PARAMETRIC ANIMATION OF DIGITAL TERRAIN MODEL USING MT.VIEWER

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ABSTRACT

Most of animation for mountain landscape used to be a flight simulation with the movement of eye positions or viewing angles. However, the authors try to animate a different way from the conventional animation. By changing parameter of terrain features, more scientific information about topography, geomorphology, hydrology, land cover etc. can be visualized in a form of animation.

The followings are the results of the proposed parametric animation.

- terraced level slicing
- sea level rise
- contour generation
- color composites of topographic information
- drainage flow
- bird's eye view in parallel projection
- panoramic bird's eye view

The results of parametric animation show that the natures of topographic features as well as the algorithm of DTM named Mt.Viewer by the authors are better understood than the static visualization.

1. INTRODUCTION

The authors have proposed a concept of virtual reality map in consideration of human sensitivity (Tanaka, N., Ono, K., and Murai, S. 1997), in which additional conditions in virtual reality will create a new type of map visualization in multi-dimensional space. Psychology, physiology and physics should be taken into account in creating the visual effect. However, static visualization has a limitation to demonstrate such effect. Animation with the continuous change of a parameter, that is called parametric animation in this paper will produce more sensitive visualization of digital terrain model (DTM) both in art and science.

The parametric animation would be more easier to generate a tremendous scenes for animation than the conventional flight simulation.

2. CONCEPT OF PARAMETRIC ANIMATION

Let a terrain feature be T with the function of the terrain points (X, Y, Z) and a parameter t.

$$T = F(X, Y, Z\,;\,t)$$

Parametric animation is to change the parameter t or any variable of X, Y, Z continuously to demonstrate how the parameter influences the terrain feature as well as visual effect.

When there are two terrain features ; T_1 and T_2, parametric animation with a linear combination of T_1 and T_2 can be visualized as follows.

$$T = (1-t)\,T_1 t + tT_2$$

Where t is a parameter of the combination ratio

$$0 \leq t \leq 1$$

The above linear combination can be applied not only to geometric feature but also color space.

3. MT.VIEWER ; DTM SOFTWARE

The authors have developed a DTM software called Mt.Viewer to generate digital elevation model (DEM), topographic features (slope gradient, slop aspect, drainage, hill shading etc.) and bird's eye view not only in parallel but also panoramic projection in consideration of human sensitivity based on psychology, psychology and physic in color visualization. The results of Mt.Viewer have been demonstrated on the cover page of monthly Journal of Survey, published by Japan Association of Surveyors since January Issue 1997 (See Figures 1-8).

Using Mt.Viewer, the following parametric animation were demonstrated.

3.1 Terraced Level Slicing with Sea Level Rise

Color is assigned in the order from the lowest to highest elevation at first without hill shading. The second step is to add hill shading in the order from the highest to the lowest elevation. Then the third step is to raise water level in the order from the lowest to the highest elevation with the combination of blue water (70%) and shaded terrain (30%) to generate some sense of transparency.

3.2 Contour Generation with Hill Shading

Contour lines with equal thickness are output in the order from the lowest to the highest elevation at the first step. Then the thickness of contour lines is changed with shading effect in the order from the highest to the lowest elevation. At the third step, the colored hill shading is added. The animation will show how the hill shading can generate 3D effect.

3.3 Color Composites of Topographic Information

Three components of elevation, slope gradient and slope aspect are generated respectively in the order from the highest to the lowest elevation. At the second step the color composites with assigned three primary colors are to be generated in the order from the highest to the lowest elevation. This animation shows how useful the three topographic information can be integrated into a color composite.

3.4 Drainage Flow Simulation

Flow directions are given in chain code with eight directions at each grid DEM with a special color. Then the flow will be continued with additional scores that count how many paths flow through. Color and thickness will be changed according to the scores of flow paths. This simulation demonstrates how water flows on the surface.

3.5 Bird's Eye View in Parallel Projection

Bird's eye view will be displayed from far to close sections with black and white and colored edge enhancement alternatively. The terraced level slicing with hill shading is also displayed in the same way.

3.6 Panoramic Bird's Eye View

Panoramic bird's eye view with the combined images of satellite and hill shading will be zoomed up toward Mt.Fuji.

A window will be set up with the ordinary intensity within the window and half tone outside.

4. Conclusions

Recognizing that producing a number of scenes for animation is not much burden in these days, the authors conclude the followings.

(1) Parametric animation in a form of raster image shows a powerful tool for extracting more topographic features with better understanding rather than static images.

(2) The results of animation demonstrate the effectiveness and usefulness of hill shading drainage flow, and other 3D visualization.

(3) Parametric animation should be more encouraged to use for academic and professional purposes.

Fig.1 Colored Hill Shading of Mt.Fuji

Fig.2 Color Composites of Topographic Information ; Mt.Fuji

Fig.3 Drainage Map of the Kiso Watershed

Fig.4 Panoramic Bird's Eye View, Western Kantou Plain

Fig.5 Bird's Eye View of Northen Japan Alps
with Hill Shading

Fig.6 Ridge Enhanced Bird's Eye View, Ina, Japan Alps

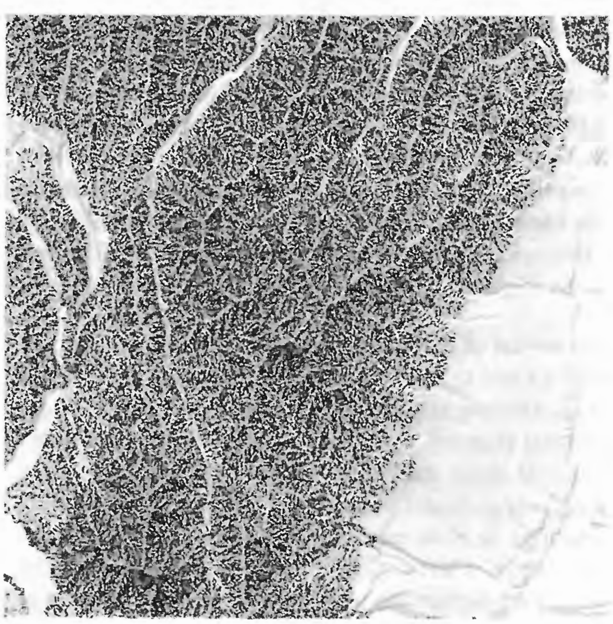

Fig.7 Pointillism Map, Ina, Japan Alps

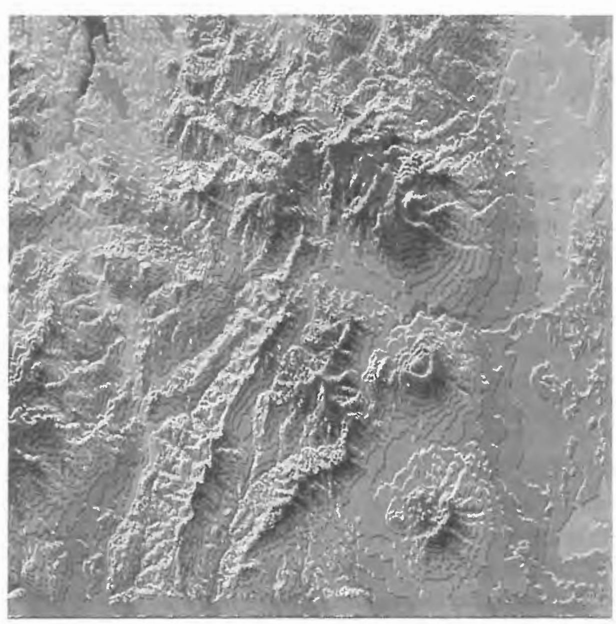

Fig.8 Reliefed Contour Map, Northen Nagano