The Center
for
Photogrammetric Training

1 INTRODUCTION TO PHOTOGRAMMETRY

Introduction

Photogrammetry is the art and science of extracting meaningful information about objects and phenomenon from imagery, either in analog or digital form, and other spatial measurement systems like laser and radar data. It is generally perceived as making measurements on photographs. It has been used for many years in mapping applications throughout the world. It provides an accurate and cost-effective alternative to conventional ground surveying techniques.

If one looks to a definition of surveying, it may state that surveying is the art and science of making measurements on, below, or above the surface of the earth. In this context, photogrammetry is a branch of surveying. Indeed, one can argue that photogrammetry, at one level, is a tool just like a global positioning system (GPS) receiver or a total station.

Besides conventional mapping, photogrammetry has been used for many different scientific tasks. It is an ideal technology when measuring features and phenomenon that are inaccessible for one reason or another. Additionally, the object to be measured may be too hot or cold, too soft or fragile, or too dangerous to measure my conventional means.

Role of Photogrammetry in a GIS

One area of geomatics that has had a major impact on the photogrammetry and remote sensing industry/profession has been the development of geographic information systems (GIS). A GIS is an information system designed to provide the decision maker with the most current, accurate and complete data about phenomenon or events within an area. This is referred to as geoinformation when these events and phenomenon contain a spatial reference. There is growing importance in this technology as more and more decisions are made based upon this data. It is a part of the national, and in some cases international, infrastructure in an information society [Heipke, 2004].

The complexity of a GIS when compared to conventional information systems lies in the fact that we deal with geo-objects, which are objects that have a spatial and even temporal component. As Heipke [2004] points out, these objects are complex in that each has its own identity and can be described by different geometric, thematic, radiometric and temporal attributes. Furthermore, objects are controlled by both topological and geometrical relationships.

Heipke [2004] describes four major requirements for a modern geographic information system. Each of them draws heavily from photogrammetry and remote sensing in order to provide the system with the data needed to meet the user needs. These requirements are:

1. The data should be topologically-based that uses an object model to define the features. It must also be able to accommodate changes in the data and to convey that change using multiple presentations. There are a couple of key issues in this requirement important from a photogrammetry and remote sensing point of view. First, topology pertains to relationships that exist between the data and many of these relationships are easily recognized and measured within imagery. The second issue is the method of describing the geospatial data. Two methods exist as described by Heipke [2004]: field-based and object based models. A field-based model consists of collecting continuous data over an area, such as contours. Normally, a digital terrain model (DTM) or digital elevation model (DEM) is obtained by observing the elevation, as an example, at discrete points over the site from which contours are derived using some type of interpolation process. The object based model will locate features and their attributes and then them into groups like roads, trees, buildings, etc. Imagery thus represents the major form of data acquisition within a GIS. In fact, Heipke [2004] has identified the role of imagery within a GIS as:

    a. Imagery is the prime means of geospatial data acquisition.
    b. Imagery is the ideal medium to use as a base or backdrop upon which map data can be overlaid to facilitate the user's understanding of the GIS data.
    c. As 3-D rendering increases, imagery is critical in providing a more realistic rendition of the conditions found at this site.

   A third issue relates to the handling of change within an area. It is a well-documented fact that the geospatial data represents a major cost in GIS development and that this data needs to be maintained in order for the GIS to remain useful. Imagery is one of a number of strategies that can be used to monitor and assess change. A picture is s snapshot of what existed at an instant in time and thus images can be used as a base from which change can be monitored. Of course, there are also a number of other types of strategies that we utilize in the data maintenance area.

2. Modern geographic information systems need to incorporate imagery within their software system and to provide the user with the tools to acquire data from the imagery and process that data as necessary. At one time, photogrammetry and remote sensing, and to some extent even GIS, were considered as separate disciplines. But today that paradigm is no longer valid and the boundaries used to define the extent of these fields are blurred. In fact, modern data acquisition involved the integration of a number of technologies including imagery (multi-temporal, multi-spectral, and multi-sensor), global positioning system positioning, inertial navigation, and collateral data contained in other geospatial databases.

3. The workflow needs to be improved such that updating can be performed more efficiently through automation. Additionally, versioning needs to be incorporated in order to monitor change as it occurs over time. As we have seen, maintaining currency within the data is critical in the life cycle of a GIS. The goal is to be able to detect change, capture the data that describes this change and update the database in an automated fashion. While automation has begun to increase our productivity in this area, there is still a lot of work to be accomplished.

4. There is a need for integration within our systems. Heipke [2004] talks about data integration or data fusion but integration also involves the means by which data are collected. Data fusion is a major problem because these data sets may employ different sensors, were produced for different purposes, and may contain data at different resolutions or accuracy levels. The goals, as Heipke [2004] points out, are:

   - being able to import data from one dataset to another from which useful information can be obtained,
   - to be able to derive new thematic information by integrating two different datasets, and
   - to automatically assess the quality of the data, make corrections to the data when necessary and to improve the overall quality of the database.

   The other issue with integration is the bringing together of different data collection tools into a single system. There are many examples of this, one being laser scanning or lidar. Here, data are collected from GPS receivers, an inertial measurement unit and a laser scanner to obtain, as an example, terrain elevation data for a DTM. Our understanding of how each component works is essential in ascertaining the accuracy of the data. Equally important is to assess how the components work together as a system.

From this discussion, it is fairly evident that imagery collected for photogrammetry and remote sensing applications will continue to play an important and critical role in the development and enhancement of geographic information systems.

References

Heipke, C., 2004. "Some Requirements for Geographic Information Systems: A Photogrammetric Point of View", Photogrammetric Engineering and Remote Sensing, 70(2): 185-195.