Remote sensing

Unit 3

Photo interpretation element

Image interpretation (in this case aerial photo interpretation) is the most basic form of analysis, consisting of manual identification of features in a remote sensing image through visual interpretation. Image interpretation is based on elements that are inherent in imagery.

Shape

Shape is the general form or outline of objects. The shape of objects or features can provide information that can aid in identification. Regular geometric shapes and straight edges are usually signs of human presence.

Tone/Color

Tone (the variation from white to black) or color is the relative brightness or color of elements in a photograph. May factors influence the tone or color of features, include the spectral properties of objects as well as the direction of illumination. For example, tone or color can be used to distinguish deciduous from coniferous tree in infrared photography.

Size

The size of objects depends on the scale of the photograph, may need to use surrounding objects or known objects to help determine scale. The relative sizes among objects in an image can be considered.

Texture

The “smoothness" or "roughness" of image features is caused by the frequency of change of tone in photographs. Calm water has a smooth texture; a forest canopy has a rough texture

Association/Site

Context can often can help identify objects. Features can often be identified by associating the presence of one object with another, or relating it to its environment. How objects are arranged with respect to one another; or with respect to various terrain features, can also aid in interpretation.

Pattern

Pattern is the spatial arrangement of objects, they can be natural or man-made. The repetition of certain forms is distinct for many features. For example the ordered spatial arrangement of trees in an orchard is distinct from that of a natural forest stand.

Shadow

Shadows can useful in identifying objects that may otherwise be difficult to recognize. Shadows can provide information about object's height, shape, and orientation.

Mosaics

A mosaic is a combination or merge of two or more images. In ArcGIS, you can create a single raster dataset from multiple raster datasets by mosaicking them together. Alternatively, you can create a mosaic dataset and create a virtual mosaic from a collection of raster datasets.

Controlled and uncontrolled mosaics

Mosaic composed of uncorrected photographs, the details of which have been matched from print to print, without ground control or other orientation. Accu rate measurement and direction cannot be accomplished. See also controlled mosaic. An assemblage of aerial photographs whose edges have usually been cut and matched to form a continuous photographic representation of the particular area is called a mosaic. If this assemblage is made without any control, then it is called uncontrolled mosaic. If, before being laid, the prints have been properly rectified, i.e., enlarged or reduced and fitted on adequate ground control, i.e., to fit pre-determined locations of certain important features, the mosaic is said to be a controlled mosaic.

The controlled mosaic, though more accurate, retains the changes in scale and displacements due to differences in relief within the individual prints. A contoured mosaic shows the relief by means of contours, and may be either controlled or uncontrolled. A semi controlled mosaic may be prepared from unrectified photograph assembled to have ground control; alternatively rectified photographs may be used with no ground control. Semi-controlled mosaics are a compromise between economy and accuracy.

Advantages and disadvantages

Image mosaic is a technique that combines several images with overlapping parts (the images may be obtained at different times, different viewing angles or by different sensors) into a large-scale seamless high-resolution image.

One hundred fifty ground farmland remote sensing images collected by UAV are used as experimental splicing objects, and the image splicing is completed by the global stitching strategy optimized by Levenberg-Marquardt (L-M). Experiments show that the strategy can effectively reduce the influence of cumulative errors and achieve automatic panoramic mosaic of the survey area.

The remote sensing technology of unmanned aerial vehicle (UAV) is a low altitude remote sensing technology. The technology has been widely used in military, agricultural, medical, geographical mapping, and other fields by virtue of the advantages of fast acquisition, high resolution, low cost, and good security. But limited by the flying height of UAV and the focal length of the digital camera, the single image obtained by the UAV is difficult to form the overall cognition of the ground farmland area. In order to further expand the field of view, it is necessary to mosaic multiple single images acquired by UAV into a complete panoramic image of the farmland. In this paper, aiming at the problem of UAV low-altitude remote sensing image splicing, an image mosaic technique based on Speed Up Robust Feature (SURF) is introduced to achieve rapid image splicing. One hundred fifty ground farmland remote sensing images collected by UAV are used as experimental splicing objects, and the image splicing is completed by the global stitching strategy optimized by Levenberg-Marquardt (L-M).

Application of mosaic in geology studies

We've developed a logging tool that automates the interpretation of different rock types in drillcore to enable rapid and reliable geological logging. The result is faster logging and more accurate 3D geological models. Three-dimensional (3D) geological models are needed for minerals exploration and to plan for mining below the surface. These 3D models show the predicted geometry and distribution of different rock types.

To create them, geologists traditionally relied on manual logging of drill samples and lab assay results. Working through this process to create a single model is time consuming, with the accuracy of the result dependent on the experience of the geologist.

With the development of a plethora of new measurement sensors delivering greater levels of data, CSIRO mathematical geologist, June Hill, says mining companies soon found "they had a whole lot of numbers instead of rock types".

What was needed was a solution that delivered more objective results and could speed up the 3D model building process.

Data Mosaic allows a geologist to model rock types on a broad scale and then zero down to finer scale details in areas of interest.

Satellite remote sensing

These **remote sensing satellites** are equipped with sensors looking down to the earth. They are the "eyes in the sky" constantly observing the earth as they go round in predictable **orbits**. In satellite remote sensing of the earth, the sensors are looking through a layer of **atmosphere** separating the sensors from the Earth's surface being observed. Hence, it is essential to understand the effects of atmosphere on the electromagnetic radiation travelling from the Earth to the sensor through the atmosphere. The **atmospheric constituents** cause wavelength dependent **absorption** and **scattering** of radiation. These **effects** degrade the quality of images. Some of the atmospheric effects can be corrected before the images are subjected to further analysis and interpretation.

Optical remote sensing

In Optical Remote Sensing, optical sensors detect solar radiation reflected or scattered from the earth, forming images resembling photographs taken by a camera high up in space. The wavelength region usually extends from the visible and near infrared (commonly abbreviated as VNIR) to the short-wave infrared (SWIR). Different materials such as water, soil, vegetation, buildings and roads reflect visible and infrared light in different ways. They have different colours and brightness when seen under the sun. The interpretation of optical images require the knowledge of the spectral reflectance signatures of the various materials (natural or man-made) covering the surface of the earth. There are also infrared sensors measuring the thermal infrared radiation emitted from the earth, from which the land or sea surface temperature can be derived.

Satellite orbiting mechanisms

The path of satellite revolving around the earth is known as **orbit**. This path can be represented with mathematical notations. Orbital mechanics is the study of the motion of the satellites that are present in orbits.

A satellite, when it revolves around the earth, it undergoes a pulling force from the sun and the moon due to their gravitational forces. This force is known as **Centrifugal force** (F_2) because this force tends the satellite away from earth.

1.general a satellite is a smaller object that revolves around a larger object in space.For eg : moon is a natural satellite of Earth.

2.Souiet onion had launched the worlds 1st artificial satellite named Sputnik 1 in 1957.

3.Nearly after 18 years , india also launched the Artificial satellite named , Aryabhata in 1975.

Multiple spectral scanning

The Multispectral Scanner System (MSS) sensors were line scanning devices observing the Earth perpendicular to the orbital track. The cross-track scanning was accomplished by an oscillating mirror; six lines were scanned simultaneously in each of the four spectral bands for each mirror sweep. The forward motion of the satellite provided the along-track scan line progression.

The first five Landsats carried the MSS sensor which responded to Earth-reflected sunlight in four spectral bands. Landsat 3 carried an MSS sensor with an additional band, designated band 8, that responded to thermal (heat) infrared radiation.

The scan monitor sensor ensures that the cross-track optical scan is 185 km at nominal altitude regardless of mirror scan nonlinearity or other perturbations of mirror velocity.

Cross- track image velocity was nominally 6.82 meters per microsecond. After 9.958 microseconds, the 83 by 83 meter image has moved 67.9 meters. The sample taken at this instant represented 15 meters of previous information and 68 meters of new information.

Along track and across track scanning

There are two main modes or methods of scanning employed to acquire multispectral image data - across-track scanning, and along-track scanning.

Across-track scanners scan the Earth in a series of lines. The lines are oriented perpendicular to the direction of motion of the sensor platform (i.e. across the swath). Each line is scanned from one side of the sensor to the other, using a rotating mirror (A). As the platform moves forward over the Earth, successive scans build up a two-dimensional image of the Earth´s surface. The incoming reflected or emitted radiation is separated into several spectral components that are detected independently. The UV, visible, near-infrared, and thermal radiation are dispersed into their constituent wavelengths. A bank of internal detectors (B), each sensitive to a specific range of wavelengths, detects and measures the energy for each spectral band and then, as an electrical signal, they are converted to digital data and recorded for subsequent computer processing.

Along-track scanners also use the forward motion of the platform to record successive scan lines and build up a two-dimensional image, perpendicular to the flight direction. However, instead of a scanning mirror, they use a linear array of detectors (A) located at the focal plane of the image (B) formed by lens systems (C), which are "pushed" along in the flight track direction (i.e. along track). These systems are also referred to as pushbroom scanners, as the motion of the detector array is analogous to the bristles of a broom being pushed along a floor. Each individual detector measures the energy for a single ground resolution cell (D) and thus the size and IFOV of the detectors determines the spatial resolution of the system. A separate linear array is required to measure each spectral band or channel. For each scan line, the energy detected by each detector of each linear array is sampled electronically and digitally recorded.

Types of resolution

There are 3 types of resolutions available to limited company shareholders:

- Ordinary resolutions – Passed by a simple majority (above 50%) of shareholders' votes. Members cast their votes on a show of hands or poll. Used for all types of decisions, unless the Companies Act, the articles of association, and/or a shareholders' agreement stipulates the need for a special resolution. The majority of ordinary resolutions must be filed with Companies House.
- Special resolutions – Passed by a 75% majority of shareholders' votes at a general meeting. Members cast their votes on a show of hands or poll. Used for extraordinary business decisions that cannot be passed by an ordinary resolution.
- Written resolutions – Used when a general meeting is not required to pass an ordinary resolution or special resolution. Any written ordinary resolution must be passed by a simple majority of shareholders' votes. Written special resolutions require a 75% majority vote. Shareholders cast their votes by signing the written resolution (if it is distributed on paper) or indicating their decision via email or online (if it is distributed by email on on a website).

Data acquisition

Data acquisition is the process of sampling signals that measure real world physical conditions and converting the resulting samples into digital numeric values that can be manipulated by a computer. Data acquisition systems, abbreviated by the initialisms *DAS, DAQ,* or *DAU,* typically convert analog waveforms into digital values for processing. The components of data acquisition systems include:

- Sensors, to convert physical parameters to electrical signals.
- Signal conditioning circuitry, to convert sensor signals into a form that can be converted to digital values.

- Analog-to-digital converters, to convert conditioned sensor signals to digital values.

Data acquisition applications are usually controlled by software programs developed using various general purpose programming languages such as Assembly, BASIC, C, C++, C#, Fortran, Java, LabVIEW, Lisp, Pascal, etc. Stand-alone data acquisition systems are often called data loggers.

There are also open-source software packages providing all the necessary tools to acquire data from different, typically specific, hardware equipment. These tools come from the scientific community where complex experiment requires fast, flexible and adaptable software. Those packages are usually custom fit but more general DAQ packages like the Maximum Integrated Data Acquisition System can be easily tailored and is used in several physics experiments worldwide.

Data interpretation

Data interpretation is the process of reviewing data through some predefined processes which will help assign some meaning to the data and arrive at a relevant conclusion. It involves taking the result of data analysis, making inferences on the relations studied, and using them to conclude.

Therefore, before one can talk about interpreting data, they need to be analyzed first. What then, is data analysis?

Data analysis is the process of ordering, categorizing, manipulating, and summarizing data to obtain answers to research questions. It is usually the first step taken towards data interpretation.

It is evident that the interpretation of data is very important, and as such needs to be done properly. Therefore, researchers have identified some data interpretation methods to aid this process.

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