Close-Range Photogrammetric Analyses of an Active Paleontological Excavation

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Applications of Photogrammetry

- Rieke-Zapp and Nearing (2005)
  - Detect soil surface change
  - Lab-calibrated dSLR camera
  - 3 mm pixel resolution

- Koch and Kaehler (2009)
  - Survey sculptured reliefs
  - LiDAR and CRP images
  - Measurements accurate within ±1 mm at center, ±3 mm at edges
Photogrammetry in Paleontology

• Breithaupt et al. (2001, 2004)
  – Document tracks and trackways
  – Remote sensing with calibrated cameras at different scales
  – Created DTM with 1 cm precision

• Matthews et al. (2006)
  – Added CRP images with 0.3-mm resolution to Breithaupt et al. (2001, 2004) methodology

• Bates et al. (2008)
  – Constructed DOM of tracks from...
The Mammoth Site of Hot Springs, SD Inc.

• Site was a sinkhole that formed from a collapsed breccia pipe
  – A minimum of 61 mammoths, both Columbian (*Mammuthus columbi*) and Woolly (*Mammuthus primigenius*), present

• An abundance of fossil material exposed and in place

• Multiple skulls and skeletons,
The Mammoth Site of Hot Springs, SD Inc.

- Data collected with:
  - Nikon D5100 dSLR camera
  - 35mm lens

- Over 10,000 photographs taken
  - Weekly basis
  - 750 ft² area daily for 1 week
The Mammoth Site of Hot Springs, SD Inc.

- Model generation in AgiSoft Photoscan Professional
  - Photos aligned based on common points
  - Planar surfaces extrapolated and given depth
  - Photographic detail draped over geometry
Preliminary Results
Preliminary Results
Preliminary Results
Preliminary Results
Preliminary Results
Output Formats

• Can export in lots of formats:
  – Adobe PDF
    • Rotatable image
  – Google Earth KMZ
  – XYZ point cloud
  – ASPRS LAS file
  – Orthophotos
    • JPEG, GeoTIFF, PNG
    • Huge amount of detail in the models
  – Arc/Info ASCII Grid
    DEM generation
AGISoft-Generated Report

- First Page
- Image of model
- Similar to model image
Second Page

Figure 1 shows the number of images taken to cover the given area of the model and the estimated central position of each image.

Statistics:

<table>
<thead>
<tr>
<th>Camera Model</th>
<th>Resolution</th>
<th>Focal Length</th>
<th>Pixel Size</th>
<th>Frecalibrated</th>
</tr>
</thead>
<tbody>
<tr>
<td>NIKON D5100 (35 mm)</td>
<td>4926 x 3264</td>
<td>35 mm</td>
<td>4.92678 x 4.92678 um</td>
<td>No</td>
</tr>
</tbody>
</table>

Table 1: Cameras.
Generated Report

- Third Page
- Gives scale and resolution of generated DEM
- Without appropriate GCS, unsure how accurate the resolution is here

Elevation change

Fig. 3. Reconstructed digital elevation model.

Resolution: 0.00079783 m/px
Point density: 10416.9 points per sq m
Future Work

• Comparison of data collected from CRP models to that traditionally collected
  – Statistical analysis of measurements made by hand and from models
  – Collect and analyze images collected at outdoor excavation

• Conduct a taphonomic study of specimens at an excavation from CRP models
  – Measuring specimen orientations
  – Document sediment changes across excavation site
Questions?