New Developments in Digital Imaging for Archaeology

Brandeis Techne Group at Autodesk

BRANDEIS TECHNE GROUP

DEVELOPMENT TIMELINE

Autodesk Technology Center Boston

WINTER 2018/2019

BOSTON, MA

- Brandeis Techne Group organized as a Resident Group at Autodesk, with the aim of developing new technological applications for archaeological research.
- Techne Group begins at Autodesk

SPRING 2019

BOSTON, MA

- Development of SCAPP concept & initial engineering
- Science the patterning for data acquisition.
- Fabrication of prototype-A in wood with 3D printed PLA carriages
- Initial testing gathering object datasets
- Fabrication of prototype-B in aluminum and markforged/PLA printed carriages; motors added to vertical and horizontal axes.

SUMMER 2019

TEL KABRI, ISRAEL

- Field testing SCAPP at Tel Kabri, Israel
- Continued modification and programming; upgrade of prototype with the team in Boston.

FALL 2019

BOSTON, MA

- Engineering and programming upgrades to Prototype-C incorporates data from field testing, additional horizontal motor added, and wiring reconfigured.
- Renewed team residency at Autodesk.

THE PROCESS

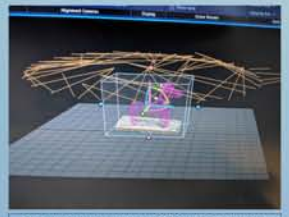
Design and fabrication of an automated gantry system to move a dSLR camera in a full circuit around an object in order to take 30-100 + photos as datasets processed in photogrammetry software. The output generated through these programs provides a scale and color accurate 3D model, best for challenging objects with high specularity.

- The SCAPP cam is specifically designed to be software independent. By normalizing the photogrammetry pattern, we get a clean enough data set that it requires minimal post processing and can be rendered in any Photogrammetry software with good results.
- The initial prototype was constructed in birch to test the perimeters of camera angles and the feasibility of the geared frame and arch system. The goal here was to have a minimal viable prototype to dial in optimized photogrammetry acquisition patterns.
- In the second incarnation of the SCAPP the entire frame was cut from aluminum using the Autodesk waterjet; carriages were printed in PLA and on a Markforged 3D printer; Traditional 3D printer stepper motors were controlled via a computer from an industry standard 3D printer control "Ramps board" – the materials were chosen for their accessibility and relatively low cost.
- The SCAPP operates essentially as if it were a 3D printer, it uses a printer control board and motors, but moves and actuates a dSLR or phone.
- SCAPP can also function as a non-automated circular tripod in which data acquisition can be done manually while maintaining the leveled set degree position of the camera.
- The whole kit was designed to be field usable, weigh under 50 pounds, and be able to be transported internationally (easily clearing customs) and setup and broken down rapidly.

FIELDWORK

- Designed as a portable imaging tool, SCAPP testing has included laboratory settings such as those at Autodesk, the classroom, and at an archaeological excavation. Initial SCAPP field testing was carried out in the summer of 2019 at Tel Kabri (Israel) by Alexandra Ratzlaff and Erin Brantmayer of the Brandeis Techne Group.
- While data was collected in the field, team members Ian Roy, Tim Hebert, and Daniel Lay developed an updated version of the SCAPP based on feedback from field and continued lab testing.
- Currently, the group is continuing to improve and refine the engineering and design of the SCAPP through collection of data sets primarily on artifacts from the Brandeis CLARC (Classical Artifact Research Collection).

Field testing at Tel Kabri – SCAPP imaging a macehead.



Beta-version processing of SCAPP imaging in Reality Capture.

RESULTS

- Succeeded in the fabrication of the SCAPP as a mobile piece of archaeological equipment viable in field and laboratory settings.
- In cases where objects are too specular SCAPP can provide a better data acquisition than comparable methodologies including traditional handheld photogrammetry and, in some instances, fractured light 3D scanning with an Artec devise.
- Datasets with the SCAPP yielded consistent images that when processed produced results exceeding expectations.

SCAPP image dataset in Agisoft Metashape of an Archaic alabastron from the Brandeis CLARC

PROJECT AIMS

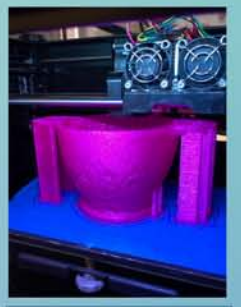
The overarching aim of the Brandeis Techne Group as Residents at the Autodesk Technology Center in Boston is to develop new equipment and methodologies to help push forward the collaboration between technology and the humanities.

- With a focus on archaeological research and applications, this group seeks to develop new ways of analyzing the material culture of the ancient and historical world.
- The eventual goal of our project is to both fabricate and prototype a 'Single Camera Automated Photogrammetry Platform' (SCAPP) with the final designs and methodology available for reproduction through an open-source platform.
- The SCAPP is intended to be relatively low-cost and easily reproduced as an alternative to other digital imaging equipment.

Start to finish digital imaging of Egyptian ushabti from the Brandeis CLARC; SCAPP scanning, processing in Agisoft Metashape and Reality Capture, final processing in Simplify3D for printing.

SIGNIFICANCE TO THE FIELD

- The SCAPP covers a gap between traditional hand held photogrammetry in the field, and the limits of Structured Light or Laser 3D Scanners to work with specular objects.
- The SCAPP cam was developed specifically to document fragile or specular objects in situ as they are excavated. Many times these objects are damaged during excavation, or are invisible to other types of 3D scanners.
- Project represents a successful partnership between an academic institution, Brandeis University, and a technology, industry leader with the corporation Autodesk.
- Specular, shiny objects can be a challenge for Structured Light and Laser based 3D Scanners. Photogrammetry is the obvious alternative, but requires the operator to make artistic decisions.



3D printing a Hellenistic skyphos from the Tel Dor HaMizgaga Museum

Processing a SCAPP image dataset in Reality Capture.

Team members Tim Hebert and Daniel Lay work on improvements to the latest version of SCAPP.

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