CORE
Metadata, citation and similar papers at core.ac.uk
Provided by NASA Technical Reports Server

A FEW MODELING AND RENDERING TECHNIQUES FOR COMPUTER GRAPHICS AND THEIR IMPLEMENTATION ON ULTRA HARDWARE

by

Hari Bidasaria
Assistant Professor
Department of Computer Science
Pearce Hall
Central Michigan University
Mt. Pleasant, MI 48859

Abstract

Ultra network is a recently installed very high speed graphics hardware at NASA Langley Research Center. The Ultra Network interfaced to Voyager through its HSX channel is capable of transmitting up to 800 Million bits of information per second. It is capable of displaying fifteen to twenty frames of precomputed images of size 1024 x 2368 with 24 bits of color information per pixel per second. I have been working towards the development of few modeling and rendering techniques in computer graphics and their implementation on Ultra hardware.

Since sometime, I have been working on the modeling and rendering images of three dimensional objects through the use of generalized cylinders. A generalized cylinder is defined as a surface generated by a sweeping cross-section along a given trajectory. The sweeping cross-section undergoes, in general a continuous transformation in shape, size, position, and orientation as a function of the location along the trajectory. The sweeping cross-section by itself may or may not be intersected by the trajectory for the part or all of the way. The generalized cylinders make a powerful tool for the modeling of variety of three dimensional objects like screws, spirals, twisted rods etc., and various aircraft and space vehicle's parts. In ray-tracing (in computer graphics), for an object modelled through the use of a generalized cylinder, problem of finding the point of intersection of the ray with the surface of the generalized cylinder and the normal to the surface may become complex depending upon the type of the surface generated. I have been working towards reducing this problem to that of finding the point of intersection between two curves in a plane. Using this method, I have modelled and displayed several images on the Ultra Network Graphics system on the Voyager.

Presently the method of stochastic fractal geometry has been gaining popularity for the modeling of natural objects like trees, mountains, fern etc. I have been actively involved in the research in this area. An object defined by fractal geometry, the details of the structure of an object remain the same (or similar) as one zooms in more and more on the object. I have been developing models and code for the modeling and rendering of such objects on the Ultra Network. I have developed methods and code for the generation of impressive looking images of

botanical trees and mountains on the Ultra Network. I have also successfully developed a tree animation on the Ultra Network.

I have been also working on the development of the ray-tracer in use here at Flight Software and Graphics branch. The ray-tracer was not compatible with the voyager system. I have made the necessary changes in the ray-tracer and now it works well on the Voyager. I have modified it substantially, particularly the modeling through triangulation component of it, to make it more efficient. In fact, I have used this feature of the ray-tracer for the first time here at this branch and I have successfully animated an F-16 fighter plane (using the triangulation data available in the branch). I have made the program run faster by at least two orders of magnitude with the changes I have made to it for better efficiency. I am working towards further modifying the ray-tracer for multi-tasking on the Voyager so that four frames of images can be generated simultaneously for animation purposes.