Modelling and Rendering Complex Environments

Dieter Fellner

Institut f. Informatik
Universiteat Bonn, Roemerstr. 164, D-53117 Bonn, Deutschland
Tel: (0228) 73-4315/-4292
Fax: (0228) 73-4382
email: fellner@cs.uni-bonn.de
http://hyperg.cs.uni-bonn.de/fellner

One of the “grand challenges” in Computer Graphics as a discipline is currently facing is the efficient handling of very complex environments. Complexity in this context can either stand for very large scenes (in terms of number of polygons) or for highly dynamic environments (creating complexity due to the rules of physics like turbulent flow, collision, deformation, ...) or for both.

One key approach to solve this challenge could be a much tighter integration of the modelling and rendering steps compared to what computer algorithms have done for the past.

This idea as well as first steps towards this direction will be illustrated on an modelling and rendering environment called MRT which has been developed in my lab over the past years. The primary goal of the project is the design of an object-based (in contrast to drawing-based) modelling and rendering platform consisting of a well structured and extensible set of objects that support all necessary operations to build a full-fledged modelling and rendering system. The 3D objects are the building blocks that lend themselves to programmer customisation through techniques such as subclassing. Further to the high-level 3D objects, rendering classes provide access to all levels of rendering algorithms from low-level z-buffering and Gouraud shading to ray-tracing or hierarchical radiosity.

As the name **Minimal Rendering Tool (MRT)** indicates, we tried to keep the package as minimal as possible. Nevertheless, experiences with the system prove that state-of-the-art functionality as well as advanced algorithms can be (and have been) incorporated into this renderer with a minimum amount of programming. MRT significantly improves the readability of the underlying algorithms, drastically improves productivity, and, most importantly, consists of building blocks that lend themselves to programmer customisation thus making 3D image synthesis more accessible.

One of the most important features of the MRT architecture is a consistent way of modelling scene objects, subscenes, and scenes. Objects keep their original representation as long as possible - in contrast of being converted to planar or other approximate representations at an early stage of the rendering pipeline.

Experiences with our (inhomogeneous) user population prove that the system meets its design goal of being highly customisable and extendible. Furthermore, it serves as a compact testbed for various modelling and rendering aspects as well as for new algorithms "outside" of the classical computer graphics domain.

This is supported by a cooperation with a German mobile communication network supplier. The development of a prototype package to simulate the 3D distribution of radio waves in urban environments based on MRT could be completed by one of our students within two weeks. The incredibly short development time (considering that we started from scratch) in combination with the fact that the prototype was significantly faster than what was available before made it fairly easy to attract external funding for this project called **CARPET (Calculation of Radio Propagation Employing a Threedimensional model)**.