UAV Remote Sensing Method for Extracting Feature Points of Aerial Photos After Fast Geolocation

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Abstract. With the rapid development of 3S and drone technology, the size of existing aerial data is getting larger and larger. Therefore, there is an urgent need for a method for quickly geo-locating feature points of aerial photographs. This article aims at the above situation through the following 5 steps to achieve: modify the name of aerial photos, unified aerial photos in a separate folder, extract aerial photo center latitude and longitude information, match aerial photos to the location of longitude and latitude information and identify the type of feature and mark. Finally, it was found that after positioning using the above steps of this method, subsequent operations will save more than 70\% of the time.

1. Introduction

Drone remote sensing is an efficient combination of drone and remote sensing technology\cite{1}, \cite{2}. Although remote sensing, geographic information systems, and global positioning systems (3S technology) have developed rapidly in recent years, traditional remote sensing technologies that rely solely on satellite platforms are greatly limited by objective reasons such as clouds and high costs. In addition, the traditional ecological field survey method has the disadvantages that many research sites are difficult to reach and the survey data are difficult to display visually. UAV remote sensing, with the flexibility, manoeuvrability and convenience of the UAV system, greatly compensates for satellite optical remote sensing susceptible to cloud interference, high price of high-scoring remote sensing products, and field surveys of traditional ecological samples. The shortcomings of legal data cannot be displayed intuitively, and UAV remote sensing can also easily obtain regional data that many researchers are not able to reach.

In summary, the importance of drone remote sensing technology has become increasingly prominent, but after acquiring aerial photos of drones, the amount of data is large or small. The process of geo-locating large-scale UAV remote sensing data, and then extracting feature points from geo-located aerial photos is extremely tedious and time-consuming. Although the feature points of aerial photos are one of the most important basic data for subsequent remote sensing inversion, the existing methods do not have an optimal result that saves time. Compared with the conventional visual interpretation and manual operation process, the purpose of this research method is to complete this...
process faster, and then to provide an effective way to save manpower, material resources and financial resources for large-scale UAV remote sensing processing technology method.

2. Research area summary

![Figure 1. Schematic diagram of aerial photography results of drones in Guizhou Province.](image)

The Guizhou Karst Plateau is in the eastern part of the Yunnan-Guizhou Plateau and is in the southwest of China. It is a unique unit with a large elevation gradient, complex geomorphological conditions, and extremely fragile ecological environments [3], [4]. Under the background of the widely distributed geological environment of carbonate rocks and the warm and humid monsoon climate, the elevation of the area rose from 90 m to 2,890 m, spanning 24 ° N ~ 29 ° N, 103 ° E ~ 109 ° E, and the total area is 1.76 × 105 km2. Among them, the exposed area of the karst landform accounted for 73%, belonging to the plateau mountainous area with the largest area and the strongest development in China and even the world's subtropical conical karst distribution area, as shown in Figure 1.

The remote sensing satellite data is Sentinel-2 data, including 2A and 2B satellites. The data were collected using multispectral imagers (MSI) on June 23, 2015 and March 07, 2017, respectively. Its flight height is 786km, which can cover 13 spectral bands with a width of 290 kilometres. The ground resolution is 10m, 20m, and 60m, the single revisit period is 10 days, and the revisit period after the two stars are complementary is 5 days. The satellite data contains visible light, near-infrared and short-wave infrared data, and there are three bands of data in the red edge range, which has obvious advantages in monitoring vegetation.

The drone data is obtained by DJI Elf series products. The drone is equipped with a 12-megapixel sensor, and the ground resolution varies depending on the flight height, from millimetre level to decimetre level.

UAV aerial photo collection uses the Frag MAP software [5] independently developed by the author team. Aerial photo processing uses PyCharm and ArcGIS software.
3. Research method
This method mainly involves 5 parts of work. First, modify the file name collected by Frag MAP software, and then place the modified aerial photos into a unified folder. The third step is to extract the central latitude and longitude information of all aerial photos. The four steps are to match the aerial photos to the position of the extracted latitude and longitude information, and the last step is to identify and mark the feature information.

3.1. Change of Aerial Photo Name

![Figure 2. Example of folder and file for aerial photo collection.](image)

After capturing with Frag MAP software, the aerial photos are in a folder named "flight". After each track setting of Frag MAP software, the newly collected aerial photos will be placed in the folder named "1,2, ..." on the left in Figure 2, where "1,2, ..." is the track number. An aerial photo of a trajectory is recorded in a folder, and the photo naming method is "DJI_0001.JPG, DJI_0002.JPG, ..." in the right figure of Figure 2. Due to the large amount of data in aerial photos, and the formatting after finishing the data each time, the newly generated drone aerial photos will continue to be named from "DJI_0001.JPG, DJI_0002.JPG, ...". Therefore, in order to distinguish each aerial photo, the name is modified, and it is implemented in PyCharm using the following code.

```python
import os
path = input ('Please enter a file path (end with /):')
# Get all files in this directory and save them in the list
f = os.listdir(path)
for i in f:
    # Set the old file name (path + file name)
    oldname = path + i
    # Set the new file name. The '1-' here needs to be modified for each folder name in the left figure of Figure 2. Use '1-' when performing the name modification operation with the name "1", and execute the name with "2" in the name change operation, and so on
    newname = path + '1-' + str(n + 1) + '.JPG'
    # Rename the file using the rename method in the os module
    os.rename(oldname, newname)
    print (oldname, '======>', newname)
    n += 1
```
The modified aerial photo name format is "track number-photo number.JPG". In the example shown in Figure 3, the aerial photo indicates that when the 162th track setting was taken, 16 unmanned tracks were collected. Aerial photo.

![Aerial Photo Example](image)

**Figure 3.** Example of modified aerial photo naming.

3.2. *Aerial photos are unified in separate folders*

Before locating the latitude and longitude information of the center point of the aerial photos, the aerial photos under all the tracks need to be copied to the same folder. Here, uses the following code to implement in PyCharm.

```python
import os
import shutil

def CreateDir(path):
    isExists = os.path.exists(path)
    # critical result
    if not isExists:
        # Create directory if it does not exist
        os.makedirs(path)
        print(path + 'Directory created successfully')
    else:
        # If the directory exists, do not create it, and prompt that the directory already exists
        print(path + 'directory already exists')

def CopyFile(filepath, newPath):
    # Get the file name in the current path and return List
    fileNames = os.listdir(filepath)
    for file in fileNames:
        # Add file name after the current file path
        newDir = filepath + '/' + file
        # If it is a file
        if os.path.isfile(newDir):
            print(newDir)
            newFile = newPath + file
            shutil.copyfile(newDir, newFile)
        # If it is not a file, recurse the path of this folder
        else:
            CopyFile(newDir, newPath)

if __name__ == '__main__':
    path = input("Input requires copying file directory:'")
```
# Create destination folder
mkPath = path + '/ total file /
CreateDir (mkPath)
CopyFile (path, mkPath)

After executing the above code, you will be prompted "Enter the file directory to be copied:" At this time, enter the "flight" folder and its directory. The execution result is that the aerial photos in all the track number folders will be finally summarized in the "flight" folder directory, under a folder named "total files".

3.3. Extract the longitude and latitude information of the aerial photo center
After the aerial photos are summarized, the Python command terminal of ArcGIS is used to extract the central latitude and longitude information of all aerial photos. The specific code is as follows.

```python
import arcpy
import math

# Enter the folder containing the drone photos
UAV_GIS_Points = "D:/ temp / flight / total folder"
# Create the required folder
arcpy. CreateFolder_management (UAV_GIS_Points, "SHP")
# Define directory
SHP_folder = UAV_GIS_Points + "/ SHP /"
photo_point = "in_memory / UAV_Points"
photo_point_UTM = SHP_folder + "UAV_Points.shp"
img_path = UAV_GIS_Points
# Define a field containing the coordinates of the center of the photo fields = ("SHAPE @ XY")
# Define MXD and data frame
mxd = arcpy. mapping. MapDocument ("current")
df = arcpy. mapping. ListDataFrames (mxd) [0]
# Set geographic coordinates
out_coordinate_system = arcpy. SpatialReference ("WGS 1984 UTM Zone 48N")
df. Spatial Reference = out_coordinate_system
# Create Drone Photo Center Point
arcpy. GeoTagged Photos to Points_management (UAV_GIS_Points, photo_point, ",", "ONLY_GEOTAGGED", "ADD_ATTACHMENT")
arcpy. Project_management (photo_point, photo_point_UTM, out_coordinate_system)

After the execution, a new folder named "SHP" will be created in the "General folder" under the "flight" folder directory. The "UAV_Points.shp" file in this folder contains the center of all aerial photos Latitude and longitude information data. This example extracts the longitude and latitude information of the center points of all aerial photos. The result is shown in Figure 1, which includes 11,320 aerial photos under 420 tracks.

3.4. Match aerial photos to the position of latitude and longitude information
After obtaining the central latitude and longitude information of aerial photos, the remaining steps are completed in ArcGIS. First, when completing the steps of matching aerial photos to the position of latitude and longitude information, you need to load the previously generated "UAV_Points.shp" file and satellite image of the research area in ArcGIS software (this example uses Sentinel-2 satellite data from Guiyang City). For the sample) and ArcGIS comes with a high-definition basemap, as shown in Figure 4.
Figure 4. ArcGIS loads the "UAV_Points.shp" file, the satellite image of the research area, and the effect of the built-in HD basemap (blue highlights are the latitude and longitude points in the center of the drone aerial photos to be matched).

Figure 5. Schematic of the center point of the track and aerial photos.

Use the tools in ArcGIS to zoom to the current screen (as shown in the left image of Figure 5, the background map is Sentinel-2). Each aerial photo has its own name (defined by the naming rules in 2.1), as shown in Figure 5. The example shows that the aerial photos in this part are 16 photos in the 103rd track. Continue to zoom in to a certain photo area (take 103-8 points as an example), as shown in the right image of Figure 5 (the background basemap is ArcGIS's own HD basemap).

Then add a 103-8 aerial photo in ArcGIS, click the Georeferencing tool in ArcGIS, set the operation layer in the toolbar to 103-8.JPG, and click Fit to Display. The 103-8 aerial photo will be displayed in the current area, such as Figure 6 shows the left picture. After completing the above operations, click the auto-calibration tool in the Georeferencing toolbar. If there is better quality satellite remote sensing data, the geographic correction of the aerial photo will be completed automatically. The built-in HD basemap and Sentinel-2 satellite imagery of ArcGIS are difficult to perform the automatic geographic correction process, and there will be error prompts. At this time, we need to set the correction point automatically, as shown in the right figure of Figure 6. Generally, after setting 3 to 5 correction points, aerial photos can meet the needs. In this example, four calibration points are set (as shown in the yellow circle on the right in Figure 6), and the three roads after registration are basically registered on the base map (as shown in the red circle on the right in Figure 6).
The above process is to match the aerial photos to the position of the latitude and longitude information. At this time, the geographic correction of the sample aerial photos is completed.

3.5. Identifying and labelling features
After completing the geographic correction of all aerial photos, you can use the aerial photos as a reference to identify the feature types on the satellite image map (Sentinel-2 in this example) and complete the marking at the same time. Here we take 103-8.JPG and 103-9.JPG as examples to show some operations.

First create a point layer file (that is, a point file in a ship type file) in ArcGIS, and then use this newly created point layer file to create different identifiable points and assign values according to different feature types to complete Feature type identification and marking. The aerial photo in the upper left of Figure 7 can be used as a reference to complete the identification and marking of the types of features in the building area in the purple circle in the upper right of Sentinel-2 in Figure 7. It should be noted that when the feature types in the red circle shown in the bottom left aerial picture in Figure 7 are inconsistent with the feature types in the lower right Sentinel-2 figure 7, it is necessary to identify and mark the feature type according to the situation.

4. Summary
There are 11,320 aerial photos in this example. If there are so many aerial photos, if you manually find the latitude and longitude information one by one, and match them to the remote sensing image after
visual inspection, it will be an extremely tedious process. Later, subsequent operations will save more than 70% of the time.

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