

## Discussion on the 3D visualizing of 1:200 000 geological map

**Xiaopeng Wang\***

Aerophotogrammetry & Remote Sensing of China coal, Xi'an, China

\*Corresponding author e-mail: imagegis@163.com

**Abstract.** Using United States National Aeronautics and Space Administration Shuttle Radar Topography Mission (SRTM) terrain data as digital elevation model (DEM), overlap scanned 1:200 000 scale geological map, program using Direct 3D of Microsoft with C# computer language, the author realized the three-dimensional visualization of the standard division geological map. User can inspect the regional geology content with arbitrary angle, rotating, roaming, and can examining the strata synthetical histogram, map section and legend at any moment. This will provide an intuitionistic analyzing tool for the geological practitioner to do structural analysis with the assistant of landform, dispose field exploration route etc.

### 1. Introduction

Geological map is the basic map to reflect the land form, lithostratigraphy, geological structure, crust movement and the development history of the geology. 1:200 000 scale geological map has covered the most area in china and is the absolutely necessary map for various mineral explorations, project construction and environment investigation. The content of geological map is two dimensional surface geology at present.

The geological map can be used in research and analyze many geological characteristics such as stratigraphic sequence, strata thickness, geological structure and geological history. Due to the topographic contour line in geological map is relatively rough, it will take some inconvenience to the geological practitioner when they do some structural analysis or design the field survey route. The 3D visualization of 1:200 000 geological map method in this paper is overlap the scanned standard 1:200 000 scale geological map with corresponding area DEM according to its coordinates. Thus we can get the geological map covered on the three dimensional terrain, added the illumination effects, and can demonstrate the landform and the earth's surface geology objectively.

### 2. Obtain DEM data

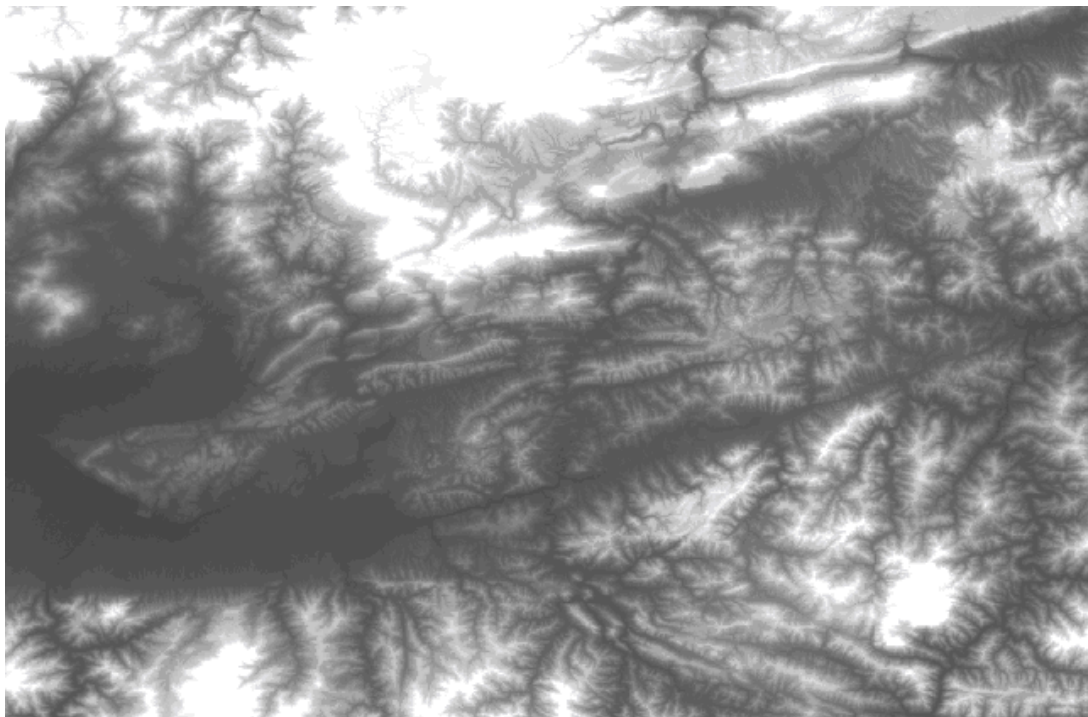
The Shuttle Radar Topography Mission (SRTM) is an international project spearheaded by the National Geospatial-Intelligence Agency (NGA) and the National Aeronautics and Space Administration (NASA). SRTM obtained elevation data on a near-global scale to generate the most complete high-resolution digital topographic database of Earth. SRTM consisted of a specially modified radar system that flew onboard the Space Shuttle Endeavour during an 11-day mission in February of 2000. It is very delight that the SRTM data covered the whole china.

SRTM data provide one file for a one longitude and one latitude mesh with two different resolutions in 1 arc-second and 3 arc-seconds called SRTM1 and SRTM3. SRTM1 file include a 3601×3601 pixel DEM data and SRTM3 file include a 1201×1201 pixel DEM data. We can get the



SRTM3 file for China and its resolution is 90m. The file name is like X1X2X3X4.hgt.zip, X1 indicate the orientation such as N or S, X2 is the latitude of the lower position, X3 is E or W shows east or west and X4 is the longitude of left side.

Take Lveyang geology map sheet in shaanxi province of China as an example. The map range is from east  $106^{\circ}$  - $107^{\circ}$  and north  $32^{\circ} 40''$  - $33^{\circ} 20''$ , so we download the file N32E106.hgt.zip and N33E106.hgt.zip. Open the file in remote sensing processes software ENVI and mosaic two files together, then cut the area with the coordinates east  $106^{\circ}$  - $107^{\circ}$  and north  $32^{\circ} 40''$  - $33^{\circ} 20''$ . Save the file in TIF format such as figure 1 shows.



**Figure 1.** The DEM of Lveyang geology map sheet

### 3. Processing the 1:200 000 geological map

Also use the Lveyang map sheet as an example. Scan the geological map, cut the map area, the strata synthetical histogram, map section and legend separately and save as JPG picture format for further use.

### 4. Compile the xml document

XML means Extensible Markup Language, it like HTML and they are both Standard Generalized Markup Language (SGML). XML is cross platform in internet environment, it is the technologies that depend on the content and is the most powerful tool when process the structured information. So we use the XML document to express the different area's 1:200 000 geological maps.

Using XML, we can compile the file related to the three dimensional geological map we want demonstrate conveniently. Such as DEM file, surface texture file (geological map), section texture, terrain display scale, histogram file, section file, legend file etc. as follows.

```
<?xml version='1.0' encoding="utf-16" ?>
<maps>
  <map name="China, Shaanxi, Lveyang geology map sheet">
```

```

<terrain demfile="D:\3DRegionGeoView\bin\Release\Terra\LveyangDEM.tif"
    texturefile="D:\3DRegionGeoView\bin\Release\Terra\LveyangGeology.jpg"
    sidesfile="D:\3DRegionGeoView\bin\Release\colors\Grid_1.png" altscale="0.15" />
<geomap legend="D:\3DRegionGeoView\bin\Release\Terra\LveyangLegend.jpg"
    profile="D:\3DRegionGeoView\bin\Release\Terra\LveyangSection.jpg"
    section="D:\3DRegionGeoView\bin\Release\Terra\LveyangHistogram.jpg" />
    <sky skyfile="D:\3DRegionGeoView\bin\Debug\skys\Sky_Gradient_Day1.jpg" visible="1" />
</map>
</maps>

```

## 5. System programming

The author using c# language in Microsoft Visual Studio 2005 developed the Direct 3D procedure, programmed the three dimensional demonstration software for geological map. The key procedure code is as follows.

```

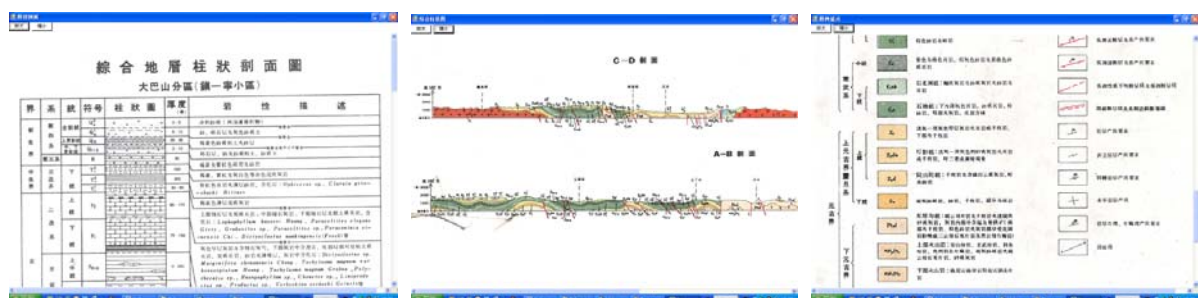
// Create device
PresentParameters presentParams = new PresentParameters();
presentParams.Windowed = true;
presentParams.SwapEffect = SwapEffect.Discard;
presentParams.AutoDepthStencilFormat = DepthFormat.D16;
presentParams.EnableAutoDepthStencil = true;
presentParams.PresentationInterval =
PresentInterval.Immediate;
device = new Microsoft.DirectX.Direct3D.Device(0, Microsoft.DirectX.Direct3D.DeviceType
.Hardware, this, CreateFlags.HardwareVertexProcessing, presentParams);
// Events
device.DeviceReset +=
    new EventHandler(this.OnDeviceReset);
device.DeviceResizing +=
    new CancelEventHandler(OnDeviceResizing);
// Set up
OnDeviceReset(device, null);
// Rendering here
CameraViewSetup();
device.VertexFormat
    = CustomVertex.PositionNormalTextured.Format;
device.RenderState.ZBufferEnable = true;
// Translation and Orientation angle / angle2
if(angle2 < 0) angle2 = 0;
if(angle2 > Math.PI / 2) angle2 = (float)(Math.PI / 2);
device.Transform.World = Matrix.Translation(dx,dy, 0);
device.Transform.World *= Matrix.RotationZ(angle);
device.Transform.World *= Matrix.RotationY(angle2);
// Light
if(showLight) LightSetup();
// Draw terrain tiles mesh
if(texture != null) device.SetTexture(0,texture);
if(meshCount > 0)
{ for(int i = 0; i < meshCount; i++) meshList[i].DrawSubset(0); }
// Draw terrain sides
if(sidesTexture != null) device.SetTexture(0,sidesTexture);
sidesMesh.DrawSubset(0);

```

The produced three dimensional geological map system interfaces is showed in figure 2. In this system, user can roam, rotate the scenes with mouse or keyboard and inspect the regional geology content. Carry out the structural analysis combined with the three dimensional terrain. And also can examining the strata synthetical histogram, map section and legend at any moment (figure.3).



**Figure 2.** Three dimensional geological map demonstration



**Figure 3.** The strata synthetical histogram, map section and legend picture

## 6. Conclusion

At the present time, the computer graphics has entered the three dimension era, three dimensional graphics are all around the people. With the method in this paper, we can demonstrate the 1:200 000 geological map in three dimensions easily. This can assistant the geology survey and engineering personnel to do geology body identification and structural analysis, so the method can be spread and utilize in many professional fields.

### Acknowledgments

This work was financially supported by National mineral resources reserves utilization status investigation project of Ministry of land and resources of China.

### References

- [1] Zhang X L. XML-based Information Organization and Processing: 1. XML Technique System [J]. Information Science 2001, (8). (in Chinese)
- [2] Peng Y P. Study on the visualization and real-time rendering of three-dimension (3D) terrain surface [D]. Chengdu: Master's dissertation of South west Jiaotong University, 2003. (in Chinese).
- [3] Chen J Y. Quality Evaluation of Topographic Data from SRTM3 and GTOPO30 [J]. Geomatics and information science of wuhan university, 2005, (11). (in Chinese)
- [4] Mao Q M. Study and realize on three dimensional visualization of geological map [D]. Hangzhou: Master's dissertation of Zhejiang University, 2006. (in Chinese)
- [5] Ma L, Li Y. Study on Accuracy of GTOPO30 and SRTM DEM -A case study of Tibet [J], Bulletin of soil and water conservation, 2006, (5). (in Chinese)
- [6] Zhang J H, Three-dimensional Visualization of Geological Map for the West Projects for the Diverting Water From the South to the North and Its Significances [J]. Acta geologica Sichuan, 2007, (3). (in Chinese)
- [7] Zhan L, Evaluation of SRTM DEM's accuracy and investigation on its applicability. -A case study in Shaanxi province. [D]. China Master's Theses Full-text Database, 2008, (11). (in Chinese)