RESEARCH ON MULTI-RESOLUTION SEAMLESS IMAGE DATABASE

Mi WANG, Jianya GONG, Deren LI
National Laboratory for Information Engineering in Surveying, Mapping and Remote Sensing
Wuhan Technical University of Surveying and Mapping，P.R. China
wangmi@rcgis.wtusm.edu.cn,dli@wtusm.edu.cn,jgong@rcgis.wtusm.edu.cn

Working Group IV/1

KEY WORDS: Multi-scale Database, Spatial Databases, Data Structures, Design, Software

ABSTRACT

This paper presents the basic concepts and principles, data structure and high efficient spatial index for Multi-Resolution Image Database. The database is characterized with arrangement of multi-resource image data and seamless mosaic, distribution-based storage and management, integration with other spatial database software such as GeoStar and GeoGrid developed by Wuhan Technical University of Surveying and Mapping.

1. INTRODUCTION

At present, digital orthoimages and orthoimage mosaics are playing an increasingly important role throughout the entire geoinformation domain. Especially after the word of Digital Earth is put forward, digital orthoimages become the main content of digital earth as well. Orthoimages offer an ideal combination of high information density, wide-area coverage, economical and quick acquisition and production.

Because every orthoimage has relatively small area, the use of wide area is inconvenient. Certainly, several orthoimages in which users are interested can be mosaiced into one big orthoimage, but it is inconvenient for users to access and process.

The investigation and implementation of basic principles, data structure and efficient spatial index algorithm for Multi-resolution Image Database are presented in this paper. Firstly the paper describes some basic concepts such as super project, project, working area, network directory and the principle. The framework of image database is composed of these concepts. Secondly the paper presents the data structure of image pyramid based on Multi-resolution. Thirdly the paper presents a four-level index based on data structure of image pyramid. This index makes the whole database work efficiently and it is also a core of the whole database. During the stages of developing the database, lots of orthoimages from several provinces of China is used for testing. The conclusion of this study shows that this image database can efficiently manage a mass of image data and that it can be used in geoinformation domain efficiently.

2. THE BASIC CONCEPTS AND PRINCIPLES OF IMAGE DATABASE

2.1 The Basic Concepts

Before designing image database, some concepts are put forward as follows:

1.Image Workspace
In order to unify the orthoimages in different scale, conveniently intergeate with vector data and DEM data, and make the image product standardized, we define the concept of Image Workspace.

Image Workspace is an image that belongs to a certain period and its size is equal to the map format. It is the smallest unit in the image database. When the image is stored in the image database, image workspace data is formed after organizing image file.

2.Map Format
Map Format is a set of orthoimages in a certain geographic area, including muti-resource and muti-temporal image data. The size of Map Format generally is of the national standard, but it may be flexible sometimes.

3.Image Project
Image Project is a bridge that links different Map Format with the same scale. The Map Format with the same scale can build one or several image projects. The data can be stored in any computer of local area network. Each image project has independently spatial index and can make map format with the same scale seamlessly display and output in logic

4.Hyper Image Project
Hyper image project is also a bridge that links and manages all image projects. By hyper image project, we can implement seamless display across scales and image projects.

5 Image Pyramid
In order to implement index of images with different scale and display images across scale, the data structure of image pyramid is adopted. Image Pyramid can organize, store and manage muti-scale and multi-resource image data efficiently. The lower level in the image pyramid has the higher resolution with a larger amount of image data. The level number of image pyramid depends on practical needs.

6 Network Directory
The whole directory string which includes computer name, share directory name and image project directory is called network directory. It exclusively identifies the location of image project and implement distributed image storage in network environment.

2.2 The Basic Principles

Multi-resolution and Multi-resource Image Database is a spatial database system, where data object are orthoimages of multi-resolution and multi-resource. On the basis of distributed file management system (RDBMS or Object-oriented DBMS may be used. But considering the efficiency of image management, we prefer to use file management system.), in order to implement image data distributed storage, the share directories in any computer are created in local area network. The image projects with different scales will be stored in these share directories. The image pyramid is built. The efficient four-level spatial index based on image pyramid can access image data conveniently and quickly. The database system is seamless in geometric space and color space. It can manage mass image data and integerate with other spatial database software on the same basis of spatial coordinate foundation. (Such as Geostar and GeoGrid developed by Wuhan Technical University of Surveying and Mapping.)

3 THE DATA ORGANIZATION OF IMAGE DATABASE

The data organization of image database adopts the approach of object-oriented design. The whole image database consists of many data access objects. The top object is hyper image project, which contains many sub-objects— image project. Each image project contains many map formats, each of which contains many image workspaces.

Take account of the data structure, the whole system is a tree with hyper-project as root, project and workspace as branchs and image as leaves. The data structure is shown as below in Figure 1:

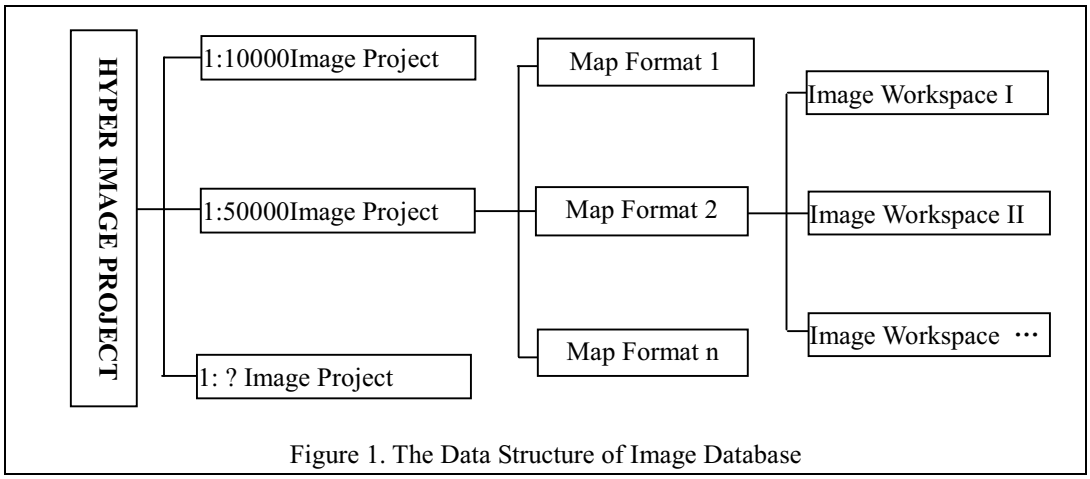

Figure 1. The Data Structure of Image Database

4. THE MECHANISM OF SPATIAL INDEX BASED ON FOUR LEVELS MANAGEMENT

Image workspace, map format, image project and image scale are the foundations of four-level management in image database. As shown in figure 1,they are:

1.Scale index based on the image window. According to this index, image scale to be used in image window is decided.

2.Image-project index based on the image window with the same scale. According to the scale that muti-scale index finds, the same scale image projects across the image window are decided.

3.Map-format index based on the image window from the indexed projects above. According to the image projects that the second index finds, map format across the image window are decided.

4.Image-workspace index based on the image type and image window. According to maps format that the third index finds, the current workspace in each map format is decided.

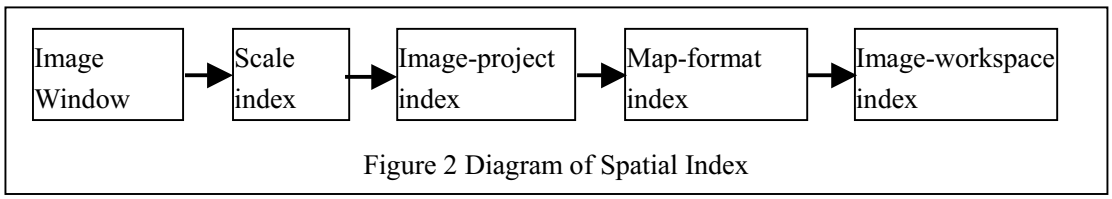

Figure 2 Diagram of Spatial Index

5. THE INTEGERATION WITH OTHER SPATIAL DATABASE

In order to update vector data in time, we may use image as the background. As image database has seamless character, it is very convenient for wide area applications. Thus it is necessary to integrate vector data and image data.

On the other hand, if we want to make virtual reality more verisimilar in large area, we must use real texture image. Through image database, the image with any area, any resolution can be provided as texture image.

As the spatial data in different spatial databases have the same mathematics foundation and spatial positoning foundation. Thus it is possible to implement the integeration of spatial data.

GeoStar is software for GIS; GeoGrid is software for DEM. These software packages are developed by Wuhan Technical University of Surveying and Mapping. During integeration we develop two DLLs GeoImageDBforGeoStar and GeoImageDBforGeoStar using Visual C++ as the developing tool. Through DLL, GeoStar and GeoGrid can freely access any range image data from image database. The sample of integeration is shown below:

Figure 3. The Integeration of Vector and Image Database

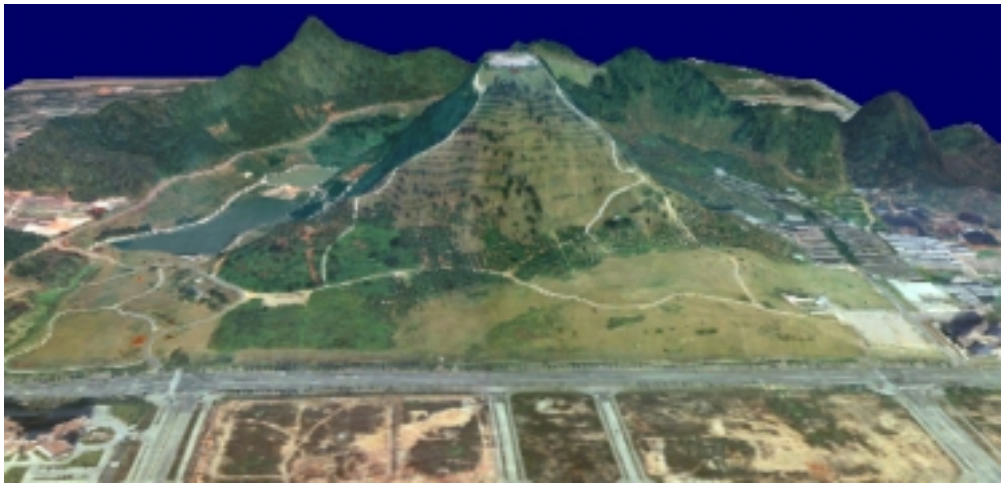

Figure 4. The Integeration of DEM and Image Database

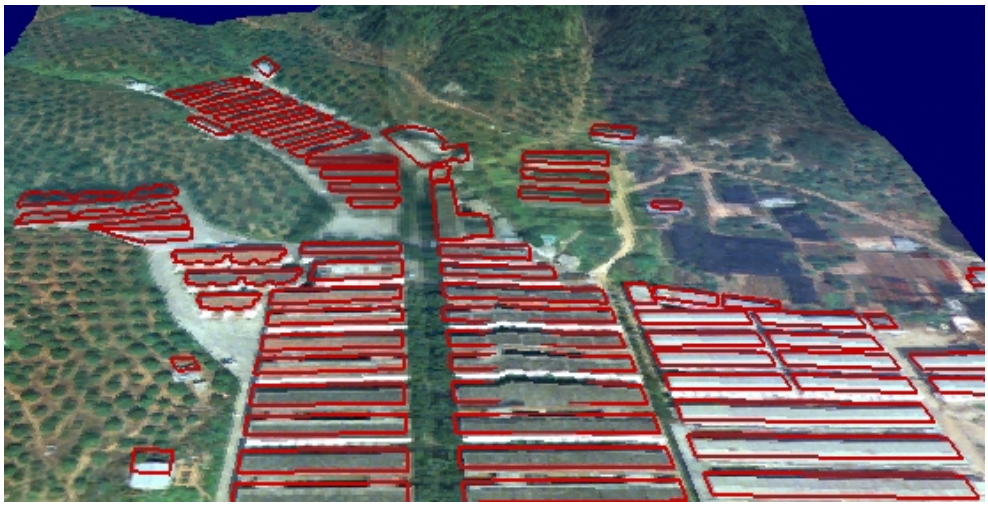

Figure 5. The Integeration of DEM, Liner graphics and Image Database

6. CONCLUSIONS

During the research of image database, we did the experiments in Guangdong and Hainan Province of China. The basic functions of image databases such as creating database, image query and image display are tested. The result proces to be very good, which shows the value of image dtabase.

As image database is a new research direction, there are still many problems. So it is worthwhile doing research.

7. ACKNOWLEDGMENT

The research described in this paper was funded by the Natural Outstanding Youth Science Foundation project of China (No. 49525101)

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