CHAPTER III
MATERIAL AND METHODOLOGY

The study divided into 3 parts: Part 1) the use of materials, equipment and software, Part 2) Aerial Photography Accessing and Part 3) Processing and Analysis to assess the accuracy in identifying landscape and photo accountability level. The details are being presented as follows

Part 1 Equipment and software

3.1 Equipment and software

Equipment, hardware and software used in the study are as follows.

1) Airplane model The SKY Airplane for UAV, FPV
   - Wingspan 1.68 m. Length 1.18 m.
2) GPS model Garmin Oregon 550t
3) Radio Control model Futaba T10 CHP 72 MHz.
4) Personal computer : Windows XP Home editor
   - CPU Intel® Core™ 2 CPU 1.67 GHz
   - Ram 1 GB
   - Hard disk 160 GB
5) GIS software ArcGIS 9.2 and Erdas Imagine 9.1
6) A camera model Sony Bloggie Touch
   - Resolution 12.8 Million pixels. Lens f 2.8 - 5.3
7) Satellite imagery
   - GeoEye (Acquisition Date/Time: 13/06/2010)
     Resolution MS: 1.65 m.

Part 2 Aerial Photography Accessing

Successful execution of any photogrammetric project requires that thorough planning be done prior to proceeding with the work. Planning, more than any other area of photogrammetric practice, must be performed by knowledgeable and experience persons who are familiar with all aspects of the subject.

3.2 Importance of Flight Planning

Because the ultimate success of any photogrammetric project probably more upon good-quality photography than on any other aspect, planning the aerial photography, also called flight planning, is of major concern. If the photography is to satisfactorily serve its intended purposes, the photographic mission must be carefully planned and faithfully executed according to the "flight plan." A flight plan generally consists of two items: a flight map, which shows where the photos are to be taken; and specifications, which outline how to take them, including specific requirement such as camera and film requirement, scale, flying height, end lap, side lap, and tilt and crab tolerances. A flight plan which gives optimum specifications for a project can be prepared only after careful consideration of all the many variables which influence aerial photography.

An aerial photographic mission is an expensive operation involving two or more crewpersons and high-priced aircraft and equipment. It addition, periods of time that are acceptable for aerial photography are quite limited in many areas by weather and ground cover conditions, which are related to seasons of the year. Failure to obtain satisfactory photography on a flight mission not only necessitates costly reflights, but also in all probability will cause long and expensive delays on the project for which the photos were ordered. For these reasons flight planning is one of the most important operations in the overall photogrammetric project.

3.3 Photographic End Lap and Side Lap

Before discussing the many aspects which enter into consideration in planning an aerial photographic mission, it will be helpful to redefine the terms end lap and side lap. As illustrated in Fig. 3.1, end lap is the overlapping of adjacent flight strips.

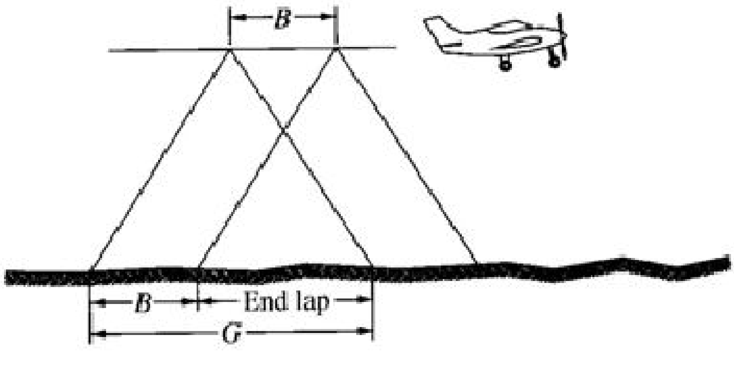
In Fig. 3.1, G represents the dimension of the square of ground covered by a single vertical photograph (assuming level ground and square camera focal-plane format), and B is the air base or distance between exposure stations of a stereopair. The amount of end lap of a stereopair is commonly given in percent. Expressed in terms of G and B, it is

$$PE = \frac{G-B}{G} \times 100 \quad (3\text{-}1)$$

Where PE = percent end lap

G = dimension of the square of ground covered by a single vertical photograph

B = distance between exposure stations of a stereopair



Normally taken as 60%

Figure 3.1 End lap, the overlapping of successive photos along a flight strip
Source: [9]

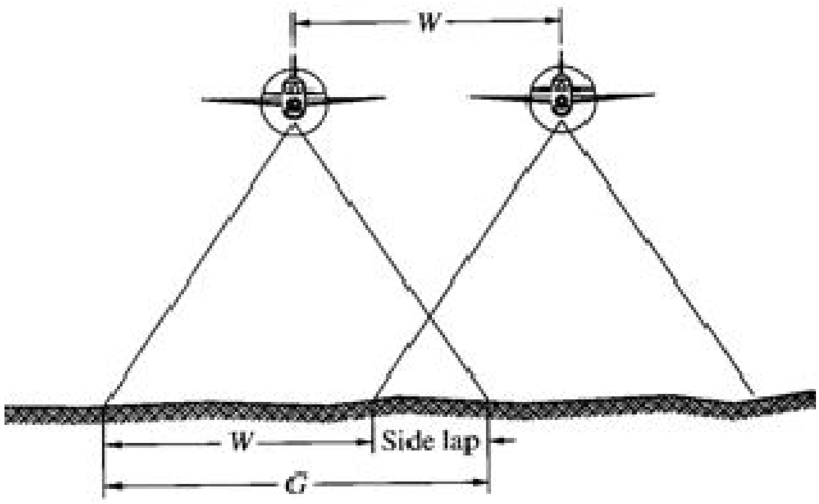
In Fig. 3.2, G represents the dimension of the square of ground covered of a single vertical photograph, and W is the spacing between adjacent flight lines. An expression for PS in term of G and W

$$\mathrm{PS} = \frac{\mathrm{G-W}}{\mathrm{G}} \times 100 \qquad (3\text{-}2)$$

Where PS = percent side lap

G = dimension of the square of ground covered of a single vertical photograph

W = the spacing between adjacent flight lines



Normally about 30%

Figure 3.2 Side lap, the overlapping of adjacent flight strips

Source: [9]

3.4 Flying height

Once the camera focal length and required average photo scale have been selected, required flying height above average ground is automatically fixed in accordance with scale.

$$S = \frac{f}{H - h_{avg}} \quad (3\text{-}4)$$

Where S = photo scale

f = the camera focal length

H = flying height above ground

H_{avg} = average scale if the flying height above mean sea level

3.5 Average Photo scale

It is often convenient and desirable to use an average scale to define the overall mean scale of a vertical photograph taken over variable terrain. Average scale is the scale at the average elevation of the terrain covered by a particular photograph and is expressed as

$$S_{avg} = \frac{f}{H - h_{avg}} \quad (3\text{-}3)$$

Where S_{avg} = average photo scale

f = the camera focal length

H = flying height above ground

H_{avg} = average scale if the flying height above mean sea level

When an average scale is used, it must be understood that it is exact only at those points that lie at average elevation and it is an approximate scale for all other areas of the photograph.

3.6 Specifications

Most flight plans include a set of detailed specifications which outline the materials, equipment, and procedures to be used on the project. These specifications include requirement and tolerances pertaining to photographic scale (including camera focal length and flying height), end lap, side lap, tilt, crab, and photographic quality.

Part 3 Processing and Analysis

The comparison and analysis process started as soon as the taking of photography by unmanned aerial vehicle completed. Raw materials from the photo were used for Geometric Correction to make the proportion; figure and shape even as well as identify the ratio of picture before making comparison and finding the almost perfect agreement of the photography

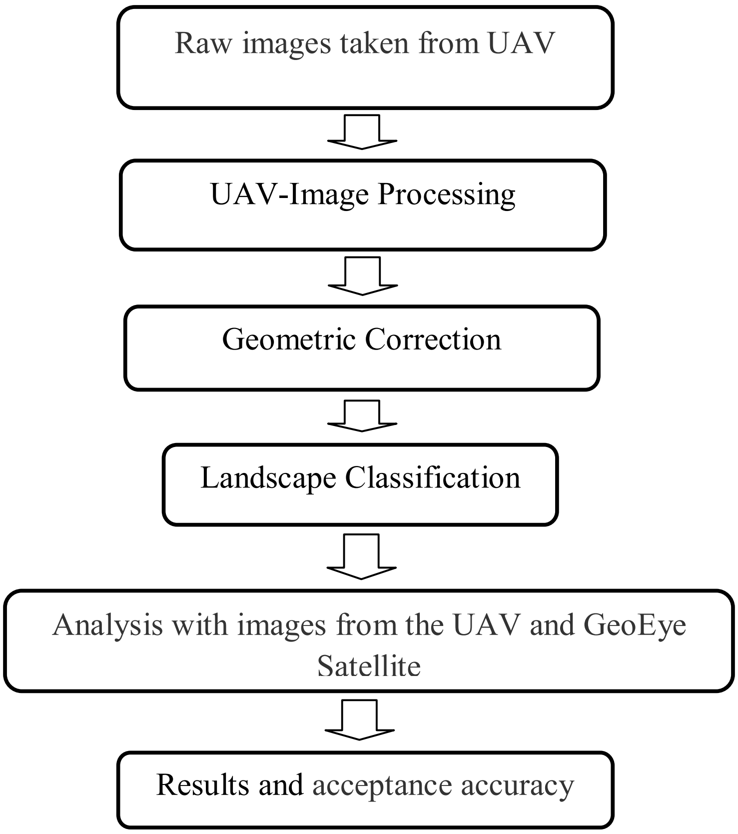


Figure 3.3 Step of processing and analysis

3.7 Raw data from Unmanned Aerial Vehicle

Raw data from unmanned aerial vehicle are regular photographs which obtained in large numbers on each flight depending on the objective of such project or mission. Because of large numbers of data, it is easy to get confuse in the mosaic process which could be the main reason why good recording in each flight is crucial, such as the coordinate, topography, flight direction, outstanding points, date and time crucial taking the photographs. These data would eliminate the confusion caused by having the massive data and the picture could be arranged easily with accuracy when doing together with the written record.

3.8 Geometric Correction

Geometric correction to change the geographic coordinate system of satellite images to meet the standard system (UTM zone 47 referred on WGS 1984 Horizontal Base) and to have the image to map correction. Principles of Geometric correction relationship between the coordinate system information to be rectified image with the geographical coordinates of the references image. In this study Geometric correct a data correction is a photo of unmanned aerial vehicle rectified base on GeoEye satellite as reference image.

3.9 Classification

The classification using visual interpretation to help decide on the data classification that is the data was classified by digitizing and saving the data in the vector format. This study was define type of landscape classification for appropriate data and determining the landscape according to the type of Land use level 3 (Department of Land Development in 2009) such as bicycle land, building, car park, green area, road, walking side, water source, sport and other area.

3.10 Accuracy Assessment

3.10.1 Purposive Sampling

The researcher was randomly selected using random selection in consideration of the researcher, based on 9 categories of classification by the number of sampling points average. Type classification 9 points in each classification to be represented in this study.

3.10.2 Accuracy Assessment in determining the landscape areas was done by the error matrix to find the overall accuracy, which was calculated by accuracy assessment with the following equation:

$$\text{Overall Accuracy} = \frac{\text{sum of major diagonal tallies}}{\text{total number of samples}} \times 100 \qquad (3\text{-}5)$$

3.10.3 Kappa index was used to calculate corrections from changes in numerical checking techniques. The correct point values on the oblique side of the created deviation table were calculated with the total result in columns and rows as per the following equation:

$$\hat{K} = \frac{N \sum_{i=1}^{k} x_{ii} - \sum^{k} (x_{i+} \times X_{+1})}{N^2 - \sum_{i=1}^{k} (X_{i+} \times X_{+1})} \qquad (3\text{-}6)$$

Where $\hat{K}$ = Points in rows or types of land utilization and land cover

X_{ii} = Oblique points in of Row i and Column i

X_{i+} = All points in Row i

X_{+I} = All points in Column i

N = Total points

The Kappa statistic measures the degree of agreement between the variables above that expected by chance alone. It has a maximum of 1 when agreement is perfect, 0 when agreement is no better than chance, and negative values when agreement is worse than chance. Other values can be roughly interpreted as:

Kappa value	Degree of agreement
<=0	Poor
0.01 - 0.20	Slight
0.21 - 0.40	Fair
0.41 - 0.60	Moderate
0.61 - 0.80	Substantial
0.81 – 0.99	Almost perfect