Gaining Efficiency in 3D Modeling by using a Drone

Amanda Adams
West Virginia University

Abstract

Flooding is a natural occurrence that can become one of the most damaging and costly disasters, because of the effects on property. Human interactions with nature can increase the intensity of destruction from flooding because of the number of structures built in flood-prone areas. 3D modeling is a good visual representation of information for flooding risks, because the public can view the effects of that flooding on their property better using a 3D model. However, creating the data necessary for 3D models can be time-consuming and expensive. Unmanned aerial vehicles, or drones, is a newer technology, which can be beneficial for this work, because drones are cheaper and more accessible. This project uses a Mavic Pro drone to create a 3D model of a portion of the Decker's Creek watershed in Morgantown, WV. This study area includes park structures potentially at risk from flooding, including a pedestrian bridge across the creek and structures associated with a swimming pool. Images captured from a Mavic Pro will be overlaid using Drone-to-Map to create a 3D model of the study area. Then water data will be added to create flood heights within the model. The final product is a 3D model of the study area showing flooding conditions of the river.

Background Information

The main methods for gathering image data of the landcover is using satellite and plane technology. This data can be costly and time consuming to create the data.

Why drones might be better:
- More readily available now
- Less costly

WV Flood tool:
- Created by the WVU Tech Center
- I meter DEM Mosaic of West Virginia 2018
- Has 100 and 500 year flood layers

Figure 1: WV Flood tool map of Study area

Research Objectives

- Can a UAV create an accurate DTM when compared with the WV Flood Tool?
- Can the UAV overcome the challenge of the tree canopy by flying during the leaf off period?

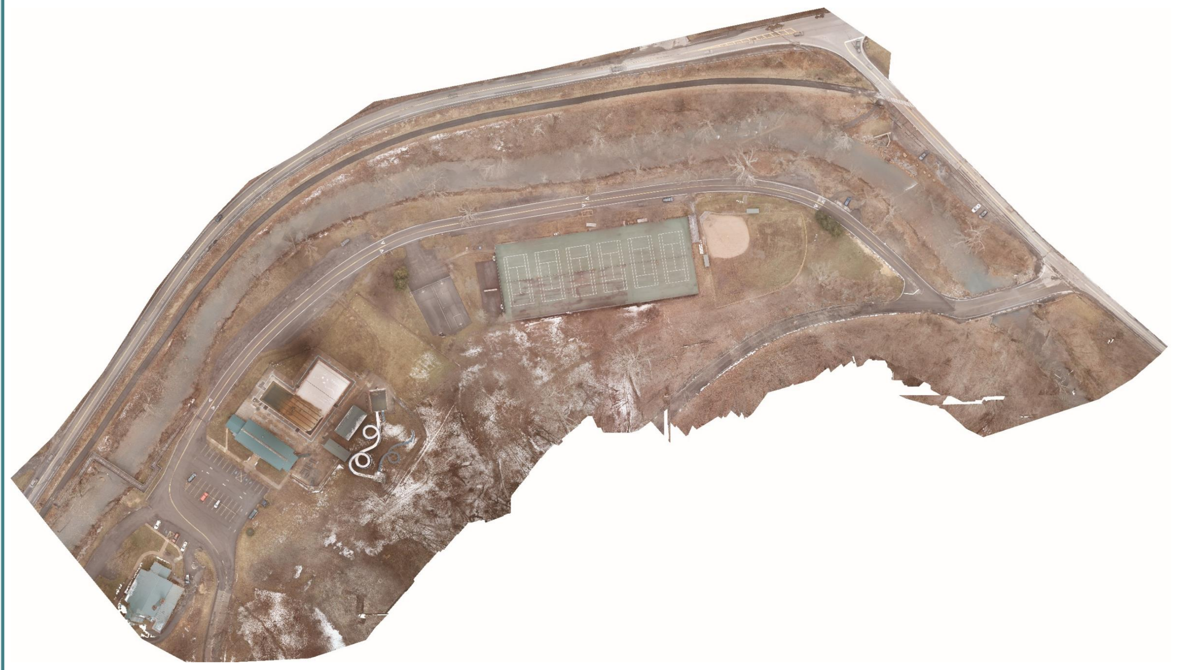

Figure 2: Study area Orthomosaic (leaf off)

Materials

Equipment
- Mavic Pro drone
- Samsung active 8 cell phone

Apps
- Pix4D Capture
- Ctrl+DJI

Programs
- Drone2Map
- ArcGIS Pro

Figure 3: Mavic Pro drone

Dataset
- I meter DEM mosaic of West Virginia 2018
- A shapefile of the study area

Methodology

Flight
I flew my Mavic pro at a height of 61 m with 85 overlay and 70 camera angle using the double grid flight plan.

Figure 4: Double grid flight plans.

Drone2Map
- Ran 1198 pictures into Drone2Map to produce:
  - DSM
  - DTM
  - Orthomosaic
  - Point cloud
  - 3D mesh

ArcGIS Pro
- Create Feature class
  - Created the shapefile from a drawn polygon
- Clip (data management tool)
  - Clip the Orthomosaic, DTM, and DEM using the shapefile as the template.
- Project Raster
  - Change the projection of DEM to the projection of DTM.
- Resample
  - Getting the same pixel size of DEM and DTM.
- Raster Calculator
  - Subtracted the DEM with DTM to find the difference between the two rasters.

Figure 8: 3D model of the study area.

Conclusion

The drone had problems with mapping the river because of the dense amount of tree limbs. The trees can also account for the different length of the river compared between the DEM and DTM. As expected, the structures (pool, trees, and bridge) are the main cause of the differences. The unexpected difference came from the tennis, baseball and basketball courts. This project shows that drones can be an effective tool when collecting data but there are some challenges like trees and tennis courts that that need to be addressed. A way around these obstacles could be attaching a LIDAR sensor to a drone.

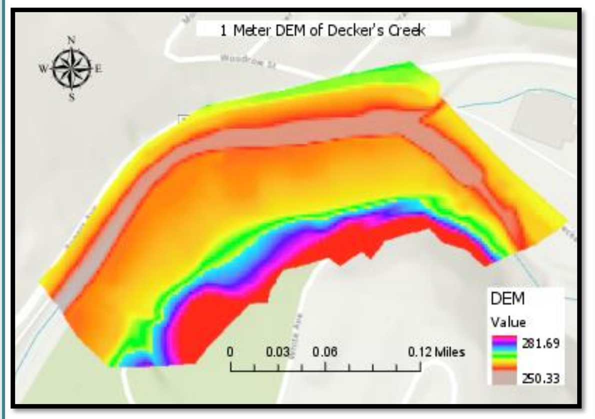

Figure 5: DEM map

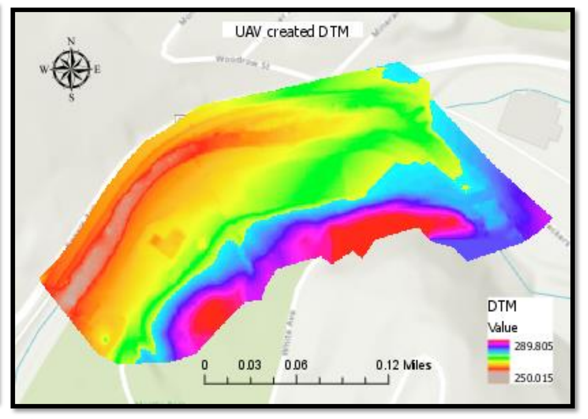

Figure 6: DTM map

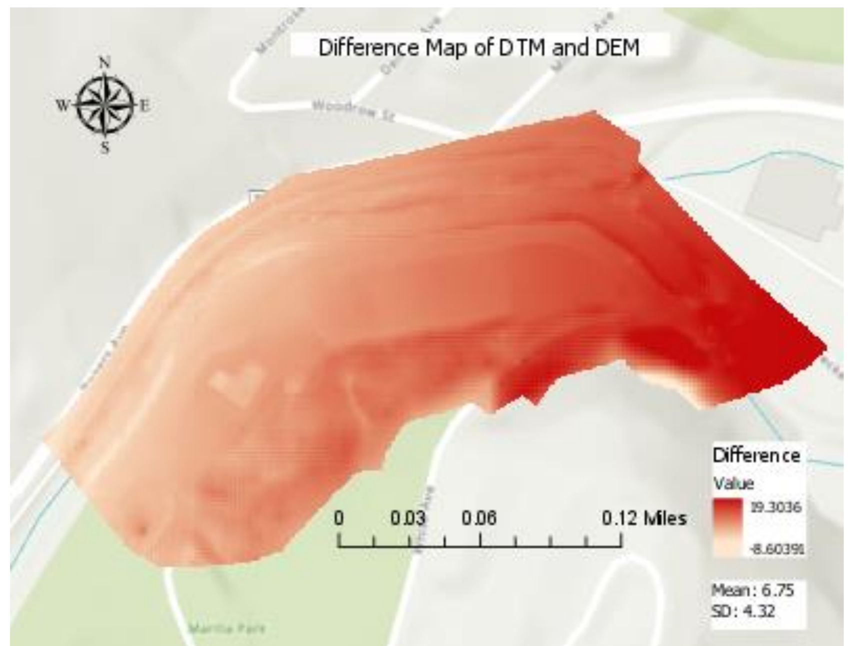

Figure 7: Difference map of DEM and DTM

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