

PACKAGE ID - 000645IB38600 RADIANCE2.3

KWIC TITLE - Geometric Modeling, Radiation Simulation,
Rendering, Analysis Package

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LIMITATION CODE -COPY **AUDIENCE CODE** - LIM

COMPLETION DATE - 12/17/1993 **PUBLICATION DATE** - 12/17/1993

DESCRIPTION - RADIANCE is intended to aid lighting designers and architects by predicting the light levels and appearance of a space prior to construction. The package includes programs for modeling and translating scene geometry, luminaire data and material properties, all of which are needed as input to the simulation. The lighting simulation itself uses ray tracing techniques to compute radiance values (ie. the quantity of light passing through a specific point in a specific direction), which are typically arranged to form a photographic quality image. The resulting image may be analyzed, displayed and manipulated within the package, and converted to other popular image file formats for export to other packages, facilitating the production of hard copy output.

PACKAGE CONTENTS - Media Directory; Software Abstract; User Commands; Behavior of Materials in RADIANCE; Materials and Their Reasonable Values; RADIANCE Tutorial; The RADIANCE 2.3 Synthetic Imaging System; Media Includes Source Code, Text Library, Object Library, User's Guide, Auxiliary Material, Compilation Instructions, Linking Instructions, Sample Problem Input Data;

SOURCE CODE INCLUDED? - No

MEDIA QUANTITY - 4 3.5 Diskettes

METHOD OF SOLUTION - The major portion of the RADIANCE package, and the part that is of chief interest to users, is the lighting simulation engine that calculates light levels and renders images. The input required for this simulation is a description of the 3-dimensional surface geometry, materials, and light sources in a scene. Rendering an image requires additional specification for the view point, direction, and angles desired. The lighting simulation engine of RADIANCE uses a hybrid approach of Monte Carlo and deterministic ray tracking to achieve a reasonably accurate result in a reasonable time. The method employed starts at a measurement point (usually a viewpoint) and traces rays of light backwards to the source (i.e. emitters). The calculation can be divided into three main parts: the direct component, the specular indirect component, and the diffuse indirect component. In addition to the basic simulation method, a secondary light source calculation may be performed for windows, skylights and other illumination

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METHOD OF SOLUTION - (CONT) portholes. The distribution of such a source is computed in a preprocess, greatly improving the efficiency and accuracy of the final rendering.

COMPUTER - IBM PC 386

OPERATING SYSTEMS - DOS-386

PROGRAMMING LANGUAGES - C

SOFTWARE LIMITATIONS - Geometric input to RADIANCE consists of a boundary representation using N-sided polygons (concave or convex, holes represented with seams), spheres, cones, cylinders and rings (ie. circles with holes). There is also an antimatter type that permits surface subtraction under limited circumstances. Scene complexity is limited by available memory, where 2000 surfaces require approximately 1 megabyte of RAM and the requirement grows linearly with the number of surfaces. This requirement may be avoided in cases of repetitive detail through the uses of instances, ie. geometric shapes duplicated in different scene locations. Instancing permits scenes with millions or even billions of surfaces to be modeled efficiently. Although RADIANCE attempts to account for all significant sources of illumination, there are a few cases that are not adequately modeled in the present calculation. The most important of these is the reflection of intense light from curved specular surfaces, such as might be found within a heliostat or parabolic light fixture. Computing light from such a system requires a ray tracing method that follows light in the forward direction, starting at the emitters and working outward. Since RADIANCE works strictly in the reverse direction, a separate preprocess is necessary to compute these output distributions. This hypothetical preprocessor is not included in the present package.

SOURCE CODE AVAILABLE (Y/N) - N

UNIQUE FEATURES - RADIANCE includes many of the features of popular computer graphics rendering programs with the physical accuracy of an advanced lighting simulation. This combination of flexibility and accuracy makes it unique in providing realistic images with predictive power for architects, engineers, and lighting designers. Its flexibility is demonstrated in applications as diverse as forensics (ie. roadway accident reenactment by Failure Analysis and Associates, CA) and aerospace (ie. space station design by NASA, Goddard). RADIANCE has been compared to other lighting calculations, scale model measurements and real spaces to validate its capabilities. No other lighting calculation has undergone a more vigorous validation.

RELATED SOFTWARE - Translators for the IES standard luminaire data format and Auto CAD's DXF format (version 10) are included with

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RELATED SOFTWARE - (CONT) the distribution.

HARDWARE REQS - Minimum recommended configuration is 8 Mbytes of RAM, 16 Mbytes of free disk space, and a 8 bit color display. Since the rendering programs are very compute intensive, a fast processor and floating point support are strongly recommended.

TIME REQUIREMENTS - Rendering time depends strongly on the output image resolution, the number of light sources, scene complexity, the importance of indirect illumination, and the desired accuracy. Rendering time depends weakly on the materials used, emitting surface dimensions and output distributions, and the number of images rendered under the same lighting conditions (since diffuse indirect values may be reused just like radiosites).

REFERENCES - G. Ward, RADIANCE Tutorial; The RADIANCE 2.3 Synthetic Imaging System.

ABSTRACT STATUS - Submitted December 1993. Released AS-IS March 1994.

SUBJECT CLASS CODE - TN

KEYWORDS -

COMPUTER PROGRAM DOCUMENTATION
R CODES
LIGHTING SYSTEMS
COMPUTERIZED SIMULATION
COMPUTER-AIDED DESIGN
IMAGE PROCESSING

EDB SUBJECT CATEGORIES -
990200 320106

SPONSOR - DOE/CE

PACKAGE TYPE - AS - IS