

Chapter 10

Scenegraph-Based Platform for 3D Computer Graphics Training

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ABSTRACT

We propose a framework for developing online interactive experiments for training students to master the basic concepts of 3D Computer Graphics. As 3D Computer Graphics has applications in a large range of fields (visual arts, media, geography. etc.), we need to devote particular attention to students that are nonexperts in Computer Science and particularly in programming. We also have to take into consideration the resources and efforts required for the development of online training modules. We describe our approach for designing and implementing accurate and efficient training modules and describe how we have implemented one particular use case scenario.

INTRODUCTION

In Cunningham (1999), the author stresses the importance of the development of courseware for online and distance education in Computer Graphics. He particularly points out the costs and human resources required. In this article, we propose a framework for developing online

interactive modules for training in 3D Computer Graphics (CG). We target two objectives: to offer valuable educational material that can be valid for non-Computer Science students; and to optimize the time and resources required for developing the modules. In the remainder of this section, we will survey the related works in the area of interactive and online educational material for 3D

CG. In the second section we develop our strategy for designing the training module. The resulting implementation is described in the third section, and a specific use case scenario is proposed in the fourth section.

We first briefly survey the available tools that teachers can use for developing interactive training exercises. The 3D CG field is particularly growing with dedicated tools. The first category of tools is 3D design software. In this category, we find some widely used software such as the 3DS Max Studio suite (3DS Max), which features strong modeling capabilities and a flexible plug-in architecture. It is widely used, for example, by video game developers, TV commercial studios, or architectural visualization studios. It is also used for movie effects and movie revisualization. Other commercial and Open Source solutions are also available. However, all these solutions offer the general 3D CG functionalities and much more. The second category of tools is programming solutions. In this case, a graphic library is used to directly write the complete training application. Currently, the most popular libraries are OpenGL and DirectX. Both provide an API dealing with 3D native functionalities. In this context, the teacher has to write a program that handles these functionalities. We need to find a compromise that directly provides a high-level access to state-of-the-art functionalities in 3D CG as with 3D design software, but also offers the flexibility to fully control the access to these functionalities as with 3D programming. There are two classical approaches to train students to let them experiment by themselves 3D CG concepts. They reflect the two types of tools available for developing interactive training material: (1) with programming exercises (Lewis, 2000; Hitchner, 2000; Cunningham, 2000) usually based on a standard programming language such as C++ or Java and a Graphics library API such as OpenGL; and (2) with design exercises (Van Gumster, 2003) usually based on a commercial or open source 3D interactive modeler such as 3DS Max

or Blender. Although these training methods are effective, they have the following basic drawbacks that prevent them from extending to interactive online training:

- Programming exercises give in-depth access to the basic concepts in 3D, but they also require as a prerequisite that the students have programming skills. This is usually the case for students in Computer Science but not for students from other disciplines. Unfortunately, the acquisition of sufficient programming skills would require too much overload to consider it as a viable general solution. Moreover, according to the range of various programming languages and 3D graphics library available, even Computer Science students may encounter difficulties mastering the programming environment.
- Interactive 3D modelers offer a complete package of features from the most basic ones to the most advanced ones. Unfortunately, as they are professional or semiprofessional production-oriented tools, they are quite complex to use and master, and they also feature a complex user interface. As a result, students need to spend a large amount of their time learning the software itself before being able to experiment with the 3D concepts. The existing efforts to provide interactive or online educational material in 3D Graphics offer a range of modalities from a simple online version of course notes with static graphics illustration (OCGn, Hyper-Graph), interactive graphics programming demonstration components (CGT, CGEMS, OpenGL tutors) (mostly in OpenGL) to be executed locally after download, to inline interactive Java applets for demonstration (ILO, AlgoViz, Exploratories, ICG). Most of them are oriented to algorithms demonstration rather than practice examples and to “low-level” (mainly graphics programming) aspects.

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