The Earth Navigation Modeling On Desktop VR

Jin-Hee Kim

Paekche Institute of the Arts

Introduction

Recently, the interactive 3D graphic authoring environment is being rapidly established according as the computer execution speed become fast enough to support applications for real-time 3D graphics on desktop PC hardware fundamentals. A user's navigation in a virtual space is a complicate perceptual process and must be precisely designed. In this study, the most appropriate and simplest form of navigation environment was modeled for the earth terrain model in an interactive 3D environment. The viewpoints were classified into Spatial-, Aerial-, and Ground-Views, respectively, and so far navigation models, suitable for Spatial-, and Aerial-Views, were developed.

1. Environment Optimization

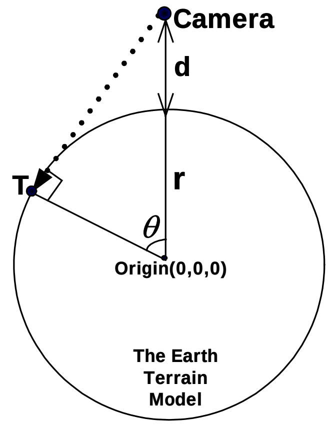
The optimum Lods (level of details) of the earth model was applied according to a user's relative distance. In the Spatial- and Aerial-Views except Ground-View a user always looks down the earth topography, thus, the similar effects were realized by mapping terrain image on a simple spherical geometry without specific 3-dimensional roughening of terrain model. 'Worlds within World Display' technique, interconnecting the multi-divided virtual worlds through entries within a world, can be applied to a Ground-View model for optimizing the load of graphics.

2. Navigation Using Rotation

A user's basic navigation can be performed by simple rotation of the earth model. By rotating the earth at center of World Coordinate Axis using the (1,0,0), (1,0,1), (0,1,0), (-1,-1,0), (-1,0,0), (-1,0,-1), (0,-1,0), or (1,1,0) vectors of World Coordinate X, Y, and Z, 8 directions of movement including forward and backward can be performed. By rotating the earth using (0,0,1) or (0,0,-1) vectors, user can change their direction into right or left. A user's view can be Zoom In and Out by controlling the camera's relative distance from the earth. Also, by rotating the camera using World Coordinates, the similar navigation effects can be created.

3. Aerial View Optimization

According to camera distance and target point change which can be controlled by a user, the user's view can be optimized. Camera height, *d*, was set up as 1/10 to 1/2 of the radius, *r*. The angle, θ, between the target point and camera can be calculated using the verticality of intercept line and trigonometry. Then, a user's view can be optimized to possibly farthest point that causes maximizing space sense. And then the target point can be rearranged to look at only terrain view of the earth without vacant space scene. It depends upon scene's aspect ratio and other pre-selected conditions like the camera distance.



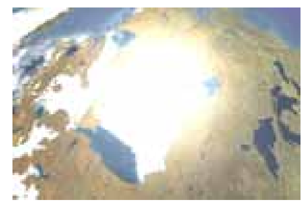
$$\frac{r}{10} \le d \le \frac{r}{2}$$

$$\cos\theta = \left(\frac{r}{r+d}\right)$$

$$\theta = \cos^{-1}\left(\frac{r}{r+d}\right)$$

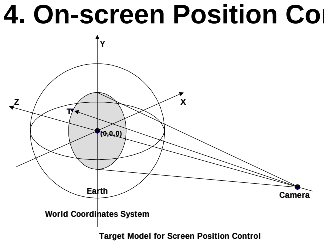
View Optimization

a view without optimization



a view with optimization

4. On-screen Position Control



In Spatial-View, the position of the earth model on a screen could be adjusted using this model. When the target position is getting away from the center of earth model, the earth model is moving away from the center of the screen. By rotating the target, T, with World Coordinate (0,0,1) vector, the earth model can move from the top to all around the right, bottom, and left positions on the screen. The size of the Circle-Plane for target modeling will shrink as the viewing distance increases.

Conclusions

The earth navigation models, most simplified and optimized, were proposed in this research. The Spatial- and Aerial-Views were presented among the categorized views, and the Ground-View navigation model is under study and will be reported later.

Acknowledgements

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