A New Quick View Retrieval Method for GF-6 Remote Sensing Images

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Abstract. As of November 3, 2019, all seven satellites for project of the high-resolution earth observation system have been launched. We have ushered in an era of massive remote sensing data. When we do large-scale forest land mapping, such as national and provincial scale, we need to retrieve images that meet the image quality requirements, are as cloudless as possible, cover the research area, and have as few images as possible. The conventional practice is that the application unit searches the web page provided by the remote sensing data provider for the remote sensing data it needs, and orders to obtain the data. It is often time-consuming and laborious to query data that meet the needs. This paper puts forward a new selection process method of GF-6, GF-1 and GF-2 satellite data. This is a step-by-step method. First, the cloud coverage, time and area are selected according to the metadatas provided by the data provider to meet the requirements. Then, according to the image quality and cloud amount set by the program, it is selected again. Finally, in this image set, the final selected image is given according to the requirements of maximum coverage of the research area and minimum overlap of the image itself. The method can greatly save the time for manually selecting images and improve the working efficiency. This paper designs a program, which can be used conveniently by users. The paper introduces the idea of program design in detail.

1. Introduction

China has implemented the project of the high-resolution earth observation system. As of November 3, 2019, all seven satellites in the civil field have been successfully launched. The application department of government has a large amount of remote sensing data that can be used for its own professional application. The challenge of remote sensing application in the era of big data is that the available remote sensing data may no longer be in short supply, but it still takes some time to select the remote sensing images that really meet the needs, and even, as the amount of data increases exponentially, the human workload will double. In the past, some workflows in the era of data scarcity could not adapt to the application of big data remote sensing.

In this paper, a new method of remote sensing data retrieval is proposed, which is oriented to application classification and mapping and implemented step by step and has general significance. This paper takes Gaofen(GF)-6 remote sensing image retrieval as an example to illustrate the workflow. In order to increase usability, our program also supports GF-1 and GF-2 remote sensing images at the same time, which makes joint image data selection possible when applied. This paper first briefly introduces GF-6, GF-1 and GF-2 satellite data, and then gives the algorithm flow. In the
implementation part, we described the programming process in detail. Finally, the difference between our program and the existing research methods is given.

2. Data
GF-1 is equipped with two 2-meter spatial resolution panchromatic and 8-meter spatial resolution multispectral cameras and four 16-meter spatial resolution multispectral wide cameras. GF-2 carries two high-resolution 1-meter panchromatic and 4-meter multispectral cameras with sub-meter spatial resolution. GF-6 is an optical satellite similar to the GF-1 satellite, but using a different instrument suit, consisting of a 2/8 m resolution panchromatic/hyperspectral camera with an image swath of greater than 90 km and a 16 m resolution wide angle camera with an 800 km image swath. Both cameras use a three-mirror anastigmat telescope. Both covers visible light to NIR bands (wavelength 450-900 nm). Data of GF-6, GF-1 and GF-2 have great application potential in forest land mapping, forest type classification and other fields.

3. Method
The conventional remote sensing data retrieval method is a quick view based on information such as sensors, imaging time of images, selected areas, cloud cover, etc. Users can select images covering the selected areas through visual interpretation.[1-3] There are two common problems here. One is that the cloud amount in the image metadata is not accurately judged, and the actual cloud amount of the image exceeds the value in the metadata. Even if such an image is selected, the user will finally discard it. Another problem is that some of the images after the primary election may be repeatedly covered for the selected area, and the user only wants the smallest set of images that can cover the research area as much as possible.

In order to solve the above problems, this paper adds two steps after the conventional data retrieval steps. Conventional data retrieval method is to select data according to sensors, spatial range, time range and cloud amount provided by metadata. After that, the image quality and cloud cover judgment index developed by the authors are used to screen the fast view again. Last, an alternative image is further selected according to the maximum coverage of the image coverage research area and the minimum overlap between the images.

The overall step-by-step algorithm flow is shown in the figure 1. Please refer to 3.2 and 3.3 of [4]

![Diagram](image-url)

**Figure 1. Workflow of GF-6 data retrieval method**

for a detailed description of GF-6 fast view image quality and cloud cover judgment and screening method proposed by this algorithm, which will not be described in detail in this paper.

This paper gives the algorithm of the last step of the method. Each quick view can be viewed as a small rectangle. The spatial selection area can be viewed as a large rectangle. The overlap of every two fast views, i.e. two small rectangles, is well calculated. The overlapping degree of multiple fast views, that is, two or more small rectangles, can be calculated in the same way. The calculation method of the overlap between the selected fast view and the spatial selection area is as follows: select the small rectangle and intersect with the large rectangle area first, then divide by the large rectangle area.

How to select the images which the maximum coverage of the research area and the minimum overlap between the images. First, let each small rectangle intersect with the large rectangle area,
record the coverage value, and record the overlapping degree of the selected small rectangles. Then let every two small rectangles intersect with the large rectangle area, record the coverage value, and record the overlap degree of each group of selected rectangles. Until finally all the small rectangles and the large rectangle areas are intersected, the coverage value is recorded, and the overlapping degree of the selected small rectangles is recorded at the same time. According to the order of coverage values and overlap degrees, first select the scheme with the largest coverage value, then select the scheme with the smallest overlap degree, and record the corresponding small rectangle numbers.

4. Results and Discussions
The program of the above algorithm is implemented by C# program framework. The program is presented in the form of a combination of a client and a web service, and the calculation is carried out on the client. The overall framework of the program uses GMap.NET. GMap.NET is a powerful, free, cross platform, open source .NET control, which enables use routing, geocoding and maps from Google, Yahoo!, Bing etc in Windows forms and presentation, supports caching and runs on windows mobile. The map service calls Amap by Autonavi Holdings Limited and so on. In the program, we also used OpenCvSharp3-AnyCPU.4.0.0.20181129 for image processing algorithm implementation, and System.Data.SQLite.Core.1.0.109.1 for fast view overlap and coverage calculation and then stored in the database to sort in the database.

![Figure 2](image.png)

Figure 2. (1) left is interface of GF-6 data retrieval program; (2) right shows the results

Figure 2 (1) shows the interface of software GF-6 remote sensing data query. Some special data selection conditions are set in the parameter setting. Figure 2 (2) shows the results of data selection. The program has a variety of scheme formulation and scheme adjustment functions. It has the capability of cloud judgment, setting up regions and automatic data selection under multi-time period setting. The optimal coverage area has at least repeated coverage adjustment. It has a variety of region visualization methods and has the capability of outputting in various formats such as sensor, quality, batch product number and scene serial number according to scheme.

This paper is the same as and different from the content-based remote sensing image retrieval [5,6] which is currently being studied. The same thing is that they all put forward the goal of further refinement of remote sensing image retrieval. The purpose of this algorithm is to reduce the number of images while covering the research area as much as possible, which is a new problem in the era of remote sensing big data. However, most content-based remote sensing image retrieval methods [6] try to find certain ground objects in remote sensing images, such as buildings, clouds, etc. The algorithm in this paper only selects data at a higher level, but it does not extract objects at a deeper level inside the image.

5. Conclusions
At present, in forest mapping and natural resources survey mapping, satellite data screening mainly relies on manual visual inspection to select fast views, which is time-consuming and laborious. Based
on metadata and fast views of GF-6 data, this paper proposes a fast automatic optimization and screening technology for GF6 satellite data to meet the data quality requirements. The main purpose is to distinguish similar and duplicate data, reduce the workload of manual selection and improve work efficiency. The algorithm also supports the joint data optimization searching of China's high-resolution satellite data on GF-6 ,GF-1 and GF-2.

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