

Chapter 2

Applications of Serious Games in Geovisualization

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ABSTRACT

The aim of this chapter is to introduce the reader to the impact of the application of serious games in geovisualization, due in particular to the use of flight simulators and associated technologies. The authors present the main elements and techniques developed for serious games that have influenced geovisualization research, and also bring an overview of some available frameworks for the implementation of serious games. They illustrate the main concepts, the development of an integrated system that combines flight simulator technologies with satellite imagery, and other diverse geographical data sources in a single geovisualization application. The chapter also presents a review of the high-end human-machine interfaces designed for games and their current and possible uses as geovisualization exploration tools. A discussion about the several challenges is provided as well as the opportunities that arise through the application of serious games in this area.

INTRODUCTION

Serious games emerged as a differentiation of computer games, where the motivation is not entertainment but to impart certain knowledge or expertise to the users (Zyda, 2005). This kind of games is becoming widespread in education, business, government, defense, health, and com-

munication, among an ever growing spectrum of application areas.

Furthermore, computer game technology in general, and flight simulators in particular, experienced a remarkable evolution during the last years, not only in performance but also in interactive features, mostly due to the leverage of GPUs (Graphics Processing Units) power to render increasingly complex 3D models in real-time. Fulfilling the growing requirements of the user community, flight simulators became

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more and more sophisticated by including all kinds of new features. The quest for photorealism, advanced interactive features, and dynamic aspects, is providing a huge thrust both to commercial and scientific research related to this kind of applications. There is a vast community of free-lance developers, professionals, researchers, and newly emerging companies that focus their efforts to generate innovative results, including for instance FSDeveloper (2011), FlightSimWorld (2011), FlightSim (2011), and AVSim (2011), to mention just a few. There are also organizations such as FlightGear (2011) and its related projects JSBSim (2011) and TerraGear (2011), among others. Also there is a strong support given by most of the companies engaged in flight simulator development, for instance Microsoft® for its product Microsoft Flight® (2011), and Laminar Research® for its product X-Plane® (2011).

Among the features that may be required in geovisualization (geographical visualization), we can mention terrain rendering (Andersson, 2007; Asirvatham & Hoppe, 2005; Olsen, 2004), modeling and visualization of clouds and atmospheric phenomena (Hasan, Karim, & Ahmed, 2005), and natural phenomena modeling and rendering (Finch, 2004; Perlin, 2004) to mention just a few examples. These typical game features have a great potential for their utilization in the development of geovisualization applications, i.e., rendering actual terrain and geographic features instead of simulated ones. One major claim of this chapter is that the key for a successful impact of serious games in geovisualization resides in the possibility of applying the same engines and frameworks that were created for game development.

There are many widespread game development frameworks and platforms that provide realistic graphics and interaction features that facilitate the construction of game-based applications. Some of them have differentiated characteristics and capabilities, depending on the main focus of the application. For instance, OpenSceneGraph (OSG) (Martz, 2007) has a considerable set of

features for being used in flight simulator based applications, as well as a specialized flight simulation functionality and tools. Id Tech 3 (Quake III Arena), Id Tech 4 (Doom III engine), Gamebryo (Civilization IV, Dark Age of Camelot), CryEngine 2 (Crysis), Unreal Engine 3 (Unreal Tournament 3), Source (Half-Life, Counterstrike), and Jupiter EX (F.E.A.R game) are developed for first person shooter games (as cited in Trenholme & Smith, 2008). Also, there are several engines or game editors designed for specific games that were further reused to construct extensions or other related applications.

On the other hand, there are more generic platforms like OGRE (Object-Oriented Graphics Rendering Engine) (Junker, 2006) and TORQUE 3D ("Torque 3D documentation", 2011) that provide a generic set of features for different kinds of environments and applications (urban environments, landscapes, war environments, etc.).

These game engines and frameworks can be used as a basis for the construction of interactive applications for geovisualization. This approach takes advantage of the use of functionalities that are fully tested in a product, ensuring robustness, usability and performance, and supporting user interactivity. We explore this possibility, developing a real time 3D visualization system for topographic environments and associated geospatial information, using flight simulators (the OSG framework), scientific visualization concepts, and geographical database (geodatabase) technologies. The underlying database model takes advantage of, and is compliant with, existing Open Geospatial Consortium® (OGC) standards (2011). It is a clear example of how a serious game platform could be used for geovisualization.

Finally, the chapter explores a recent trend that is transforming the arena of game interaction, which is the use of new, high-end human-machine interfaces for gaming, and developing new controllers that complement and promote new interaction mechanisms. Game technology innovation enables the exploration of new ways

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