Development of Hierarchical Structure System for Real-time Generation of Large Terrain Data Sets

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ABSTRACT

Recently, we are making quick acquisition of huge geographical feature information data by rapid measurement and development of satellite information technique. We expect the geographical feature information to be acquired; to be analyzed accurately to minimize data loss and massive data volume visualization to be executed. We require the technique which the user makes is possible for reality world immersion. We are applying the LOD (Level of Detail) algorithm to point key element for visualization execution. To accomplish detail level decision considers to user view, immediate utility is impossible a source data (DEM), and we need a factor overlay decision which is hierarchy based on users view.

In this research, to acquire the thorn of massive volume DEM, we choose the 4X4 tile hierarchy or 2X2 structure. To express user center terrain information for real sense, we apply DEM and produce Hill Shading Image. Terrain blocks file is produced to hierarchy tile structure. We transform terrain data to various factors overlay. Connect this by the hierarchy each other. We express a factor overlay change in the height quality, follow, minimize data loss and try to do a frame speed.

Keywords : GIS, DEM, DTM, LOD, Tile Structure, LiDAR, Real-time, Hierarchical, Hill Shading

1. Introduction

Through our equipments recently become introduction, touch huge terrain data easily, Real-Time Visualization edge View shed analysis**,** A contour extraction, Hill Shading etc. 3D Terrain analysis is become the utility. An execution visualization is followed and reacted by user view and meant to express without the loss of a source data within restricted time. For massive volume terrain rendering, we adjust the factor overlay of a level terrain and compress the piece of the terrain to a level star of each hierarchy and makes a senior pyramid relation possible for rendering expression unit by constructing the senior relation.

To check a loading yes or no terrain piece of child node, we construct a terrain data of a hierarchy structure. When constructing data, We produce the index optimize data approach speed constructing in the mode to of the file. Because of a memory foundation loading is not the right massive volume data, when terrain rendering, the recitation of the terrain by the reflection of the light becomes more the thorn to reality entering. Hill Shading image is Mapped at the level of piece of the terrain which is particularly produced. A recitation of relief image of a terrain piece of parents is a recitation of relief of one chapter produced for combination of a terrain pieces of the low rank.

In expressing a brush lead model which a 3 Dimension graphic API increases currently, we are expressing a 3D Mesh plain in the combination of the triangle. The thing which is represented consequently at PC prize to reduce the maximum the three angles wife of elder brother become a key point technique which an execution visualization does for massive terrain volume information. The Terrain Patch which the eye-sight don't see order the exclusion and order speed enlargement in a rendering pipe.

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2. A terrain data preprocessing

A terrain source data exists vary from Raster Grid, Contour, LiDAR, DTM(Digital Terrain Model), DEM(Digital Elevation Models). The size of the terrain data is due to the factor overlay of the terrain and width of the object area. Data grows bigger, however if it is narrow area the interval of height price is narrow. For a terrain hierarchy, we need DEM (Digital Elevation Models) which appears in the space to express the change of the terrain relief continuously, through a grid matrix which is generally regular (Burrough,1986). Consequently, A terrain source data which composed of the combination of vertexes to be continuous, a digital modeling of a grid format must become the leading. In a preprocessing course, if necessary for a terrain lump generation, we need DEM which a grid interval of large scale terrain is modified to be the hierarchy.

3. A terrain hierarchy structure setup

Whole source data to be handled is one huge terrain lump. To structuring the hierarchy of this lump, the definition must do the size of data which we come to become the existence at a tree node a hierarchy depth and prize which consists the hierarchy, above all. To rescue a hierarchy depth, it peels off strong number of a terrain lump of least significant hierarchy to be determined comes out, we can rescue the depth of the hierarchy if we divide it into 2 to the return. After a piece for the rendering of the terrain pane compaction, to check a loading yes or no of each level of a terrain piece of a low rank node, we construct a terrain data of a hierarchy structure a(**Figure 1)**.

To separate a terrain block to lump of small unit, a factor overlay expression of small lump is possible for each stage DEM to be handled, Divides into the size to count bigger than 2 drainages value which it become normal.

In dividing small lump of the terrain, according to resolution of each terrain which hears a terrain lump which is the hierarchy, maintain the succession relation of the parent child. A factor overlay level is decided and becomes a schedule factor overlay, organize the structure to call a child block. The succession relation comes to reconfiguration to the depth of a terrain block node and index. We organize data with the factor overlay of a source data factor overlay of the least significant level so that they are identical. A length index to each tree depth and edge in a hierarchy structure set up, saved at an index file and file of the separate way which a terrain block is saved to increase and to guarantee a terrain block when loading data approach, keeping the size together within a file location of actual terrain block data at the index file.

4. Create Hill Shading Image

The recitation of poem of the terrain by light is become more the thorn to reality. Reflection of the light and shadow effectiveness for each height price which consists of the terrain. We rescue the gradient of the terrain by comparing a height price of the vertex which is contiguous each other with a height price of each vertexes. We give the color sense of an image each pixel with the gradient combination of the light direction vector.

4.1 Slope

Slope is measured by calculating the tangent of the surface. The tangent is calculated by dividing the vertical change in elevation with horizontal distance. If we view the surface in cross section we can visualize a right angle triangle (**Figure 2**). Slope is normally expressed in planning as a percent slope which is the tangent (slope) multiplied by 100.

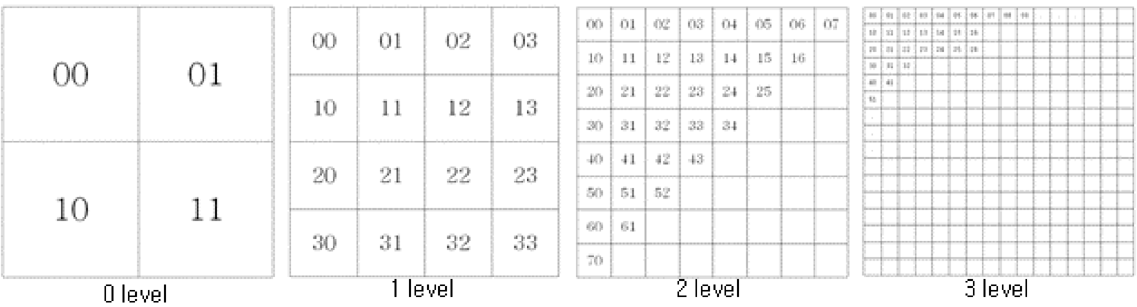

Figure 1. A terrain hierarchy structure block index

Percent Slope = Height / Base * 100

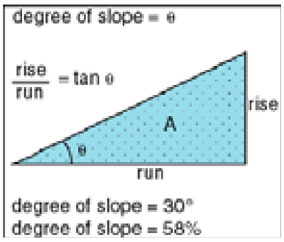

Figure 2. Slope

4.2 Hill shading

Analytical hill shading is a technique for producing shaded relief maps automatically. Relief shading is used to visually enhance the terrain features by simulating the appearance of the effects of sunlight falling across the surface of the land. Hill Shading estimates surface reflectance from the sun at any altitude and any azimuth. The reflectance is calculated in a range from 0 to 100. The equation for the sun in the northwest sky with a 45 degree altitude is as follows

Reflectance = 1/2 + (p'/2) / SQR(po2 + p'2) * 100

Where : **p' = (po * EW + qo * d NS) / SQR(po2 + qo2)**

po = 1 / SQR(2)

qo = -po

5. Real-time Visualization

To express massive volume of terrain, we divided huge terrain into blocks and constructed terrain structure which is the hierarchy beforehand. The root in huge terrain hierarchy structure, the block to be included namely in a most significant parent node resides always at the memory when execution. The rendering is composed of child nodes derived in parent node and a block structure of most significant parents' node and least significant child node is identical. A rendering level of the block is determined according to the view of the user. They control the number of triangle to be rendered according to the level. The relation possession of parents children is maintained through succession and the senior relation of an identity level of a neighborhood node is maintained logically. When creating children node, the factor overlay of the child node is decided by taking the relation of observer view into account and produce the child node again according to the degree of the factor overlay. We achieve great in a return method with the real world execution visualization.

6. The experiment

For this research experiment, we used LiDAR to measure data of Daejun, Kore. The source data a width x height 4000 x 5000 pixel of ERDAS Imagine format and applied data to have a 1 m resolution. For the program we used DirectX graphic API and Microsoft Visual C++ 6.0 MFC .We expressed the terrain in the screen such as the **Figure 3** and **Figure 4.**

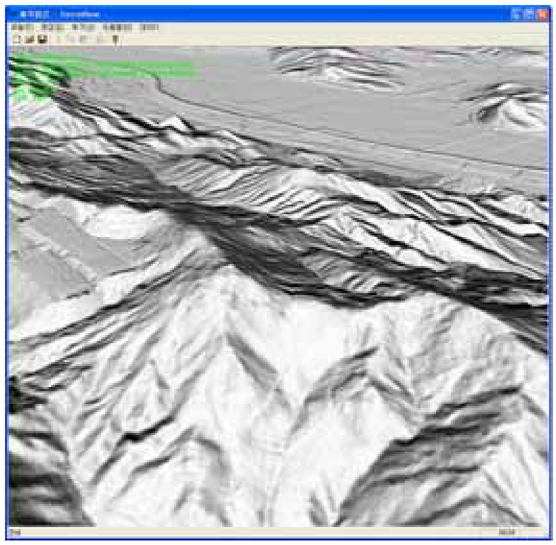

Figure 3. Hill Shading Image Texture

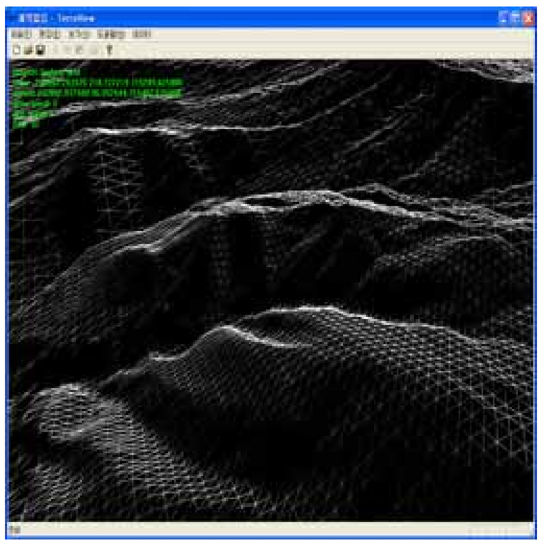

Figure 4. Wireframe Terrain

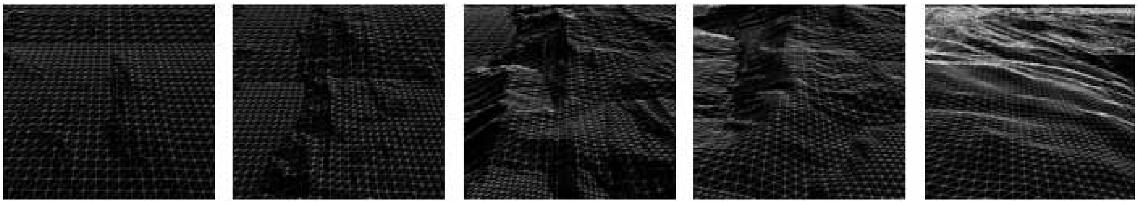

Figure 5. Korea Daejun part LiDAR DTM LOD approach (Wireframe)

7. Conclusions

For executing real time visualization of massive volume terrain information, we use a tile structure of a tree structure. We express extensive area so that similar with reality at individual computer and we try to apply data and to progress the analysis of wide terrain. For hereafter development, We need the module development about various terrain analysis to append this. Also, instead of recite relief image which is constructed currently, it will consist terrain world for sense of reality rather than mapping the satellite image. We do the air image at a terrain model which has a topology school register coordinate. At a three dimension terrain model foundation upside, the real world and we construct similar facilities information to become model. We are considering the implementation of doing simulated reality

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