RayStorm Documentation

Andreas Heumann

COLLABORATORS			
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ACTION	*NAME*	*DATE*	*SIGNATURE*
WRITTEN BY	Andreas Heumann	June 25, 2022	

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1.2 RayStorm Documentation

```
                                                      06  ←↩
                                                 August ←↩
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            R a y S t o r m
    v1.0
```

```
                                           Demoversion
                         by Andreas Heumann and Mike Hesser


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1.3   Introduction

```
                 INTRODUCTION
```

RayStorm has been written to be as fast as possible, and use as less
memory as possible. Thus we have implemented a octree algorithm, and
optimized all calculations as much as we could.

It has been developed on Amiga and also on PC, therefore there also
exists a
                 PC-Version
                 .

This demo version is limited to a resolution of 160x128, only 2
lightsources and only 17 objects.

The full version is unlimited.

    FUNDAMENTALS ABOUT RAYTRACING

                 General

                 Octree

                        Antialiasing

                        Surfaces

                        Internals

1.4   General

    GENERAL

Raytracing makes it possible to generate fotorealistic pictures of objects.

A raytracer casts a ray form the position of the viewer through a scene
and calculates the intersections with the objects in that scene.
If a intersection is found, the raytracer decides which color the object
at this position has. If the object is reflective or transparent, the
raytracer casts new rays from this positon and tests the intersections
again and so on ... .

To make the surfaces of the objects more realistic, textures which
simulate marble or clouds or water or other surfaces can be used.

1.5   Octree

    OCTREE

Simple raytraces determine the intersections with objects by testing all
objects. This can lead to long rendering times if there are a lot of
objects in the scene.

One solution of this problem is the Octree algorithm.
This algorithm divides the scene in eight childcells and every childcell
again in eight cells and so on until there are less than one objects in the
cell or the maximum depth of the tree is reached.

Octree division

```
              _
             /| z
            /
     /-------/-------/|
   ^ y/       /       / |
   | / left  / right / b|
   |/       /       / |a|
   |-------/-------| f|c|
   |               | r|k|
   |      up       | o| /
   |--------------| n|/
   |               | t|
   |     down      | /   x
   |--------------|/-->
```
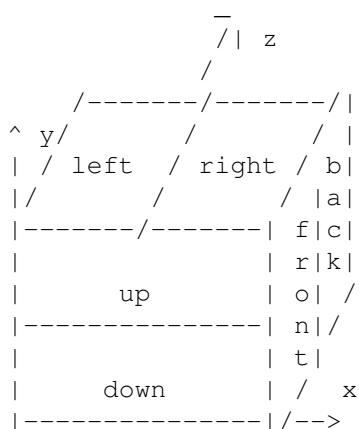
1.6   Antialiasing

```
   ANTIALIASING
```

RayStorm uses a algorithm called 'Adaptive Supersampling' to do antialiasing.
This algorithm cast for each pixel which has a high contrast against it's
four neighbours new rays which are close to the ray used for the pixel
itself. The new color of the pixel is calculated with the supersampled
pixels and the gaussian filter.

```
Example:
  Settings: squareroot of number of samples per pixel: 3


|--------|--------|--------|
| super- | super- | super- |
| sampled| sampled| sampled|
|        |        |        |
|--------|--------|--------|
| super- |        | super- |
| sampled| pixel  | sampled|
|        |        |        |
|--------|--------|--------|
| super- | super- | super- |
| sampled| sampled| sampled|
|        |        |        |
|--------|--------|--------|

|- Gaussian filter width  -|
```

The rendering time increases dramatically if you use antialiasing. The
values below depend on the contrast of the picture.

```
Samplesetting       rendering time
1                   x1
2                   x4
3                   x9
4                   x16
...                 ...
```

Setting higher than 3 are not leading to significant better results.

1.7   Surfaces

```
   SURFACES
```

Ambient (set with AMBIENT)

This determines the color of the object in sections, which are in shadow.

Diffuse reflection (set with DIFFUSE)

The diffuse reflection falls off as the cosine of the angle between
the normal and the ray to the light. Diffuse reflection determines the

main color of the object (color in Imagine).

Specularly reflected highlights (set with SPECULAR)

Specularly reflected highlights fall off as the cosine of the angle
between the reflected ray and the ray to the light source (specular in
Imagine)

Specular reflection exponent (set with REFPHONG)

Determines the size of the specularly reflected highlights, the higher
the smaller the highlight (hardness in Imagine)

Diffuse transmission (set with DIFFTRANS)

Same as diffuse reflection, but only used if the lightsource is on
opposite side of surface. Only applied if tranlucency is not 0.

Specular transmission (set with SPECTRANS)

Same as specular reflection, but only used if the lightsource is on
opposite side of surface. Only applied if tranlucency is not 0.

Specular transmission exponent (set with TRANSPHONG)

Same as specular reflection exponent, but only used if the lightsource
is on opposite side of surface.

Specular transmittance (set with TRANSLUC)

Specular transmittance.

Transparency (set with TRANSPAR)

Transparent color (filter in Imagine).

Reflectivity (set with REFLECT)

Reflective color (reflect in Imagine).

Transmission attenuation (set with TRANSATTU)

(fog in Imagine).

Index of refraction (set with REFRINDEX)

Determines how the ray through transparent objects is refracted, the higher
the more (index of refraction in Imagine).
Is calculated with the formula

```
          lightspeed in vacuum
  index = --------------------
          lightspeed in object    .
```

1.8   Internals

```
   INTERNALS
```

Memory requirements

```
Triangle:       142 Bytes (flat shaded)
                178 Bytes (Phong shaded)
Sphere:          58 Bytes
Plane:           66 Bytes
Surface:        118 Bytes + length of name
Screenbuffer:     4 Bytes per pixel
```

Memory requirements of the octree depends on the scene.

1.9   Requirements

```
                REQUIREMENTS
```

(1) You will need at least Kickstart 2.0 and a 68020 processor and a
    mathematical coprocessor (68881/882 or internal 68040/060 version).

    The faster the better :-).

(2) ShowObj was written using
                 MUI
                 . So you need
    muimaster.library V2.0+ or later to run ShowObj.

```
Tested with:
A2000 68040/30, 9MB, 250+250MB HD, Merlin Gfx-board
A2000 68030/14, 68882/20, 4MB, 720+52MB HD
```

1.10   Features

```
   FEATURES
```

- Fast. About 20% faster than Imagine.

- ARexx-port. RayStorm can be used by all programs with the ARexx-port.

- Imagine compatible. RayStorm is designed to be almost compatible to
  Imagine. It can load Imagine objects and use Imagine textures.

- Octree algorithm used for rendering.

- Antialiasing possibility (adaptive supersampling).

- Image can be saved as 24Bit IFF-ILBM file.

- Three builtin object types: sphere, plane and triangle.

– Three light types: ambient, point and spot.

– Depth of field

1.11   Installation

   INSTALLATION

There is a installation script included in the archive which uses the
Commodore Installer. Run it to install RayStorm.

1.12   ARexx Interface

                 AREXX INTERFACE

Address

The ARexx-address of RayStorm is 'RAYSTORM'.

Parameter conventions:
  /S – Switch.
  /N – Number.
  /A – Required.

  All other numeric parameters are floating point numbers.

ARexx commands

               General

               Objects

               Attributes

               Animation

              Errors
        Alphabetically sorted

–A–

               ALIGNMENT

               AMBIENT

               ANTIALIAS
               –B–

               BRUSH

               BRUSHPATH

```
-C-

CLEANUP
-D-

DIFFTRANS

DIFFUSE

DISPLAY
-I-

IMTEXTURE
-L-

LOADOBJ
-M-

MAXFRAMES
-N-

NEWSURFACE
-O-

OBJECTPATH
-P-

PLANE

POINTLIGHT

POSITION
-Q-

QUIT
-R-

REFEXP

REFLECT

REFRINDEX
-S-

SAVEPIC

SETCAMERA

SETSCREEN

SETWORLD

SIZE

SPECTRANS

SPECULAR
```

```
            SPHERE

            SPOTLIGHT

            STARTRENDER
            -T-

            TEXTUREPATH

            TRANSATTU

            TRANSEXP

            TRANSLUC

            TRANSPAR

            TRIANGLE
            -W-

            WINTOFRONT
```

1.13 antialias

```
            ANTIALIAS

Arguments:     SAMPLES/N/A     squareroot of number of samples per
                               pixel (max. 8)
               WIDTH           width of gaussian filter
               CONTR,CONTG,CONTB  max. allowed contrast
Description:   Sets antialiasing parameters (see
                Antialiasing
                )
Default:       ANTIALIAS 1 1.8 51 38 76
```

1.14 brushpath

```
   BRUSHPATH

Arguments:     PATH/A          pathname
Description:   Defines the path where to search brushes.
```

1.15 cleanup

```
   CLEANUP

Arguments:     none
Description:   Deletes all defined objects, lightsources and surfaces
```

1.16 display

```
DISPLAY
```

```
!!! CAUTION !!!
THIS COMMAND ISN'T RELEASED IN THIS VERSION YET
!!! CAUTION !!!
```

```
Arguments:     FLOYD/S       dither with Floyd-Steinberg algorithm
Description:   Displays rendered pic on screen
```

1.17 objectpath

```
OBJECTPATH
```

```
Arguments:     PATH/A          pathname
Description:   Defines the path where to search Imagine objects.
```

1.18 pointlight

```
POINTLIGHT
```

```
Arguments:     POSX, POSY, POSZ     position
               COLR/N, COLG/N, COLB/N     color
               SHADOW/S              cast shadows if keyword given
Description:   Creates a point lightsource
Default:       POINTLIGHT 0 0 0  255 255 255
```

1.19 quit

```
QUIT
```

```
Arguments:     none
Description:   Quits Raystrom
```

1.20 savepic

```
SAVEPIC
```

```
Arguments:     NAME/A               name of file to save
Description:   Saves rendered pic as IFF-ILBM-file
```

1.21 setcamera

```
   SETCAMERA
```

```
Arguments:    POSX/A, POSY/A, POSZ/A  position
              VIEWX, VIEWY, VIEWZ  viewpoint
              VUPX, VUPY, VUPZ     viewupvector
              FOVX, FOVY           field of view (in degree)
                (20 degree creates camera like Imagine default camera)
              FOCALDIST            distance from eye to focal plane
              APERTURE             aperture width (0 == pinhole)
Description:  Sets the parameters of the camera
Default:      SETCAMERA 0 0 -10  0 0 0  0 1 0  45 45 1. 0.
```

1.22 setscreen

```
   SETSCREEN
```

```
Arguments:    RESX/N/A, RESY/N/A   resolution
              COLORS/N             number of colors (not yet implemented)
Description:  sets the screen parameters
Default:      SETSCREEN 128 128 32
```

1.23 setworld

```
   SETWORLD
```

```
Arguments:    BACKR/N/A, BACKG/N/A, BACKB/N/A  backgroundcolor
              AMBR/N, AMBG/N, AMBB/N           ambientcolor
Description:  Sets world parameters
Default:      SETWORLD 0 0 0  0 0 0
```

1.24 spotlight

```
   SPOTLIGHT
```

```
Arguments:    POSX, POSY, POSZ     position
              COLR/N, COLG/N, COLB/N    color
              DIRX, DIRY, DIRZ     direction
              COEFF                coefficent
              SHADOW/S             cast shadows if keyword given
Description:  Creates a spot lightsource
Default:      SPOTLIGHT 0 0 0  255 255 255
```

1.25 startrender

```
    STARTRENDER
```

```
Arguments:    QUICK/S                 render quick (no shadows, reflections and
                                      transparency)
              DEPTH/N                 depth of generated octree (Default 3)
Description:  Starts rendering process
```

1.26 texturepath

```
    TEXTUREPATH
```

```
Arguments:    PATH/A        pathname
Description:  Defines the path where to search textures.
```

1.27 wintofront

```
    WINTOFRONT
```

```
Arguments:    none
Description:  Brings RayStorm window in front
```

1.28 loadobj

```
    LOADOBJ
```

```
Arguments:    NAME/A                filename
              POSX, POSY, POSZ      position
              ALIGNX, ALIGNY, ALIGNZ  alignment (in degrees)
              SCALEX, SCALEY, SCALEZ  scaling
Description:  Loads an Imagine TDDD-file object with attributes, brushes
              and textures
```

1.29 plane

```
    PLANE
```

```
Arguments:    SURF/A                surface name
              POSX, POSY, POSZ      position
              NORMX, NORMY, NORMZ  normal
Description:  Creates a plane
Default:      PLANE ??? 0 0 0  0 1 0
```

1.30 sphere

```
SPHERE
```

```
Arguments:    SURF/A                surface name
              POSX/A, POSY/A, POSZ/A  position
              RADIUS/A              radius
Description:  Creates a sphere
```

1.31 triangle

```
TRIANGLE
```

```
Arguments:    SURF/A                surface name
              P1X/A, P1Y/A, P1Z/A  first point
              P2X/A, P2Y/A, P2Z/A  second point
              P3X/A, P3Y/A, P3Z/A  third point
              N1X, N1Y, N1Z        first normal
              N2X, N2Y, N2Z        second normal
              N3X, N3Y, N3Z        third normal
Description:  Creates a triangle
```

1.32 newsurface

```
NEWSURFACE
```

```
Arguments:    NAME/A
Description:  Creates a new surface with name 'NAME'
```

1.33 ambient

```
AMBIENT
```

```
Arguments:    COLR/N/A, COLG/N/A, COLB/N/A    color
Description:  Sets the ambient color of surface
Default:      AMBIENT 255 255 255
```

1.34 brush

```
BRUSH
```

```
Arguments:    NAME/A                name of brush file (IFF-ILBM)
              TYPE/A                Brush type: valid strings
                                    COLOR, REFLECT, FILTER, ALTITUDE
              WRAP/A                Brush wrapping method: valid strings
                                    FLAT, WRAPX, WRAPY, WRAPXY
              PX/A, PY/A, PZ/A      position
```

```
                AX/A, AY/A, AZ/A      alignment
                LX/A, LY/A, LZ/A      length of each axis
Description:    Adds a brush to surface (only 24Bit-IFF-ILBM images are
                supported)
```

1.35 difftrans

```
   DIFFTRANS
```

```
Arguments:    COLR/N/A, COLG/N/A, COLB/N/A     color
Description:  Sets the diffuse transmission color of surface
Default:      DIFFTRANS 0 0 0
```

1.36 diffuse

```
   DIFFUSE
```

```
Arguments:    COLR/N/A, COLG/N/A, COLB/N/A     color
Description:  Sets the diffuse color of surface
Default:      DIFFUSE 255 255 255
```

1.37 imtexture

```
   IMTEXTURE
```

```
Arguments:    NAME/A           name of Imagine texture file
              PX, PY, PZ       position
              AX, AY, AZ       alignment
              LX, LY, LZ       length of each axis
              P1, P2, P3, P4, P5, P6, P7, P8, P9, P10, P11, P12, P13,
              P14, P15, P16    texture parameters
Description:  Adds a Imagine texture to surface
Default:      defaults are take from texture if not all paramters are given
```

1.38 refexp

```
   REFEXP
```

```
Arguments:    VALUE/A               specular reflection exponent
Description:  Sets the specular reflection exponent of surface
Default:      REFEXP 12.
```

1.39 reflect

```
   REFLECT

Arguments:      COLR/N/A, COLG/N/A, COLB/N/A      color
Description:    Sets the specular reflectivity of surface
Default:        REFLECT 0 0 0
```

1.40 refrindex

```
   REFRINDEX

Arguments:      VALUE/A                   index of refraction
Description:    Sets the index of refraction of surface
Default:        REFRINDEX 1.
Examples:       MATERIAL                          Index
                -------------------------------------
                Vacuum ..................... 1.00000 (exactly)

                Air (STP)................... 1.00029
                Acetone .................... 1.36
                Alcohol .................... 1.329
                Amorphous Selenium ......... 2.92
                Calspar1 ................... 1.66
                Calspar2 ................... 1.486
                Carbon Disulfide ........... 1.63
                Chromium Oxide ............. 2.705
                Copper Oxide ............... 2.705
                Crown Glass ................ 1.52
                Crystal .................... 2.00
                Diamond .................... 2.417
                Emerald .................... 1.57
                Ethyl Alcohol .............. 1.36
                Flourite ................... 1.434
                Fused Quartz ............... 1.46
                Heaviest Flint Glass ....... 1.89
                Heavy Flint Glass .......... 1.65
                Glass ...................... 1.5
                Ice ........................ 1.309
                Iodine Crystal ............. 3.34
                Lapis Lazuli ............... 1.61
                Light Flint Glass .......... 1.575
                Liquid Carbon Dioxide ...... 1.20
                Polystyrene ................ 1.55
                Quartz 1 ................... 1.644
                Quartz 2 ................... 1.553
                Ruby ....................... 1.77
                Sapphire ................... 1.77
                Sodium Chloride (Salt) 1 ... 1.544
                Sodium Chloride (Salt) 2 ... 1.644
                Sugar Solution (30%) ....... 1.38
                Sugar Solution (80%) ....... 1.49
                Topaz ...................... 1.61
                Water (20 C) ............... 1.333
                Zinc Crown Glass ........... 1.517
```

1.41 spectrans

```
SPECTRANS
```

```
Arguments:     COLR/N/A, COLG/N/A, COLB/N/A     color
Description:   Sets the specular transmission color of surface
Default:       SETSPECTRANS 255 255 255
```

1.42 specular

```
SPECULAR
```

```
Arguments:     COLR/N/A, COLG/N/A, COLB/N/A     color
Description:   Sets the specular color of surface
Default:       SPECULAR 255 255 255
```

1.43 transattu

```
TRANSATTU
```

```
Arguments:     VALUE/A                specular transmission attenuation
Description:   Sets the specular transmission attenuation of surface
Default:       TRANSATTU 1.
```

1.44 transexp

```
TRANSEXP
```

```
Arguments:     VALUE/A                specular transmission exponent
Description:   Sets the specular transmission exponent of surface
               object
Default:       TRANSEXP 12.
```

1.45 transluc

```
TRANSLUC
```

```
Arguments:     VALUE/A                diffuse transmittance
Description:   Sets the specular transmittance of surface
Default:       TRANSLUC 0
```

1.46 transpar

```
   TRANSPAR
```

```
Arguments:     COLR/N/A, COLG/N/A, COLB/N/A     color
Description:   Sets the diffuse transmittance of surface
Default:       TRANS 0 0 0
```

1.47 alignment

```
   ALIGNMENT
```

```
!!! CAUTION !!!
THIS COMMAND ISN'T RELEASED IN THIS VERSION YET
!!! CAUTION !!!
```

```
Arguments:     BEGIN/N,END/N              begin and end of position
               ALIGNX/A, ALIGNY/A, ALIGNZ/A  alignment
Description:   Sets the alignment of the object
```

1.48 maxframes

```
   MAXFRAMES
```

```
!!! CAUTION !!!
THIS COMMAND ISN'T RELEASED IN THIS VERSION YET
!!! CAUTION !!!
```

```
Arguments:     FRAMES/N        amount of frames
Description:   Sets the amount of objects
```

1.49 newactor

```
   NEWACTOR
```

```
!!! CAUTION !!!
THIS COMMAND ISN'T RELEASED IN THIS VERSION YET
!!! CAUTION !!!
```

```
Arguments:     NAME               name of new actor
Description:   creates a new actor
```

1.50 position

```
   POSITION
```

```
!!! CAUTION !!!
THIS COMMAND ISN'T RELEASED IN THIS VERSION YET
!!! CAUTION !!!
```

```
Arguments:      BEGIN/N,END/N           begin and end of position
                POSX/A, POSY/A, POSZ/A  position
Description:    Sets the position of the object
```

1.51 size

```
    SIZE

!!! CAUTION !!!
THIS COMMAND ISN'T RELEASED IN THIS VERSION YET
!!! CAUTION !!!

Arguments:      BEGIN/N,END/N           begin and end of position
                SIZE/A,SIZEY/A,SIZEZ/A  position
Description:    Sets the size of the object
```

1.52 General ARexx-commands

```
          GENERAL AREXX-COMMANDS


      ANTIALIAS
        sets antialiasing parameters

      BRUSHPATH
        sets brush path

      CLEANUP
        cleanups scene

      DISPLAY
        displays scene

      OBJECTPATH
        sets object path

      POINTLIGHT
        creates point lightsource

      QUIT
        quits RayStorm

      SAVEPIC
        saves scene as IFF-ILBM-file

      SETCAMERA
        sets camera parameters

      SETSCREEN
        sets screen parameters
```

```
SETWORLD
  sets world parameters

SPOTLIGHT
  creates spot lightsource

STARTRENDER
  starts rendering

TEXTUREPATH
  sets texture path

WINTOFRONT
  brings window to front
```

1.53   ARexx-commands for creating objects

```
     AREXX-COMMANDS FOR CREATING OBJECTS


LOADOBJ
  loads an Imagine TDDD-file

PLANE
  creates a plane (ground in Imagine)

SPHERE
  creates a sphere

TRIANGLE
  creates a triangle
```

1.54   ARexx-commands for setting attributes

```
     AREXX-COMMANDS FOR SETTING ATTRIBUTES


NEWSURFACE
  creates a new surface

AMBIENT
  sets ambient color

BRUSH
  adds a brush

DIFFTRANS
  sets diffuse transmission color

DIFFUSE
  sets diffuse color
```

```
                    IMTEXTURE
                      adds a Imagine texture

                    REFEXP
                      sets the specular reflection exponent

                    REFLECT
                      sets the specular reflectivity

                    REFRINDEX
                      sets the index of refraction

                    SPECTRANS
                      sets the specular transmission

                    SPECULAR
                      sets the specular color

                    TRANSATTU
                      sets the specular transmission attenuation

                    TRANSEXP
                      sets the specular transmission exponent

                    TRANSLUC
                      sets the specular transmittance

                    TRANSPAR
                      sets the diffuce transmittance
```

1.55   ARexx-commands for animation control

```
                     AREXX-COMMANDS FOR ANIMATION CONTROL


                    ALIGNMENT
                      sets alignment

                    MAXFRAMES
                      sets amount of frames
NEWACTOR    creates a new actor

                    POSITION
                      sets position

                    SIZE
                      sets size
```

1.56   ARexx-errors

```
    AREXX-ERRORS
```

```
10      Error in argumentstring
11      Unknown command
12      Error using Imagine texture
13      Not enough memory for this command
14      File not found
15      Error reading IFF-ILBM file
16      Error reading IFF-TDDD file
17      Surface not defined
```

1.57   Examples

    EXAMPLES

There are several examples in the directories 'rexx' and 'examples'.

In the 'arexx' directory are examples scripts which show the usage of
RayStorm with ARexx. Start them simply by typing 'rx ???.ray' in a shell
(???.ray is the name of the script).

Attrtest.ray

Several examples for attributes.

Attrtest1.ray

Several examples for attributes.

Brush.ray

Demonstrates usage of brush mapping.

Bump.ray

Test of bump texture.

Chess.ray

Chess scene.

Dof.ray

Test of depth of field.

Eight.ray

Billard scene.

Im_texture.ray

Example for usage of Imagine textures.

Marble.ray

Test of marble texture.

Randomsphere.ray

Randomly colored sphere.

Supersample.ray

Demonstrates adaptptive supersampling.

Title.ray

Renders the RayStorm title.

Title1.ray

Renders the RayStorm title.

Wood.ray

Test of wood texture.

In the 'examples' directory are C-programms which show the usage of
RayStorm directly with a program. They can only be run from a shell.
These programs are producing a couple of pictures no animation, which must
be glued together with a utility like MainActor.

Sphanim

Animation of several spheres which jump over a checker board. Camera
follows them.

Worldanim

Rotating world.

1.58 Textures

                  TEXTURES

Textures are mathematical generated patterns which can be applied to the
surface of a object.
There are several textures in the directory 'textures'.

          Bump

          Checker

          Linear

          Marble

          Wood

1.59 Bump

```
BUMP
```

This texture applies a bumps to the surface.
Size of texture determines size of bumps.

Parameters:

X bump size – Y bump size – Z bump size
Sets the 'depth' of the bumps.

1.60 Checker

```
CHECKER
```

This texture applies a normal checks pattern to the surface.

Parameters:

Color Red – Color Green – Color Blue
Color of the checks, other color is taken from object.

Reflect Red – Reflect Green – Reflect Blue
Reflect color of the checks.

Filter Red – Filter Green – Filter Blue
Filter color of the checks.

1.61 Linear

```
LINEAR
```

This texture varies the color of the object in the y-direction of the
texture.

Parameters:

Color Red – Color Green – Color Blue
Color to inerpolate to.

Reflect Red – Reflect Green – Reflect Blue
Reflect to inerpolate to.

Filter Red – Filter Green – Filter Blue
Filter to inerpolate to.

1.62 Wood

```
    WOOD
```

This texture applies a wood like texture to the surface.
Size of texture determines size of wood.

Parameters:

Color Red – Color Green – Color Blue
Color. Other color is taken from object.

Reflect Red – Reflect Green – Reflect Blue
Reflect color.

Filter Red – Filter Green – Filter Blue
Filter color.

Octave
Than higher the octave than noisier are the wood rings.

Frequency
Than higher the frequency than smaller the wood rings.

1.63   Marble

```
    Marble
```

This texture applies a marble like texture to the surface.
Size of texture determines size of bumps.

Parameters:

Color Red – Color Green – Color Blue
Color. Other color is taken from object.

Reflect Red – Reflect Green – Reflect Blue
Reflect color.

Filter Red – Filter Green – Filter Blue
Filter color.

Octave
Than higher the octave than noisier is the texture.

1.64   Legal Stuff

```
                DISCLAIMER
```

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                    MUI

1.65   MUI

                        This application uses

                    MUI – MagicUserInterface

                 (c) Copyright 1993/94 by Stefan Stuntz

MUI is a system to generate and maintain graphical user interfaces. With
the aid of a preferences program, the user of an application has the
ability to customize the outfit according to his personal taste.

MUI is distributed as shareware. To obtain a complete package containing
lots of examples and more information about registration please look for
a file called "muiXXusr.lha" (XX means the latest version number) on
your local bulletin boards or on public domain disks.

         If you want to register directly, feel free to send

                    DM 30.- or US$ 20.-

```
                                    to

                             Stefan Stuntz
                        Eduard-Spranger-Straße 7
                            80935 München
                              GERMANY
```

1.66 Credits

```
   CREDITS
```

I want to thank the following person:

 - Stephan Dorenkamp - for testing

1.67 Register

```
   REGISTER
```

If you like RayStorm send me 20 DM or 15 US $ and a empty disk and you get
the full version of RayStorm.

1.68 Author

```
   AUTHORS
```

For bug reports, comments, suggestions ... you can contact us at the
following addresses.

```
   Andreas Heumann

   E-mail:  heumann@hugo.rz.fh-ulm.de
   S-mail:  Heilmeyersteige 105
            89075 Ulm
            Germany


   Mike Hesser

   E-mail:  s_hesser@rzmain.rz.uni-ulm.de
            hessermi@pcpool1.informatik.uni-ulm.de
   S-mail:  Heilmeyersteige 105
            89075 Ulm
            Germany
```

1.69   History of Changes

    HISTORY

version 1.0 (09-July-95)
- first release.

1.70   PC-version

    PC-VERSION

There is also a PC-version of RayStorm under development, but unfortunately
it's not finished yet.

1.71   Future

    FUTURE ADDITIONS

- more objects (torus, cylinder, ...)

- real motion blur

- JPEG-saver (use datatypes to load and save pics)

- use Imagine staging files (animation possibility)

- fog

- bright flag for objects

- backdrop picture

- global reflection map

- TeX documentation

- animation language

- shadow caching