AGOCG Rendering Evaluation

Introduction

This survey of rendering systems was funded by AGOCG, the UK Advisory Group on Computer Graphics.

Almost too much information has now become available about 3D rendering systems and their associated formats. Someone unfamiliar with 3D rendering systems could find it difficult to make a judgement about which direction to take. One of the difficulties is the different uses to which 3D rendering is put: visualization, entertainment, virtual reality, animation and so on.

This live survey aims:

- to take a broad approach, so that the diversity of uses to which renderers are put are represented here
- to use a common template where appropriate, to help make information easier to find
- to store as little as possible - where the content already exists elsewhere, a link is made to it, except for some brief summarising comments.
- to include information on formats and their converters, because the format of the renderer rarely matches the format of the data.

Structure of the Information

This survey contains information about software packages, the main interest being in renderers and format conversion. Information includes the platforms on which they run, the input formats they accept and, where relevant, the output formats also.

The survey also contains information on formats that are relevant to rendering systems - either those formats which are used directly as input to a renderer or can easily be converted to one. Software primarily devoted to format conversion is reachable via the formats which it handles.

Trademarks

Trademarks are not explicitly marked in these pages. However the web page for each product includes a link to a web page of, to the best of our belief, the relevant organisation. If there is any product for which this is not the case, please inform the contact point .

People involved in the survey

The survey has been carried out by the following people in the Department for Computation and Information at RAL: Julian Gallop, Chris Osland, Janet Haswell and Roger May.

If there are suggestions for additions or other improvements to this web on Rendering Systems, please mail the contact point for this survey.

Julian Gallop, 3 December, 1997

Rendering Survey - Packages

Information on specific packages

- AVS - scientific visualization system
- IBM Data Explorer (DX) - scientific visualization system
- GOOD - research object-oriented system for modelling and rendering
- Interchange - software for converting between a wide range of 3D geometry formats
- Iris Explorer - scientific visualization system
- MultiGen - modelling and animation systems
- Radiance - system for precise light modelling calculations
- Rayshade - system for high quality rendering
- RenderWare - fast rendering library on PCs, used as the basis for several VRML browsers
- Softimage - system for high quality rendering and animation
- 3D Studio - system for high quality modelling and rendering

General information other people have gathered

- general raytracing information

Packages - AVS

Purpose and General Description

AVS is a scientific visualization system. It provides a visual approach to analysing scientific and other data, using the dataflow approach to visualization. It is currently available in 2 versions: the older AVS5 and the current AVS/Express which comes in a Visualization Edition and a Developers' Edition. A wide range of public domain modules are available from the International AVS Centre. More information (dating from 1995) is available about dataflow systems in general, including AVS.

Output Formats Generated

The result of working with AVS can be a 3D abstract scene. Although AVS has a renderer, there may be reasons for wishing to export 3D scenes - for example, to make it available on the Web, to make a high quality still or video or to analyse it in a VR system. AVS generates its own geometry format and in Visualization Edition can also generate VRML. Other modules from the International AVS Centre can create other geometry formats.

Supplier and Cost

In the UK academic community, AVS is commercially available via a CHEST deal. In the UK but outside the academic community, it is available from Advanced Visual Systems Ltd and otherwise from Advanced Visual Systems

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Information last updated on 2 December 1997.

Packages - Data Explorer (DX)

Purpose and General Description

The IBM Visualization Data Explorer DX - or via European mirror . provides a visual approach to analysing scientific and other data, using the dataflow approach to visualization. A wide range of public domain modules are available via the Data Explorer Repository. More information (dating from 1995) is available about dataflow systems in general, including DX.

Output Formats Generated

The result of working with DX can be a 3D abstract scene. Although DX has a renderer, there may be reasons for wishing to export 3D scenes - for example, to make it available on the Web, to make a high quality still or video or to analyse it in a VR system. DX generates its own geometry format and other modules via the Data Explorer Repository can create other geometry formats.

Supplier and Cost

DX is commercially available from IBM .

Information last updated on 2 December 1997.

Packages - GOOD

Purpose and General Description

GOOD is a public domain software environment for interactive programming of 3D graphics. It consists of: a Tcl/C++ Raytracer/Shader/Radiosity (YART); an Interactive Object Manipulator (IOM); and (not available at present) a Module Application Framework (MAF), a C++ class library for dataflow-driven applications including IPC and data transfer.

Input Formats Accepted

YART accepts files which have been interactively prepared using IOM.

Output Formats Generated

YART generates images directly for display using X11 or a graphics packages such as OpenGL or GL.

Platforms

OpenGL (display lists, all rendering modes, Tk), IRIS GL (display lists, all rendering modes, Tk), X11 (all rendering modes, Tk [Very slow!]), and X11_VOGL (just wireframe and ray-tracing, no vertex colors, no gouraud shading, limited colors, no radiosity output, Tk)

Functionality

More detail about the functionality of YART and IOM can be found via the main page for GOOD .

Supplier and Cost

The GOOD environment is available public domain.

Information last updated on 2 December 1997.

Packages - InterChange

Purpose and General Description

InterChange translates between many different 3D file formats.

Input Formats Accepted

Many are accepted including 3DS, DXF, NFF (Haines), NFF (Sense8), QuickDraw 3D - see the complete table for each platform.

Output Formats Generated

All the formats mentioned above as "input", but also Renderman RIB, Renderware RWS and VRML - see the complete table for each platform.

Platforms

Microsoft Windows (3.1, 95 and NT) and SGI, on which InterChange handles a few additional formats. A different set is supported on the Amiga.

Functionality

Fuller description including a complete set of formats imported and exported.

Supplier and Cost

This is a commercial product from Viewpoint .

Information last updated on 2 December 1997.

Packages - Iris Explorer

Purpose and General Description

Iris Explorer is a scientific visualization system. It provides a visual approach to analysing scientific and other data, using the dataflow approach to visualization. A wide range of public domain modules are available online. More information (dating from 1995) is available about dataflow systems in general, including Iris Explorer.

Output Formats Generated

The result of working with Iris Explorer can be a 3D abstract scene. Although Iris Explorer has a renderer, there may be reasons for wishing to export 3D scenes - for example, to make it available on the Web, to make a high quality still or video or to analyse it in a VR system. Iris Explorer generates its own geometry format and VRML. Other modules online can create other geometry formats.

Supplier and Cost

Iris Explorer is commercially available from Nag .

Information last updated on 16 December 1996.

Packages - MultiGen

Purpose and General Description

MultiGen is an "interactive, graphical modeling system for creating, editing and viewing 3D, fully textured, out-the-window scenes and instrumentation for real-time visual simulation, VR and entertainment applications".

(Note the Web pages require high bandwidth for best results)

Input Formats Accepted

MultiGen can import 3D models in DXF, Alias, Wavefront and 3D Studio data formats. It can import terrains from DTED, USGS, SIF or DFAD data. It can import textures from image formats including GIF, TIFF, PCX, JPEG, IFF, Alias PIX and Wavefront RLA.

Output Formats Generated

In addition to its own database, MultiGen can export DXF.

Platforms

Available on SGI platforms.

Functionality

Numerous options exist, including Road Tools for civil engineering, terrain modelling (from USGS and DMA DTED data), textures, audio, behaviour and instrumentation.

Comments

Other related products are available from MultiGen, including SmartScene is also intended for assembling 3D scenes for real time use, but provides a more intuitive design, taking advantage of natural hand-eye coordination.

Applications include "flight, ground and marine simulation, accident reenactment, virtual reality, entertainment and other real-time applications".

Supplier and Cost

Commercial product available from MultiGen

Information last updated on 2 December 1997.

Packages - Radiance

Purpose and General Description

"Radiance is a suite of programs for the analysis and visualization of lighting in design." "Radiance is used by architects and engineers to predict illumination, visual quality and appearance of innovative design spaces, and by researchers to evaluate new lighting and daylighting technologies." "Radiance includes many of the features of popular computer graphics rendering programs with the physical accuracy of an advanced lighting simulation." Radiance is used by the ECADAP project in the UK, who have some Radiance images online.

Input Formats Accepted

"Input files specify the scene geometry, materials, luminaires, time, date and sky conditions (for daylight calculations)." These files are Radiance's own format. Translators to Radiance from the "IES standard luminaire data format and AutoCAD's DXF format (version 10) are included with the distribution." Translators to Radiance from other CAD formats and some image formats are also available.

Output Formats Generated

The resulting output is an image. The reference manual mentions an AED 512 graphics terminal and an X-window server. Translators to other image formats are available.

QuickTime VR movies and objects have also been generated with Radiance on a Macintosh.

Platforms

Radiance is available on Unix systems and requires an 8 bit colour display. The rendering programs are very compute intensive.

Several useful Macintosh applications have been written by Paul Bourke and his associates at Auckland University in New Zealand, including a 3-dimensional editor that produces Radiance scene descriptions as an export option."

"A few of the programs rely on interprocess communication or the presence of the C-shell interpreter, but the majority will run unmodified on non-UNIX systems, and have even been ported to a DOS (386) environment"

Functionality

The package includes programs for modeling and translating scene geometry, luminaire data and material properties. The lighting simulation itself uses ray tracing techniques to compute radiance values. Reflections can include specular and diffuse components. The package can use low resolution output images for speed or high resolution for accuracy.

Supplier and Cost

Radiance is available from the main ftp distribution site. It is free but not public domain - there are conditions in the README file.

Information last updated on 2 December 1997

Packages - Rayshade

Purpose and General Description

Rayshade is an extensible system for creating ray-traced images and is designed to be easy to alter. The introductory page links to the Rayshade archives, a full user's guide, a quick-reference sheet, example images, course notes, user-contributed extensions, the Rayshade objects library and the Utah Raster Toolkit.

Input Formats Accepted

Tools are provided with Rayshade to convert from various alternative formats into Rayshade's own native format .ray - in addition Iv2Ray (link not available when last attempted) converts from Inventor format.

Output Formats Generated

Rayshade generates images and makes use of the Utah Raster Toolkit .

Platforms

The general information page reports that Rayshade has been tested on many different UNIX-based computers, including: SGI 4D, IBM RS6000, Sun Sparcstations, Sun 3&4, DECstation, Apollo DN10000, NeXT, HPs, and so on. If your machine has a C compiler (non-ANSI OK), enough memory (at least 4Mb), and runs something resembling UNIX, Rayshade should be fairly easy to port. Rayshade has also been ported to non-UNIX platforms, including MSDOS, the Macintosh, the Amiga, and OS2.

Functionality

- The general information page provides further detailed information about Rayshade.

Supplier and Cost

Rayshade is free.

Information last updated on 2 December 1997.

Packages - RenderWare

Purpose and General Description

RenderWare is a 3D Graphics Library, targeted mainly at games developers. It claims to achieve fast rendering even without the benefit of a graphics accelerator.

- RenderWare summary (link not available when last attempted)

Input Formats Accepted

Tools are available within the package for converting DXF, VRML and 3DS to RenderWare's own native format RWS.

Platforms

PC with DOS/Windows 3.1/Windows 95 or Power Mac.

Functionality

- Example of a RenderWare script
- RenderWare demonstrations (link not available when last attempted)

Supplier and Cost

RenderWare price list for the UK (link not available when last attempted)

Information last updated on 2 December 1997.

Packages - Softimage

Purpose and General Description

Softimage 3D is a high-end software package for 3D animation - modelling, animating, and rendering - all within one seamless environment and is used for high quality work.

Platforms

SGI platforms and more recently also available on PCs with Windows NT. A range of graphics accelerators is supported.

Functionality

Details of Softimage 3D are available.

Supplier and Cost

Softimage 3D is a commercial product, obtainable via sales offices world wide.

Information last updated on 2 December 1997.

Packages - 3D Studio

Purpose and General Description

3D Studio products are widely used for modelling, rendering and animation. They include 3D Studio R4, 3D Studio MAX and 3D Studio VIZ.

Input Formats Accepted

- 3DS (the native format for 3D Studio)
- DXF

Output Formats Generated

Being the native format, 3D Studio can also save 3DS files.

Platforms

Available on PC

Functionality

More details of 3D Studio products

Supplier and Cost

Commercial product, obtainable from Autodesk

Information last updated 2 December 1997.

Rendering Survey - Formats

Information on specific formats

- BGF - the binary geometry format for Division's VR software.
- DXF - interchange format originally for AutoDesk's AutoCAD software. Many CAD systems and modelling packages can export DXF and there are convertors from DXF to most other 3D geometry formats.
- IGES - used for the exchange of information between CAD systems.
- Inventor - the format associated with the SGI Open Inventor toolkit. Its usage widened when it became the basis for VRML 1.0.
- NFF - in fact two different formats. One is the Haines Neutral File Format and was used in conjuction with tests of rendering algorithms. The other is the neutral file format for the Sense8 World ToolKit.
- VDI - the format for defining a virtual environment for Division's VR software.
- VRML - with its high profile on WWW and its progress towards standardisation within ISO, this is becoming accepted as a way of exchanging information about virtual environments and linking them together over the Internet.
- 3DS - designed as the interchange format from AutoDesk's 3D Studio modelling, rendering and animation system. Can be converted to the formats for other rendering systems and VR systems. Appropriate if using 3D Studio for modelling and using a different system for rendering.

General information other people have gathered

- Keith Rule's 3D Home Page - uses Common Ground conventions and is only readable on MS Windows.
- Graphics File Formats Page from University of Edinburgh
- A brief summary of 3D object file formats , some of them including a link to the specification.

Data Format - VDI & BGF

Purpose and General Description

BGF and VDI are formats used by VR software from Division . BGF is the Binary Geometry File format. VDI is the Virtual Data Interchange format and contains a comprehensive set of definitions for a virtual environment. As well as a reference to geometry files, a VDI file can contain audio, collision, constraint management, events, keyframes for animation, lights, physical properties, references to material and texture files, space zoning and the definition of the user role in the virtual environment.

Packages/Toolkits that output VDI

Several Geometry Conversion Tools to VDI and accompanying BGF files from 3DS, DXF, Inventor, VRML and Wavefront OBJ and MTL formats are available from Division.

Packages/Toolkits that input BGF

Geometry Conversion Tools from BGF to 3DS and DXF are available from Division.

Information last updated on 17 March 1998.

Data Format - DXF

Purpose and General Description

The DXF format is the interchange file format for AutoDesk's AutoCAD package. The format has become a widely accepted format for the transfer of 3D geometries between different packages, not necessarily involving AutoCAD, and, for any given renderer format, a converter from DXF usually exists. DXF includes support for 3D objects, curves, text and associative dimensioning.

Packages/Toolkits that output it

In addition to the CAD systems that can export it, DXF can be converted to/from other formats.

- from Wavefront OBJ files
- MultiGen
- Geometry Conversion Tools from Division's Dvs/Dvise VR system
- Excel spreadsheets to DXF
- InterChange converts from a large number of formats including: 3DS, Haines NFF, Sense8 NFF, Wavefront OBJ.

Packages/Toolkits that input it

- The Silicon Graphics DXFtoIv converter (README and tar file)
- MultiGen
- Geometry Conversion Tools to Division's Dvs/Dvise VR system
- DXF-IN for Visual Basic 2.5
- to VRML - see the translators in the VRML Repository
- InterChange converts to a large number of formats including: 3DS, Haines NFF, Inventor, POV, Renderman RIB, Renderware RWX, Sense8 NFF, VRML, Wavefront OBJ.

Functionality

Information on the DXF format can be found elsewhere as follows:

- Format specifications for DXF 14 and earlier

Information last updated by JRG on 17 March 1998

Data Format - IGES

Purpose and General Description

IGES, the Initial Graphics Exchange Specification, is a widely used CAD data exchange specification. However, IGES is a very complex specification and fully utilizing IGES data files requires expert knowledge of the format. An overview of the IGES validation service at NIST is available.

Many CAD systems import and export IGES including systems from Parametric Technology Solutions / Computervision.

It is also possible to convert

IGES to VRML.

Further Information

- The role of IGES in CALS (this page also similarly summarises the role of STEP).

Information last updated on 17 March 1998

Data Format - Inventor

Purpose and General Description

Open Inventor is an object-oriented toolkit for developing interactive, 3D graphics applications. It also defines a standard file format for exchanging 3D data among Open Inventor applications.

The Open Inventor format was originally available only on SGI based machines, but has recently become more available on other platforms due to the work of Template Graphics (TGS) and has become more widely used due to its role as the starting point for VRML (overview of the relationship between Inventor and VRML 1.0).

Packages/Toolkits that output it

- SGI 3D file translators and translators from Abaco including: DXF, Alias, Softimage, Obj, 3DS .
- InterChange converts from a large number of formats including: 3DS, DXF, Haines NFF, Sense8 NFF.

Packages/Toolkits that input it

- ivToVRML translator to VRML
- Iv2Ray translator to Rayshade format (.ray).
- On SGI, InterChange converts to a large number of formats including: 3DS, DXF, Haines NFF, Inventor, POV, Renderman RIB, Renderware RWX, Sense8 NFF and VRML.

Functionality

- An introduction to the Open Inventor file format
- Open Inventor information from Template Graphics including the FAQ and the specification
- Descriptions of the Open Inventor File format

Input Formats - NFF

There is some confusion about the NFF file format. In addition to Network File Format, which is not a 3D geometry format, there are two different formats using the same name, Neutral File Format. The following are pages containing information about them.

- Haines Neutral File Format
- World Toolkit Neutral File Format

Data Format - VRML

Purpose and General Description The Virtual Reality Modeling Language (VRML) is a standard language for describing interactive 3-D objects and worlds delivered across the Internet using the World Wide Web. The goal of VRML (pronounced by some "vermel") is to create the infrastructure and conventions of cyberspace, a multi user space of many virtual worlds on the Net.

VRML 1.0 is based on the Inventor File Format (ASCII) with some additions to allow linking out to the Web and including other URLs (overview of the relationship between Inventor and VRML 1.0). The linking out feature (WWWAnchor) provides the same feature that HREF anchors provide in HTML. Another critical feature was the LOD (level of detail) which allows the right amount of data for an object based on how prominent it is in the scene, or the rendering speed of the browsing machine. VRML .0 is a major enhancement and now entering the formal ISO standardisation process.

The VRML repository at the San Diego Supercomputer Center or its Italian Mirror are good places to start looking for information on VRML, including specifications of VRML 1.0 and .0 . Packages/Toolkits that output it The SDSC repository has a comprehensive list of convertors which export VRML, which are numerous for version 1.0 and increasingly so for .0. Packages/Toolkits that input it The SDSC repository has a comprehensive list of VRML browsers , which are numerous for version 1.0 and increasingly so for .0.

A few of the translators referred to in the SDSC repository import VRML and convert to another format, such as: wrloff Functionality

- Specifications of VRML
- Information on the original 6 proposals for VRML .0, from which the choice for further work was made, and the result of the poll.
- The VRML FAQ
- Links to popular VRML sites

Further Information Examples:

- Example Applications referred to by the SDSC VRML Repository

- BT - AA&T Portal (examples of VRML)
- xtal-3d VRML construction of 3D crystal structures

Some key players:

- VRML Architecture Group which is responsible for fostering the future of VRML
- Template Graphics Software which is responsible for a variety of VRML tools

Commercial VRML products

The Marriage of Java and VRML by Adrian Scott.

Information last updated on 1 September 1996

Data Format - 3DS

Purpose and General Description

The 3DS format was originally designed for use with the 3D Studio package from AutoDesk. 3D Studio is a powerful rendering and animation package for PCs.

- Large amount of information about 3D Studio (formats, gallery, FAQ's etc)

Packages/Toolkits that output it

- A translator for Wavefront OBJ to 3DS
- Translator for Division BGF files to 3DS
- A translator for Pro/Engineer SLP to 3DS
- InterChange converts from a large number of formats including: DXF, Haines NFF, Sense8 NFF.

Packages/Toolkits that input it

- A 3DS to VRML translator
- A translator for 3DS to SGI Inventor format
- A translator for 3DS to Division VDI format
- A translator for 3DS to Materials and Geometry Format MGF
- A translator for 3DS to Softimage HRC
- A translator for 3DS to Wavefront obj files
- A translator for 3DS to Apple QuickDraw3D Metafile Format
- InterChange converts to a large number of formats including: DXF, Haines NFF, Inventor, POV, Renderman RIB, Renderware RWX, Sense8 NFF and VRML.