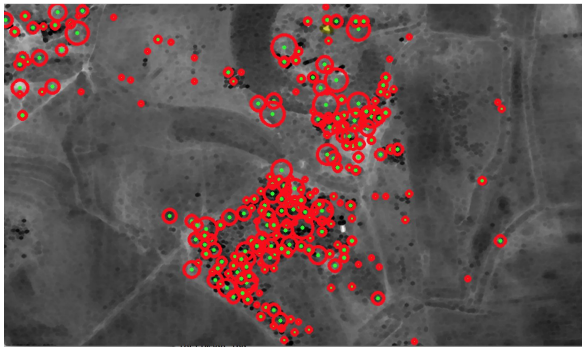
Towards the Automatic Detection of Archaeological Looting Using Computational Methods
Phillip Wang, Class of 2018

Archaeological looting is a rampant problem today that not only endangers the preservation of human history and heritage, but also funds the activities of dangerous groups such as ISIL. Monitoring this looting is made difficult by the dangerous nature of many of these sites and the vast amounts of land that are at risk. In addition, these traditional methods require a significant amount of time and human resources. Archaeologists such Sarah Parcak, have successfully begun to monitor looting using new methods that use satellite imagery. Looting appears in satellite imagery in the form of small dark pits that are dug by looters. These novel methods have allowed archaeologists to cover larger amounts of land in less time, but still require a substantial amount of human input. This summer, I researched the possibility of creating a computer program that automatically detects archaeological looting using satellite imagery and computer vision algorithms. This program would allow archaeologists to rapidly track looting over vast expanses of land.

I began my project by researching possible sources of satellite imagery. There are multiple sources of satellite imagery, both private and government owned, that provide a variety of benefits and resolutions. After considering multiple sources, I decided to use imagery sourced from Google Earth Pro. This program provides free high resolution satellite imagery and provides data from many different years, allowing one to seeing changes over time. I then began an extensive literature review on academic papers covering a mixture of archaeological and computational topics. These papers provided insight on other work occurring in the field of space archaeology and provided me with ideas of methods and places to investigate. After considering crater detection and template matching algorithms, I decided to utilize algorithms contained in OpenCV's library. OpenCV is an open source library that contains a wide range of algorithms that can be used for a variety of tasks from image preprocessing to object detection.

Many academic papers that I read utilized image preprocessing to make characteristics of looting more detectable. Therefore I first began to experiment with the processes of erosion and dilation, both available as algorithms within OpenCV to make looting holes more easily detectable. After experimenting with different sets of code and parameters, I was able to make looting holes appear as distinct black circles. I then utilized another function found within OpenCV's library called the Hough Circle Function and by adjusting settings and parameters was able to detect these looting holes successfully. See below for an image of a looted site where the holes are detected (marked as red circles with green centers).



While I was able to detect these looting holes, I also discovered that my current methods using these algorithms detect many false positives. Therefore I will continue this research as an independent study and continue to experiment with OpenCV and will likely write my own algorithm. So far the results are promising and I am hopeful that this project will eventually lead to a fully automated program.

Faculty Mentor: Laura Toma
Funded by the Surdna Foundation Undergraduate Research Fellowship Program