Development of 3D visualization of Rainfall Radar Data using Unity 3D Terrain

Yeong-Cheol CHOI, Yu-Yeon LEE and Dae-Ik KANG

Abstract: This study presents the development of the function designed for 3D visualization of rainfall radar data using the terrain of the unity engine. The provided rainfall radar data is about the rainfall data provided by radars operated in Seoul. The data has an extension of tif, and a resolution of 1000*1000. In order to create a terrain, first, tif files were converted into png and RAW files. When converting png files, tif values were converted into RGB color values and stored according to the arbitrary legendary reference table. The RAW files were converted in the same way, but they are converted not into RGB but into white and black values and used. Based on the legend, the higher value was converted into whiter, and the lower value was converted into blacker. The terrain model was created in a RAW file, and using the png data converted in the Material's Transparent Shader, the 3-dimensional rainfall radar was implemented. To ensure the utilization of the relevant data, the base map used the Google map, and the Alpha value was designated in the Terrain Material of the created radar to achieve a semi-transparent visualization of the radar. The 3-dimensional rainfall radar, created by this function, offers the strengths of enabling the user to view the data in various rotating directions and to ensure a multi-dimensional analysis. Further, since the conversion is based on the initial tif file values, it has nearly no error rate of visualized data. The function, if further improved through a survey of user requirements, will facilitate the analysis of rainfall data.

Keywords: Rainfall Radar, 3D Radar, Unity3D, OpenMap, Terrain

1. Introduction

Although high precision climate data can be obtained by using remote sensing equipment such as high precision rainfall radar, multi-dimensional display service for visual analysis has not been realized up to satisfactory level. In addition, the 2D data is simply overlaid on the map when visualizing the relevant data based on the observed rainfall and climate data. This study describes the development of monitoring and analysis of the rainfall radar data more effectively than simple planar presentation.

2. System Description

The system was developed using Unity3D. Unity3D was originally developed as a game engine without any connection to GIS. According to the recent trend, however, various functions are being updated with its position in the GIS field also being established. The disadvantage of Unity3D is that you can't import GIS coordinate systems and other commonly used GIS file

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formats (shp, tif, etc.). However, this problem can be solved by additional development. Furthermore, it is much more advantageous for visualization than existing GIS engine.

The development environment used for system development in this study is shown in Table 1. Since the main functions of the system are for visualization, a graphics card is essential for smooth development and execution.

Table 1. Development environment

Category	Explanation
CPU	I7-6700 3.4Ghz
RAM	16GB
VGA	NVIDIA GTX 1060 6GB
Development Tool	Unity3D 2018.2.0f2, Visual Studio 2015
Program Language	C#

We used Unity3D's Terrain function for rainfall radar data 3D visualization. The terrain function is provided to enable convenient handling of the terrain, but this study was used for the visualization of the radar data. This function requires data in RAW format. The structure of a RAW file is composed of grid values and is set to gray scale, from white to black, from maximum to minimum. Rainfall data used in this study is provided in tif format, one file per minute. The data in the tif format consists of a 32-bit 1000 * 1000 resolution. Since the format of the provided data and the format required by the terrain function are different, the RAW data required for creating the function and PNG data that will be used for mapping must be additionally processed in order to utilize the Terrain function.

Based on the value of the provided tif data, it was first processed into PNG with RGB values according to the arbitrary legend used in this study, and converted to 1000 * 1000 resolution and 32 bits to prevent loss of original data. The raw processed PNG data was further processed to produce RAW data that will be used for terrain generation. White RGB (255, 255, 255) to black RGB (0, 0, 0) was converted based on the maximum and minimum RGB values of the legend used for PNG data conversion (Figure 1).

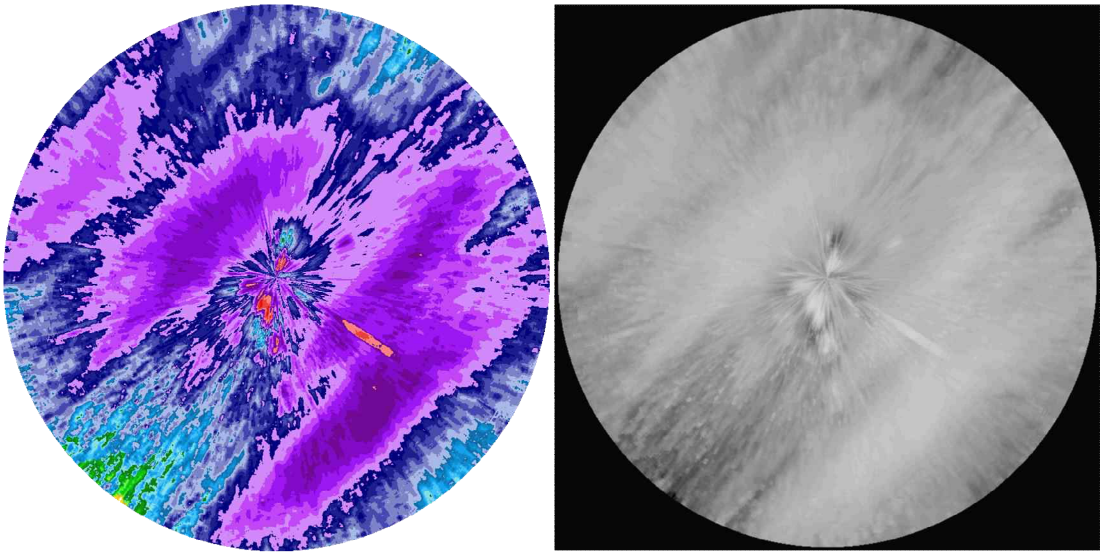

Figure 1. PNG Conversion (Left) / RAW Conversion (Right)

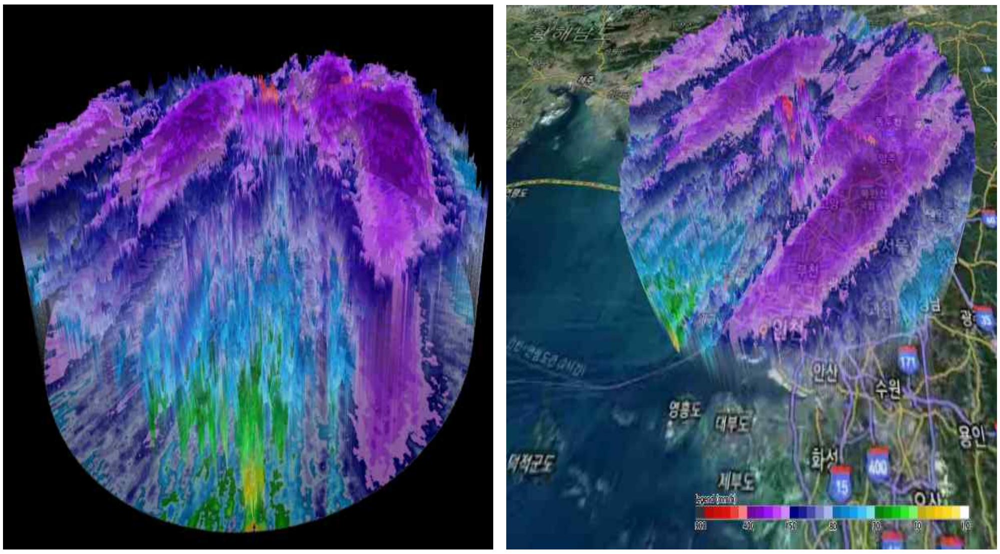

Figure 2. 3D radar visualization by mapping and mapping Google Map

And the converted data is automatically calculated through the specified path through the first PNG conversion and the second RAW conversion when tif data is inputted.

As the terrain feature is primarily intended to create terrain, its shape is opaque and crude. To compensate for this, we added a Material Shader to the Terrain to modify the rendered surface.

Visualization was completed by changing MainTex from Standard to Shader to RGBA and assigning transparency to integrate with other data.

In addition, the feature for analyzing location-based rainfall distribution in multiple angles is provided by linking and mapping GoogleMAP to the implemented rainfall data 3D visualization system. (Figure 2)

3. Conclusion

In this study, we developed a system to visualize lattice tif data in 3D using Unity3D. This visualization function can effectively analyze the pattern of rainfall, which is far cry from the simple planar presentation service in the past, and enable more intuitive service. In addition, the software developed in this study was developed based on the general-purpose 3D graphics platform that does not require a separate license, and has advantages in terms of scalability. In the future, efficient utilization of rainfall data based on this system will be possible in the future, which can be used for reliable rainfall prediction and monitoring.

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