bbellavance@email.arizona.edu

MAPPING EARTH FISSURES USING UAV-BASED MULTI-ANGLE PHOTOGRAPHY IN
SOUTH CENTRAL ARIZONA

by

Bailey Bellavance
ABSTRACT

The semiarid valleys of southern and central Arizona have been home to a growing number of earth fissures -- large cracks in the ground caused by land subsidence related to groundwater withdrawal. Given their oftentimes destructive nature, the necessity for monitoring these features has grown. Traditional field measurements are labor intensive and often only supply an estimate of fissure depth and width. This project was conducted to determine if multi-angle aerial photography from unmanned aerial vehicles (UAVs) could be used to accurately measure fissures using structure-from-motion photogrammetry. The 3km long fissure mapped is located in Pinal County, Arizona. In an effort to combat shadows within the fissure, three flights were completed using a UAV at dawn, sunrise, and noon. Over 500 images of the fissure were taken per flight and were used in photogrammetry software to create an ultra-dense 3-D point cloud and orthomosaic. In-situ width and depth were measured at 17 different locations along the fissure via traditional collection methods for comparison with the UAV-based results. A comparison between the imagery-based and manual fissure width measurements shows an $R^2$ value of 0.997. UAV based depth measurements could not be derived in the narrow fissures due to the lack of adequate illumination. Depth measurements taken where the width was greater than 1.8 meters has an $R^2$ value of 0.9525. To measure a narrow fissure depth, an active LiDAR sensor would be more appropriate. The application of photogrammetry to measure earth fissures can provide accurate results of fissure location and width and provides limited information about the depth.