A19 Using Structure From Motion Photogrammetry to Quantify Volume Gain and Loss During the Human Decomposition Process

Kathleen Flor-Stagnato, BA, 225 Craddock Avenue, Apt C, San Marcos, TX 78666; Susan Sincerbox, BS*, 625 Creekside Way, Apt 1246, New Braunfels, TX 78130; and Nicholas P. Herrmann, PhD, Texas State University, Dept of Anthropology, 266 ELA, 601 University Drive, San Marcos, TX 78666*

After attending this presentation, attendees will better understand the basics of using photogrammetry to quantify volume gain and loss in human cadavers. Additionally, attendees will understand the typical decomposition process for human remains in central Texas.

This presentation will impact the forensic science community by presenting a new method that can be used to quantify volume gain and loss during human decomposition. Quantifying general trends (i.e., bloat) with respect to influential variables (i.e., body size and ambient temperature) will assist in producing more precise reconstructions of the progression of human decomposition, promoting accuracy and precision of postmortem interval estimates.

This research investigates the use of Structure from Motion (SfM), a type of digital photogrammetry that creates 3D models from photographs, for estimating the total body volume of individuals in the fresh, bloated, and post-bloated stages of decomposition. This project seeks to quantify parameters of volume gained during bloat and lost following collapse of the abdominal cavity to better understand how the progression of early decomposition events is affected by ambient temperature, as measured by Accumulated Degree Days (ADD), and body size.

This project utilized ten human cadavers procured through the Forensic Anthropology Center at Texas State's Willed Body Donation Program. Donor bodies were excluded from the study if the donor was being treated with chemotherapy prior to death, if the donation was not in the fresh stage of decomposition at the time of placement at the Forensic Anthropology Research Facility, if the donation was autopsied or presented with significant thoracic trauma, or if tissue samples were harvested from the donation for concurrent projects during the period of study. These criteria were selected so that the entire bloat process could be observed and to ensure that bloat proceeded "naturally" by minimizing potential antemortem disruption of the microbiome and preventing gas and fluid loss through autopsy or traumatic injury sites. After placement, donations were monitored daily. Flexible fiberglass tape measures placed under the body were used to monitor the circumference of the neck, chest, and abdomen. The presence of bloat indicators (e.g., protrusion of the tongue, inflation of the scrotum, and swelling of the head and neck) and purge occurrence and location were noted.

Three SfM models of the cadavers were created; one on the initial date of placement, one during the three days encompassing the period of maximum bloat as determined by the cadaveric measurements, and one after the collapse of the abdominal cavity. Photographs were taken using an Olympus® OM-D EM-5 Mark II 16-megapixel camera, on manual settings. Two different photograph collection methods were used to ensure proper camera calibration in Agisoft PhotoScan™. First, a "flat" project was completed by taking photos parallel to the ground surface and the body being photographed. Subsequently, a "dome" project was completed to ensure that the entire surface of the individual was collected completely. The photographs for the dome project were collected by moving around the individual, taking photos at four elevations. These elevations were approximately 6 feet, 5 feet, 3 feet, and .5 feet from the ground surface. Overlap of at least 66% between each photograph for the dome project was ensured by moving no more than 30 degrees between each photo station.

Photos were processed and optimized in Agisoft PhotoScan™ software, which was also used to measure the volume of each model. The model was scaled using ground control points shot in with a total station, which were placed near the head, hands, and feet of each individual. Percentage increase from the date of placement to the date of maximum bloat was calculated for all physical circumferences and model-generated volume for each donation to account for variation in initial body size. Tukey mean-difference plots were then constructed in R to assess agreement between methods, comparing the change in each circumference to the corresponding change in volume. ADD to maximum bloat and abdominal collapse, determined using physical measurements and volumes, were calculated using temperature data collected from an on-site weather station. Frequency distributions were constructed and descriptive statistics calculated for each group to describe the central tendency and dispersal of the data. ADD was also regressed against percentage change in physical measurements to determine how much variation in bloat is explained by temperature. Additional statistical methods may be employed as needed.

This project will contribute detailed quantitative data on variation in bloat, which is influenced by characteristics of both the individual and the immediate environment, and add to the body of knowledge about the decomposition of human remains. Postmortem interval estimation is a critical component of medicolegal death investigations, as it can aid in narrowing a list of missing persons and facilitating identification.

Photogrammetry, Decomposition, PMI

*Presenting Author