogue architectural drawing

11. **14.10 Archaeological Illustration and the Digital Age I**  
Photogrammetrical orthophotos and architectural illustration  
Photogrammetry and trench section drawings  
*Workflow for 2D digital recording of architectural features and trench sections*

12. **16.10 ARCHLab day**  
2D illustration practice

13. **21.10 Digital documentation of archaeological fieldwork I**  
Archaeological Fordism: The paper form revolution  
History of archaeological databases  
Archaeological databases: what to record?  
Software solutions

14. **23.10 Digital documentation of archaeological fieldwork II**  
Real-time tablet-based digital documentation.  
Case Studies: Kaymakçı, Keros, Agora & iDIG
15. **30.10 The use of drones in archaeology II**
   Drones and macro-scale 3D modeling
   Topographic Maps
   Orthophotos and Digital Elevation Models
   *Workflow for DEMs and Orthomaps*

16. **4.11 Cultural Heritage Management and Digital Age I**
   Can a virtual museum save Palmyra?
   Museum collection management
   *New Media: museums & archaeological sites*
   3D reconstruction

17. **11.11 Cultural Heritage Management and Digital Age II**
   The Internet, Social Media, and the presentation of archaeological projects
   Open Access to archaeological data (or the lack thereof)

18. **13.11 Formal What?: Ontology, Cidoc-CRM and integrated archaeological big data**
   *Guest speaker: Dr George Bruseker*

19. **18.11 New Approaches in Archaeological Sciences I**
   Ancient-DNA Revolution and human past
   Archaeological critique

20. **20.11 Archaeological Illustration and the Digital Age II**
   History of archaeological illustration
   Small object (pottery, stone tool, etc.) illustrations and digitization
   Is automated small object illustration possible?

21. **2.12 New approaches in Archaeological Sciences II**
   Zooarchaeology, Paleoethnobotany, Physical Anthropology
   *Introduction to micromorphology and geo-archaeology*
   *Guest lecturer: Laura Magno*

22. **4.12 Wiener Lab Visit**
   We will visit a state-of-the-art archaeological science lab, *The Wiener Lab, ASCSA*

23. **9.12 Theorizing Digital Archaeology I**
   Critical approaches
   Efficiency vs Slow Archaeology Debate

24. **11.12 Theorizing Digital Archaeology II**
   Discussion
   General Review for the Final exam
Readings


**Online Sources**


Archaeology-related articles in Remote Sensing Journal

Autodesk ReMake - How to Take Photos for Photogrammetry – YouTube

Conversation Piece: Disciplining the Digital | Issue 6 - June 2017 | Issues | British Art Studies

Digital Photogrammetry applied to Archaeology Research Papers - Academia.edu
https://www.academia.edu/Documents/in/Digital_Photogrammetry_applied_to_Archaeology.


Home | CIDOC CRM http://www.cidoc-crm.org/.

Home | Rekrei https://projectmosul.org/.

How LiDAR was used to to uncover archaeology in South Downs – YouTube
https://www.youtube.com/watch?v=iVnzsYLatNI.


Inking Archaeological pottery with ILLUSTRATOR - Open Shape (bowl rim) - 1 – YouTube
https://www.youtube.com/watch?v=3F2c0_UIDS0&t=.


National Geographic - Lost Treasures of the Maya Snake Kings – YouTube
https://www.youtube.com/watch?v=SwihfjgRRvs.


———“Opinion | How to Talk About “Race” and Genetics - The New York Times”

Supplemental Material for Excavation is Destruction Digitization: Advances in Archaeological Practice: Journal of Field Archaeology: Vol 40, No 3
The Legacy of Ancient Palmyra (Getty Research Institute)

The magic of lidar 3d mapping – YouTube https://www.youtube.com/watch?v=0XdqGNu9bhk.

The PRESIOUS Project | Presious http://www.presious.eu/.