Chapter 4
A Component-Based 3D Geographic Simulation Framework and its Integration with a Legacy GIS

Zhen-Sheng Guo
Hokkaido University, Japan

Yuzuru Tanaka
Hokkaido University, Japan

ABSTRACT

There is an increasing demand for 3D geographic simulation systems. Most systems currently available are closed and based on fixed architectures. Some systems allow us to develop and customize a 3D geographic simulation system, but this usually requires the writing of extensive program code. Especially in 3D geo-disaster simulations, for example, we need to dynamically integrate 2D legacy GIS with 3D geographic simulation systems in order to investigate the details about the damaged areas and the consequences of the disasters. The authors propose a component-based application framework for 3D geographic simulation that can integrate a legacy 2D GIS with geographic simulation systems in a 3D visual environment. Their framework provides a set of 3D visual components required for the development of a new interactive 3D visual geographic simulation. In their framework, component integrators can construct 3D geographic simulation systems by composing the 3D visual components. Moreover, the authors’ integration framework provides

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two fundamental integration mechanisms, view integration and query integration mechanisms, to integrate it with legacy 2D systems. The view integration function maps the 2D rendering of a legacy 2D GIS onto the surface of the 3D geography used in a 3D visual geographical simulator, and then dispatches every event on the geographic surface to the original 2D GIS. The query integration automatically converts each 3D simulation result that is shown as a set of highlighted regions on the surface of the geography to the corresponding regional query to the 2D GIS. The proposed framework is based on their 3D meme media architecture in which components are represented as meme media objects, and their interoperation is defined by slot connections between them. As a result, their framework enables users to compose 3D geographic simulation systems and 2D GIS and geographic simulation systems and to integrate a legacy 2D GIS with a 3D geographic simulation system simply by composing display objects.

INTRODUCTION

Various geographic simulation systems have been developed to meet the growing need for 3D geographic simulation of disasters, such as avalanches, floods, and landslides. In general, the development of each has been primarily independent with closed and fixed architectures, it is therefore difficult to introduce existing functions of one existing geographic simulation system to others. Moreover, although the geographic simulation systems generally have strong disaster simulation capability, they often lack the information necessary for analysis and evaluation of the disaster, whereas many legacy geographic information systems (GIS) can provide visual map and region query functions for disaster analysis and evaluation. For this reason, GIS and geographic simulation systems often need to be integrated. However, in general, the development of the 3D geographic simulation systems and legacy GIS have been primarily independent and integrative uses are still at an early stage.

There are many conventional GIS, and simulators have become more advanced. Because these types of software are usually independent, closed systems, they are difficult to customize and to integrate with others. Although some systems, such as GRASS (GRASS) and ArcGIS (ArcGIS), can be customized with library packages, they still require users to write lengthy programs. Other systems, such as GeoVista

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