Application of 3D Remote Sensing Technique in Tour Resources Investigation

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Abstract—**Remotely sensed imagery can reflect characteristics of sceneries, such as formation, structure and spatial correlation etc, in order to make people know the surface matters form a macroscopic and holistic view. But two dimension plane showed in remote sensing image could not get the 3D space in the realistic world reappearance. As the wider and wider use of 3D visualization technique, the visualization processing on the basis of remote sensing technique not only ensures the realization of the real-time 3D visualization, but also is better for the interpretation of remote sensing image. In this article it discusses a simple and feasible way of recurring the 3D remote sensing image taking Mount Taishan as the example. At the same time, by means of intuitionistic character of 3D image the characteristic of geology structures, physiognomy and entironment in this area could be evaluated combining with other correlated data. At last the types of physiognomy landscape are divided and the distribution character is depicted. This study enhances the practicability of remote sensing technique, as well as, it takes positive effect on the planning and development of tour resources of Mount Taishan.**

Key words: *3D visualization; remote sensing; real-time; recurring*

I. INTRODUCTION

With the development of Remote Sensing technique, the traditional expressional way of two dimensions can not meet the need and the 3-D visualization become more and more necessary. The Remote Sensing image can objectively reflect the feature of shape, structure, space relationship etc, which can make people have a whole understanding to surface features. But the Remote Sensing image of 2-D can not reappear the real-life 3-D space and the unprofessional do not identify. So the 3-D visualization technique is a hotspot in the study and it is been widely applied in the flood-control and disaster reduction, the exploitation, the environmental evaluating and military affairs, etc[1-5]. Take the example of Taishan, this paper discusses the simple approach of 3-D Remote Sensing image visualization, which provides science basis for objectively and precisely analyzing and studying the world famous natural and cultural heritage from different aspects and has important meaning.

II. SOFTWARE AND DATA SOURCES

A. *Software system*

- Photoshop 5.0
- ER Mapper 6.1
- R2V

B. *Data sources*

Two data will be made:

- The scale of the map used is 1:50,000(J50 E 023013),which is aerial photographed in July, 1984, drawn in 1997 and regularly put into use in 1999. The map adopts the Xian coordinate systems of 1980 and the Huanghai elevation systems of 1985. The distance between contours is 10 meters. The range of the map is from 117° 00′ to 117° 15′ east longitude and from 36° 10′ to 36° 20′ north latitude.
- A Landsat-7 ETM$^+$ subscene is selected and the image is dated 1 Jan 2002.By the compare of Landsat-5 TM,

ETM^+ increases a band of ETM^+-8,which is a panchromatic band and the range of band is 0.5—0.9um and the spatial distinguish is 15 meters. According to the need of this study, only a sub-area including Mount Taishan is cut. The size of the image is 8910×7023 pixels involving seven bands.

III. DATA PROCESSING

A. DEM creating

The topographical vectorgraph need be built in order to create three dimensional digital elevation model of Taishan Mount. Firstly, the map is scanned and transferred to grid. The digital method, scanning by hand, is adopted in this article. it is simple and it is easy to be realized. Secondly, the image is preprocessed by means of image processing software, Photoshop 6.0, including image rotation, adjusting contrast and brightness, et al. The data source of DEM is digital map with the ratio of 1:50000 and the distance between contours is fifty meters. The image is vectored using R2V software and for distilling contours and elevation points.

Then, the digital elevation model is created using the topographical vectorgraph. Spatial coordinates (X,Y) and elevation information (Z) are stored in the numerical form in DEM, that is creating raster image. In fact, the areas are divided into regular grids with the same size and shape. Each grid in two dimension is oriented with line and row number of matrix and elevation value is expressed with gray value of matrix element[1]. DEM is created using the topographical vectorgraph by the grid command of ER Mapper (Fig. 1).

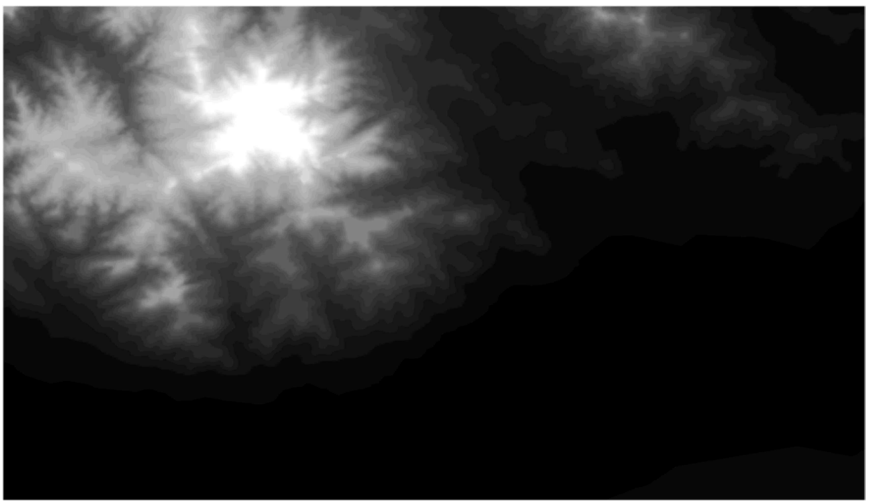

Figure 1. DEM of Taishan Mount

Figure 2. 3D image of Mount Taishan

B. ETM^+ data processing

The spatial resolution of band 1-5 and 7 of ETM+ is thirty meter and that of band 8 is fifteen meter. In order to improve the spatial resolution of image and make it easier for image recognition, each band need be registered. Firstly, six bands, band 1-5 and 7, are registered with band 8. Then it is concluded that information of band 4 is maximum by correlative and principal component analysis and information of band 1, 5 and 7 is second. But band 1,4 and 7 are selected for color synthesis due to the high correlation between band 4 and band 5. The image is processed further, including histogram adjusting, image enhancement, spatial filters ect.

To overlay topographical vectorgraph to the remote sensing image, they must be uniformed to the same reference frame. The geometrical rectification includes two steps generally. One is the transform of image coordinate, the other is computing the gray value of every pixel.

In this article, geometrical rectification is realized using ground controlling points. First, some ground controlling points are selected in the map, which are obvious and even. The original image is turned from the former distortion coordinate space to standard coordinate space by operational processing by means of the corresponding relationship. Second, because of the change of coordinate space, most of the corresponding coordinate values which are found in the standard space are not in the center of the original pixels. Therefore the lightness values must be computed again in the standard space. According to the applied requirement of the image rectified, there are three resampling ways which are nearest neighbor, bilinear and cubic convolution.

C. Overlay and view of DEM and ETM^+

From the above, DEM is created using contours and elevation points, so it has the geometrical coordinates and can be used to overlay on the remote sensing image. Under the support of ER Mapper, in the algorithm a height layer is added with Edit→Add Raster Layer→Height and the DEM data are loaded in this layer. Then the view model is switched to 3D perspective or 3D flythrough to view the Mount Taishan in three-dimensional space. The 3D model of the Mount Taishan(Fig. 2) can be observed from different places, directions and elevations by the operation of rotation, tilt and pan, which make people be personally on the scene.

CONCLUSIONS

We have tried to generate DEM using R2V and ER Mapper software by means of topographical vectorgraph.

ETM+ image is adopted in this study. Band 1-5 and 7 are registered with band 8 for color synthesis, which is of not only multispectral information, but also high spatial resolution of band 8.

The three dimension remote sensing image is created by overlaying DEM and ETM+ image and the visual effect is ideal. The users can enjoy a vivid and living three dimension model. This article makes it more objectively and accurate to study Mount Taishan. Mount Taishan, which is world famous natural and cultural heritage, can be protected better.

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