COLORADO STATE UNIVERSITY
EXTENSION

UAV REMOTE SENSING OF CAMERON PEAK WILDFIRE AND WATERSHED IMPACTS

LARIMER COUNTY, COLORADO

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PROJECT INTRODUCTION

The Cameron Peak Fire is the largest recorded wildfire in Colorado history. The fire began in August of 2020 and burned over 200,000 acres for three months. This wildfire event burned throughout both the Arapahoe and Roosevelt National Forests in Larimer County, Colorado. The Cameron Peak Fire scorched land in three different watersheds, which will have long-term impacts on the environment and water quality.

The purpose of this project was to collect aerial imagery using UAVs (drones) of tributaries in the Cache la Poudre watershed to measure landscape change over time in fire-affected areas. Our team collected imagery at three different study sites. The study sites included Dry Creek and Washout Gulch, located west of Rustic Colorado on highway 14, and Blue Lake, five miles Northeast of Cameron Pass. We used a DJI Phantom 4 RTK system with terrain-following capabilities to collect the imagery in remote high relief topography. The aerial imagery was post-processed using Agisoft Metashape and ArcGIS Pro to create structure from motion (SfM) digital elevation models (DEMs) and orthomosaic images to quantify impacts from the Cameron Peak Fire.

INTERNSHIP GOALS

The goal of this internship was to:

1. Gain experience as a commercial drone pilot
2. Support research by examining the impacts of the Cameron Peak Fire on the Cache la Poudre watershed
3. Enhance education through practical work experience flying UAVs in unique and remote environments

"Participating in this internship was essential for furthering my education in drone technology and remote sensing. I am more qualified, experienced, and confident in my abilities after participating in this work experience. "

FLIGHT PLANNING and OPERATIONS

Flight Planning:

Flight planning is the first step in acquiring aerial imagery. To create a flight plan in the Phantom 4 RTK system, you need a KML file of the flight area. These files were created in Google Earth and imported onto the Phantom 4 RTK controller.

Figure 1. Google Earth KML files of the Blue Lake study site were imported with a DEM into the RTK controller for flight planning.

Next, you must upload a digital elevation model of the flight area into the RTK controller to use Terrain Following Mode. Once you have the KMLs and the DEM imported, you can edit and save the flight parameters for each mission.

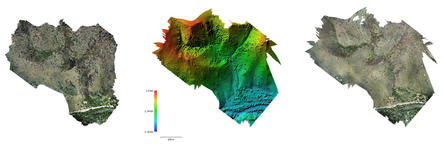
Flight Operations:

Flight operations require three primary components for collecting high-accuracy aerial imagery.

1. The base station (GPS receiver)
2. Remote Controller (transmitter)
3. Aircraft (rover)

The base station receives and corrects satellite signals during flights. The coordinates of the base station are entered into the controller to improve accuracy. The controller stores the flight plans and allows the pilot to use automated or manual controls during missions. The DJI Phantom 4 RTK aircraft is also equipped with an RTK positioning system and calculates its location relative to the base station. The three components work together to determine the horizontal and vertical location for each image captured. Accurate positional data is essential for SfM post-processing of aerial imagery to create DEMs and orthomosaic images. Aerial imagery is imported into Metashpae and filtered to create a Dense Point Cloud. This point cloud can then be processed into DEMs and Ortho images. Metashpae generates reports to provide detailed information about SfM products.

Figure 2. Post Processing Models | Dry Creek



Dense Point Cloud | Digital Elevation Model | Orthomosaic Image

Survey Data

Number of images:	939	Camera stations:	939
Flying altitude:	122 m	Tie points:	1,379,753
Ground resolution:	3.22 cm/pix	Projections:	6,784,751
Coverage area:	0.522 km²	Reprojection error:	0.252 pix

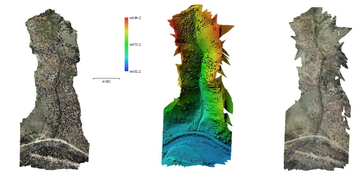
Camera Model	Resolution	Focal Length	Pixel Size	Precalibrated
FC6310R (8.8mm)	5472 x 3648	8.8 mm	2.41 x 2.41 µm	No

Table 1. Cameras

LEARNING OUTCOMES

- Safe and effective flight operations in high relief mountainous topography with a DJI Phantom 4 RTK aircraft
- Understanding and working with complex GPS and RTK systems
- Overcoming challenges in the field through cooperation and communication with a flight team
- Working for stakeholders including, the project mentors and the research group
- Post-processing techniques in Agisoft Metashpae and ArcGIS Pro

Figure 3. Post Processing Models | Washout Gulch



Dense Point Cloud | Digital Elevation Model | Orthomosaic Image

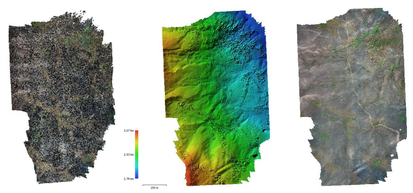
Survey Data

Number of images:	522	Camera stations:	522
Flying altitude:	119 m	Tie points:	877,223
Ground resolution:	3.1 cm/pix	Projections:	3,755,301
Coverage area:	0.302 km²	Reprojection error:	0.231 pix

Camera Model	Resolution	Focal Length	Pixel Size	Precalibrated
FC6310R (8.8mm)	5472 x 3648	8.8 mm	2.41 x 2.41 µm	No

Table 2. Cameras

Figure 4. Post Processing Models | Blue Lake



Dense Point Cloud | Digital Elevation Model | Orthomosaic Image

Survey Data

Number of images:	1,547	Camera stations:	1,534
Flying altitude:	128 m	Tie points:	1,273,815
Ground resolution:	3.5 cm/pix	Projections:	4,100,983
Coverage area:	1.05 km²	Reprojection error:	0.196 pix

Camera Model	Resolution	Focal Length	Pixel Size	Precalibrated
FC6310R (8.8mm)	5472 x 3648	8.8 mm	2.41 x 2.41 µm	No

Table 3. Cameras

NEXT STEPS

- Use ArcGIS Pro to filter points clouds of aerial imagery and create DEMs for study sites
- In ArcGIS Pro, create DEMs of Lidar imagery from these areas
- Difference Lidar results with drone imagery
- Learn to analyze and report on drone imagery models
- Train new pilots on this technology so that they can continue to support research on the Cameron Peak Fire using UAVs