Title: Acquiring and post processing 3D data in anthropology and archaeology

Class 1, 10th-14th, June 2019

Format: ACQUIRING AND POST PROCESSING 3D DATA : anthropology, archaeo-zoology and cultural heritage.

10th June

- **9.00am – 9.30am PLENARY PRESENTATION**: Introducing topics, lecturers, daily routine and location.

- **9.30am – 1.00pm I TOPIC**: Surface scanner and High-Resolution Micro-CT and Nano-CT, Imaging with advanced radiation sources (e.g., microfocus X-ray tubes, synchrotron radiation)
  Lecture and Practical session: Eng. Massimiliano Fantini (School of Engineering and Architecture - UNIBO) Dr. Daniele Panetta (CNR Institute of Clinical Physiology, Pisa)

  Introduction to 3D scanning: technologies and working principles (i.e. laser and structured-light 3D scanners). Technical features, characteristics, how to deal with raw data. 3D scanning in archaeo-anthropological and biomedical field: case reports on 3D data acquisition and 3D models reconstruction (i.e. for virtual anthropometric analysis, dentistry and prosthetic maxilla-facial rehabilitation). Examples of data fusion starting from different data sources.

  Introduction to equipment for high-resolution non-destructive testing and applications to preclinical imaging (in-vivo), biology and drug discovery (in-vivo and ex-vivo), analysis of skeletal remains, and current limits of spatial resolution (e.g., conventional radiology and (micro CT).

- **1.00pm – 2.00pm LUNCH BREAK**

- **2.00pm –5.00pm II TOPIC**: 3D Scan and data acquisition
  Practical session: Dr. Laura Buti (Department of Cultural Heritage, UNIBO), Dr. Gianluca Renzi,(3D systems), Dr. Antonio Di Leo (3D systems)

  Acquiring materials from different fields of interest and by different instruments: 3D BLU LIGHT SCANNER, LASER Scanner, photogrammetry.

11th June

- **9.00am – 01.00pm III TOPIC**: Geomagic Design X
  Lecture session: Dr. Laura Buti; Dr. Gianluca Renzi

Introduction to post processing software: Geomagic workflow, import acquired data, point cloud alignment, noise cleaning. All the data for the practical sessions are anthropological and archeological 3D models provided by the Department of Cultural Heritage University of Bologna.

- **1.00pm – 2.00pm LUNCH BREAK**

- **2.00pm – 5.00pm III TOPIC**: Geomagic Design X
  Practical session: Dr. Laura Buti; Prof. Stefano Benazzi
  Practical section on managing surface data.

12th June

- **9.00am – 01.00pm III TOPIC**: Geomagic Design X
  Lecture session: Dr. Laura Buti; Prof. Stefano Benazzi
  Mesh generation, healing defects, 3D model construction. Dealing with models, surfaces and meshes, models aligning, saving, how to export the data, file formats, compatibility.

- **1.00pm – 2.00pm LUNCH BREAK**

- **2.00pm – 5.00pm III TOPIC**: Geomagic Design X
  Practical session: Dr Laura Buti; Prof. Stefano Benazzi
  Practical section on managing surface data. Surface editing, preparing images for publications/presentations.

13th June

- **9.00am – 01.00pm IV TOPIC**: Avizo
  Lecture session: Dr. Timothy Ryan
  Introduction to Avizo's concept: how the software works. Getting started, raw data, Avizo preferences, file formats, data import.

- **1.00pm – 2.00pm LUNCH BREAK**

- **2.00pm – 5.00pm IV TOPIC**: Avizo
  Practical session: Dr. Timothy Ryan
  Set parameters, filters, large data, clipping, slicing visualization, multiplanar view, volume rendering, isosurface creation, lines and sections, tools and applications. All the data for the practical sessions are anthropological and archeological 3D models provided by the Department of Cultural Heritage University of Bologna.

14th June

- **9.00am – 01.00pm IV TOPIC**: Avizo

  Lecture session: Dr. Timothy Ryan

  Resampling and cropping, slice alignment. Segmentation process: Automatic and manual segmentation, segmentation editor, surfaces generation, surface visualization, save data, save project. Measurements, difference between isosurface and surface, exporting data and measurements.

- **1.00pm – 2.00pm LUNCH BREAK**

- **2.00pm – 5.00pm IV TOPIC**: Avizo

  Practical session: Dr. Timothy Ryan

  Practical session on segmentation protocol, surface editing, preparing images for publications/presentations, simple animations, camera path, animation director.

Class 2, 17th-19th, June 2019

Format: MORPHOSTATS-3D: Geometric Morphometric Methods for the analysis of shape and form variability.

17th June

- **9.00am – 10.00am I TOPIC:** INTRODUCTION TO GEOMETRIC MORPHOMETRICS: Definitions, History, Data Acquisition, (semi) Landmarks, Procrustes Superimposition, Shape and Form analysis, Applications.

  Lecture session: Prof. Stefano Benazzi

  Geometric morphometrics is a toolkit of methods for the numerical analysis of 2D and 3D shape variation. Anthropologists use geometric morphometric methods for answering questions about how parts of a body vary or how they respond to processes like growth, evolution, or injury. Moreover, these methods find applications in archaeology, archaeozoology, and in life science disciplines.

- **10.00am – 10.30am II TOPIC**: VIEWBOX

  Lecture session: Dr. Rita Sorrentino, Prof. Stefano Benazzi

  Introduction to the software. All the 3D models for the practical sessions are provided by the Department of Cultural Heritage University of Bologna.

- **10.30am – 12.30pm III TOPIC:** EDITING 3D MODELS

  Lecture and practical session: Dr. Rita Sorrentino, Prof. Stefano Benazzi

  How to Viewbox options can be used to edit 3D models.

- **12.30pm – 2.00pm LUNCH BREAK**

- **2.00pm – 5.00pm IV TOPIC**: CREATION OF 3D TEMPLATE IN VIEWBOX

Lecture and practical session: Ms. Carla Figus, Prof. Stefano Benazzi

Conceptualization and creation of 3D configuration of landmarks, curve semi-landmarks and surface semi-landmarks.

18th June

- **9.00am – 12.30am V TOPIC:** APPLICATION OF THE TEMPLATE TO THE TARGET
  Lecture and practical session: Dr. Gregorio Oxilia, Prof. Stefano Benazzi
  Upload target sample in Viewbox and application of the template.

- **12.30pm – 2.00pm LUNCH BREAK**

- **12.30am – 4.00pm VI TOPIC:** APPLICATION OF THE TEMPLATE TO THE TARGET
  Practical session: Dr. Rita Sorrentino,Tutors.
  Participants will continue with the application of the template to the target models in order to create a sample that they will statistically analyze.

- **4.00pm – 5.00pm VII TOPIC**: WORKING WITH DAMAGED/INCOMPLETE SPECIMENS
  Lecture and practical session: Dr. Rita Sorrentino, Prof. Stefano Benazzi
  How to include damaged specimens (e.g., fossils, archaeological materials) in the sample estimating missing landmarks and semi-landmarks. We will cope with a damaged specimen and provide a virtual reconstruction of the missing portions using GM techniques.

19th June

- **9.00 am-10.30 am VIII TOPIC:** STATISTICAL ANALYSIS IN VIEWBOX
  Lecture and Practical session: Dr. Rita Sorrentino, Prof. Stefano Benazzi
  General Procrustes analysis (GPA) and Principal component analysis (PCA). Shape space and form analysis.

- **10.30 am-12.30 pm IX TOPIC:** LANDMARK SUFACE WARPING AND GRID DEFORMATION
  Lecture and Practical session: Dr. Rita Sorrentino, Prof. Stefano Benazzi
  Reconstructing the shape changes along the principal axes warping a mesh to a target. Recognize morphological differences between two specimens by means of Thin Plate Spline (TPS) grid.

- **12.30pm – 2.00pm LUNCH BREAK**

- **2.00pm – 4.00pm X TOPIC:** FROM VIEWBOX TO OTHER SOFTWARE
  Lecture: Dr. Rita Sorrentino, Prof. Stefano Benazzi
  How to extract and save shape coordinates from the target model. Using data collected in Viewbox to make analysis in other software (e.g., R, Avizo).

- **4.00pm – 5.00pm XI TOPIC** RECAP AND QUESTIONS

FEES:

CLASS 1
Under graduate students, graduate, phd students: 350 euros
Professionals: 500 euros

CLASS 2
Under graduate students, graduate, phd students: 250 euros
Professionals: 350 euros

FEES FOR PARTECIPANTS TO BOTH CLASSES:
Under graduate students, graduate, phd students: 550 euros
Professionals: 800 euros

Sponsored by Fondazione Flaminia , Avizo(FEI), 3D systems and dHAL Software.

Venue and laboratories:

DBC, V. Ariani, 1 – 48121 Ravenna

DICAM, V. Tombesi Dall'Ova, 55-48121 Ravenna