

# **RayStorm Documentation**

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**COLLABORATORS**

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# Chapter 1

## RayStorm Documentation

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## 1.2 RayStorm Documentation

12 January 1996

R a y S t o r m v1.16  
 Demoverision  
 by Andreas Heumann and Mike Hesser

Introduction	What is RayStorm?
Requirements	What do I need to run it?
Features	What can RayStorm do?
Installation	How can I install it?
ARexx interface	Which commands doe it have?
Examples	How do I use the examples?
Tutorials	Some tutorials
Tips&Tricks	Useful tips,tricks and hints
Textures	How do I use textures?
Known bugs	Bugs
Legal Stuff	Legal stuff
Register	What must I do to register?
Credits	Thanks go to...
Authors	Who had written it?
PC-Version	Where can I get the PC-version?
Homepage	Where to find us on the World Wide Web
History	What happened in the past?
Future	What is planned for the future?

## 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.

Originally, RayStorm has been developed on Amiga using Maxon C++ 3.0 Developer.

The PC version has been compiled with WATCOM C++ 10.5.

This demo version is limited to a resolution of 160x128.

The full version is unlimited. See {"register" link Register} how to register.

FUNDAMENTALS ABOUT RAYTRACING

---

General  
 Octree  
 Antialiasing  
 Depth of field  
 Soft shadows  
 Surfaces  
 Internals  
 Virtual Memory  
 Motion Blur

## 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.

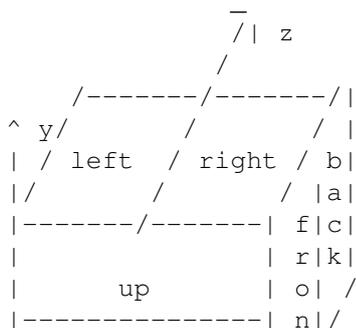
## 1.5 Octree

### OCTREE

Simple raytracers 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 child-cells and every child-cell 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.

Division of space with the octree algorithm:



```

|           | t |
|   down   | /  x
|-----|/-->

```

## 1.6 Antialiasing

### ANTIALIASING

RayStorm uses a algorithm called 'Adaptive Supersampling' to do antialiasing. This algorithm cast for each pixel with 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.

Supersampling is also used to do depth of field and soft shadows. So if you want to use this features you have to set a antialiasing value greater than one. (-> ANTIALIAS)

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 Depth of field

## DEPTH OF FIELD

Objects in computer graphics are normally rendered in an image plane using a pinhole camera model. That is to say, no matter how far or how near the objects are from the camera, they are always in sharp focus. Depth of field means that only objects at a certain distance from the camera lens are in sharp focus. Further and nearer objects produce a blurred image on the film plane.

[From 'Advanced Animation and Rendering Techniques']

To use depth of field you have to set ANTIALIAS to a value bigger than one.

Example for DOF

## 1.8 Soft shadows

### SOFT SHADOWS

Real Light sources never have a zero size, therefore the shadows behind objects are never hard edged, they are soft. RayStorm generates this shadows by jittering the position of the light source. To use soft shadows you have to set DISTRIB to a value bigger than one.

## 1.9 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 REFEXP)

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 TRANSEXP)

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).

Fog lenght (set with FOGLEN) (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

$$\text{index} = \frac{\text{lightspeed in vacuum}}{\text{lightspeed in object}} .$$

## 1.10 Internals

INTERNALS

Memory requirements

Triangle:	156 Bytes (flat shaded)
	192 Bytes (Phong shaded)
Sphere:	70 Bytes
Plane:	78 Bytes
Surface:	122 Bytes + length of name
Screenbuffer:	4 Bytes per pixel

Memory requirements of the octree depends on the scene.

---

## 1.11 Virtual Memory

### VIRTUAL MEMORY

RayStorm has been tested successfully with VMM 3.1 from Martin Apel. If you want use RayStorm with virtual memory notice following hints:

- set Minimum VM allocation to 100 bytes if you define large scenes with many objects, because RayStorm only allocates small pieces of memory for single objects (less then 200 bytes). If you're loading Imagine objects RayStorm allocates big blocks of memory so you don't have to set Minimum VM allocation to 100.
- use a partition or a pseudo-partition for VMM, this is faster

## 1.12 Blur

### MOTION BLUR

Motion blur is temporal anti-aliasing. In animated sequences, the normal rendering process functions like a camera that possesses an infinitely short exposure time and this eliminates the blurring of the image due to relative motion between an object and the film plane. When a series of images, generated without motion blur, is displayed as an animated sequence, the illusion of smooth motion is diminished by strobing effects. As human beings we expect to see loss of detail in moving images.

Motion blur is accounted for in distributed ray tracing by extending the distributed sampling and jittering into the time domain and computing a solution that extracts information from the scen over the duration of the shutter exposure time. Objects are moved as required in the time period and visibility consequently changes over this time intervall. This method ensures that highlights and shadows are blurred or not, depending on the nature of the motion.

[From 'Advanced Animation and Rendering Techniques']

## 1.13 Requirements

### REQUIREMENTS

- (1) You will need at least Kickstart 2.0.
  - (2) 020+-version: 68020 processor and a mathematical coprocessor (68881/882 or internal 68040/060 version).
  - (3) 000-version: 68000 processor (should even run on a Amiga 500 (not tested))
  - (4) 512KB RAM minimum
  - (5) RayStorm was written using MUI . So you need muimaster.library V2.0+ or later to run RayStorm.
-

recommended: 68030, 68882, Harddisk, GFX-Board

The faster the better :-).

Tested with:

A1200 68030/50, 6MB, 200MB HD

A2000 68040/30, 9MB, 250+250MB HD, Merlin Gfx-board

A2000 68030/14, 68882/20, 4MB, 730+52MB HD

A4000 68030/25, 68882/57, 4MB, 730+80MB HD

## 1.14 Features

FEATURES

- Up to 30% faster than Imagine (in trace mode).
- ARexx-port. RayStorm can be used by all programs with 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.
- Color, reflectivity, filter, altitude and specular mapping.
- Flat, cylinder and sphere mapping.
- Soft brush mapping.
- Mathematical textures: wood, marble, bumps, checker, linear, radial, stars.
- Transparency and physically correct refractions.
- 8 levels of antialiasing (adaptive supersampling).
- Rendering box.
- Three builtin object types: sphere, plane and triangle.
- Three light types: ambient, point and spot.
- Depth of field with adjustable focal distance and aperture.
- Soft shadows.
- Backdrop picture.
- Global fog and foggy objects.
- Material attributes for realistic objects: ambient color, diffuse color, specular color, specular reflection exponent, diffuse transmission color, specular transmission color, specular transmission exponent, specular transmittance, transparent color, reflective color, index of refraction, foglength.
- Bright objects.
- Motion blur for realistic animations.
- Quick rendering.
- Global reflection map.
- Image formats: IFF-ILBM, PNG, TGA.
- Object format: Imagine-TDDD
- New image- and object-formats can be easily included because of the modular concept.

## 1.15 Installation

INSTALLATION

---

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

## 1.16 ARexx Interface

### AREXX INTERFACE

#### Introduction

RayStorm is completely controled through it's ARexx interface. We recommend that you have a look at the example script files in the 'ARexx' directory. These examples cover most of the features of RayStorm. We encourage you to create your own files and make them available for the public. You can send them to us and we might add them as an example files in the next version of RayStorm or we include them to our Homepage. In one of the next versions of RayStorm we'll create a more powerful language, which has a similar syntax to C++.

It's the same if you write the the commands in upper case or lower case. But it's important to enclose all commans in quotes because ARexx tries to interpret the line before it sends it to ARexx. It may happen that the line is changed and RayStorm don't do this what you want.

A typical structure of a scene file is:

```
/* title, comments, ... */

/* setting resolution, world, camera, lightsources */
'SETSCREEN 160 128'
'SETWORLD [0,0,0] [40,40,40]'
'SETCAMERA <0,0,80> <0,0,0> <0,1,0> 25 20'
'POINTLIGHT <10,-10,100> [255,255,255] SHADOW'

/* define surfaces and actors */
'NEWSURFACE TEST1'
'AMBIENT [255,0,0]'
'DIFFUSE [255,0,0]'
'SPECULAR [255,255,255]'

'NEWSURFACE TEST2'
'AMBIENT [0,0,255]'

/* creating objects */
'SPHERE TEST1 <0,0,0> 10'
'SPHERE TEST2 <0,0,0> 10'

/* finally start to render the scene */
'STARTRENDER'

/* save the image */
'SAVEPIC "test.iff"'

'CLEANUP'
```

The parameters of a command can be FLOATs, INTEGERs, VECTORs, COLORs,

---

STRINGS, and IDENTIFIERS.

FLOAT      An FLOAT is a floating point number with single precision

NUMBER     A NUMBER is a simple integer number

VECTOR     A VECTOR is embedded in '< ' >' and consists of three FLOATs

COLOR      A COLOR is embedded in '[' ']' and consists of three INTEGERS with a range of 0 to 255

STRING     A STRING consists of characters

KEYWORD    An KEYWORD is a switch and consists of uppercase characters

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  
DISTRIB

-F-  
FOGLEN

-G-  
GETERRORSTR

-I-  
IMTEXTURE

-L-

---

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-N-  
NEWSURFACE  
-O-  
OBJECTPATH  
-P-  
PLANE  
POINTLIGHT  
POSITION  
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QUIT  
-R-  
REFEXP  
REFLECT  
REFRINDEX  
-S-  
SAVEPIC  
SETCAMERA  
SETSCREEN  
SETWORLD  
SIZE  
SPECTRANS  
SPECULAR  
SPHERE  
SPOTLIGHT  
STARTRENDER  
-T-  
TEXTUREPATH  
TRANSEXP  
TRANSLUC  
TRANSPAR  
TRIANGLE  
-W-  
WINTOFRONT

## 1.17 General ARexx-commands

### GENERAL AREXX-COMMANDS

ANTIALIAS	sets antialiasing parameters
BRUSHPATH	sets brush path
CLEANUP	cleanups scene
DISPLAY	displays scene
DISTRIB	sets parameters for distributive sampling
GETERRORSTR	gets a error string for a given number
OBJECTPATH	sets object path
POINTLIGHT	creates point lightsource
QUIT	quits RayStorm
SAVEPIC	saves rendered picture
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

## 1.18 antialias

ANTIALIAS

Template:

SAMPLES/N/A,WIDTH,CONTRIB

Arguments:

NUMBER SAMPLES

square root of number of samples per pixel (max. 8)

FLOAT WIDTH

width of gaussian filter

COLOR CONTRIB

max. allowed contrast

Description:

Sets antialiasing parameters (see Antialiasing)

Default:

ANTIALIAS 1 1.3 [51,38,76]

## 1.19 brushpath

BRUSHPATH

Template:

PATH/A

Arguments:

STRING PATH

pathname (format: 'path1;path2;...;pathn')

Description:

Defines the path where to search brushes.

## 1.20 cleanup

CLEANUP

Template:

none

Arguments:

none

Description:

Deletes all defined objects, lightsources, surfaces and actors

## 1.21 display

---

DISPLAY

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

Template:

FLOYD/S

Arguments:

KEYWORD FLOYD/S

dither with Floyd-Steinberg algorithm

Description:

Displays rendered pic on screen

## 1.22 distrib

DISTRIB

Template:

SAMPLES/N,SOFTSHADOW/N

Arguments:

NUMBER SAMPLES/N

squareroot of number of samples per pixel for motionblur

NUMBER SOFTSHADOW/N

squareroot of number of samples per pixel for softshadows

Description:

Sets number of samples per pixel for distributive sampling (used for  
and )

Default:

DISTRIB 1,1

## 1.23 geterrorstr

GETERRORSTR

Template:

ERRNUM/N/A

Arguments:

NUMBER ERRNUM

error number

Description:

Returns the error string for the given error number

## 1.24 objectpath

OBJECTPATH

Template:

PATH/A

---

Arguments:

PATH

pathname (format: 'path1;path2;...;pathn')

Description:

Defines the path where to search Imagine objects.

## 1.25 pointlight

POINTLIGHT

Template:

POS, COLOR, SIZE, SHADOW/S, ACTOR, FALLOFF

Arguments:

VECTOR POS

position

COLOR COLOR

color of light

VECTOR SIZE

size of light source (used for soft shadows)

KEYWORD SHADOW/S

cast shadows if keyword given

STRING ACTOR

name of actor

FLOAT FALLOFF

distance where the brightness of the light is zero

Description:

Creates a point lightsource

Default:

POINTLIGHT <0,0,0> [255,255,255] 0 ?? ?? 0

## 1.26 quit

QUIT

Template:

none

Arguments:

none

Description:

Quits Raystorm

## 1.27 savepic

SAVEPIC

Template:

NAME/A, FORMAT

Arguments:

STRING NAME

name of file to save

```
STRING FORMAT
    image format (default ILBM)
```

**Description:**

Saves rendered picture. If an error occurs the command returns an error string.

## 1.28 setcamera

```
SETCAMERA
```

**Template:**

```
POS/A,VIEWPOINT,VIEWUP,FOVX,FOVY,FOCALDIST,APERTURE,POSACTOR,VIEWACTOR
```

**Arguments:**

```
VECTOR POS
```

```
    position
```

```
VECTOR VIEWPOINT
```

```
    viewpoint
```

```
VECTOR VIEWUP
```

```
    viewupvector
```

```
FLOAT FOVX, FOVY
```

```
    field of view (in degree) (20 degree creates camera like Imagine
    default camera)
```

```
FLOAT FOCALDIST
```

```
    distance from eye to focal plane
```

```
FLOAT APERTURE
```

```
    aperture width (0 = pinhole) (-> depth of field)
```

```
STRING POSACTOR
```

```
    name of position actor
```

```
STRING VIEWACTOR
```

```
    name of point of view actor
```

**Description:**

Sets the parameters of the camera

**Default:**

```
SETCAMERA <0,0,-10> <0,0,0> <0,1,0> 45 45 1. 0.
```

## 1.29 setscreen

```
SETSCREEN
```

**Template:**

```
RESX/N/A,RESY/N/A,COLORS/N
```

**Arguments:**

```
NUMBER RESX, RESY
```

```
    resolution
```

```
NUMBER COLORS
```

```
    number of colors (not yet implemented)
```

**Description:**

Sets the screen parameters. Note that in the demo-version the resolution is limited to 160x128!

**Default:**

```
SETSCREEN 128 128 32
```

## 1.30 setworld

SETWORLD

Template:

BACK/A, AMBIENT, RANDJIT/S, BACKDROP, FOGLEN, FOGHEIGHT, FOGCOLOR, REFLMAP

Arguments:

COLOR BACK

backgroundcolor

COLOR AMBIENT

ambientcolor

KEYWORD RANDJIT

use random jitter for depth of field and soft shadows

STRING BACKDROP

name of backdrop picture

FLOAT FOGLEN

global fog length

FLOAT FOGHEIGHT

highest fog y-coordinate

COLOR FOGCOLOR

fogcolor

STRING REFLMAP

name of reflection map

Description:

Sets world parameters

Default:

SETWORLD [0,0,0] [0,0,0] ?? 32 0 [255,255,255]

## 1.31 spotlight

SPOTLIGHT

Template:

POS, COLOR, LOOKPOINT, ANGLE, SIZE, SHADOW/S, ACTOR, LOOKP\_ACTOR, FALLOFF

Arguments:

VECTOR POS

position

COLOR COLOR

color

VECTOR LOOKPOINT

lookpoint

FLOAT ANGLE

opening angel (in degree max. 180)

FLOAT SIZE

size of light source (used for soft shadows)

KEYWORD SHADOW

cast shadows if keyword given

STRING ACTOR

name of position actor

STRING LOOKP\_ACTOR

name of lookpoint actor

FLOAT FALLOFF

distance where the brightness of the light is zero

Description:

Creates a spot lightsource. The rays emitted from a spotlight are constrained by a cone. The LOOKPOINT vector gives the center of the illuminated area.

Default:

```
SPOTLIGHT <0,0,0> [255,255,255] <0,0,1> 45 0 ?? ?? ?? 0
```

## 1.32 startrender

STARTRENDER

Template:

```
QUICK/S,DEPTH/N,FROM,TO/N,LEFT/N, TOP/N,RIGHT/N,BOTTOM/N
```

Arguments:

KEYWORD QUICK

render quick (no shadows, reflections and transparency)

NUMBER DEPTH

depth of generated octree (default 3)

FLOAT FROM,TO

time code (default 0,0). If you want motion blur you have to set FROM and TO to different values, if not only set FROM.

NUMBER LEFT, TOP, RIGHT, BOTTOM

coordinates for rendering box. Picture is rendered only inside of rectangle.

Description:

Starts rendering process. If you set QUICK shadows, reflections and transparency are not calculated. In very complex scenes it is useful to increase the octree depth in order to reach a better performance during the rendering process. But this can only be done with enough memory!

## 1.33 texturepath

TEXTUREPATH

Template:

```
PATH/A
```

Arguments:

PATH

pathname (format: 'path1;path2;...;pathn')

Description:

Defines the path where to search textures.

## 1.34 wintofront

WINTOFRONT

Template:

```
none
```

Arguments:

```
none
```

Description:

Brings RayStorm window in front

## 1.35 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

## 1.36 loadobj

LOADOBJ

Template:

NAME/A, POS, ALIGN, SCALE, ACTOR

Arguments:

STRING NAME

filename

VECTOR POS

position

VECTOR ALIGN

alignment (in degrees)

VECTOR SCALE

scaling

STRING ACTOR

name of actor

Description:

Loads an Imagine TDDD-file object with attributes, brushes and textures.

Where to get Imagine object files?

Look on FTP-servers which support AMINET. For example try out

ftp.uni-paderborn.de

Path: ftp/aminet/pub/gfx/3dobj/

Default:

LOADOBJ ??? <0,0,0> <0,0,0> <1,1,1>

## 1.37 plane

PLANE

Template:

SURF/A, POS, NORM, ACTOR

Arguments:

STRING SURF

surface name

VECTOR POS

position

VECTOR NORM

normal

```
STRING ACTOR
  name of actor
Description:
  Creates a infinite plane
Default:
  PLANE ??? <0,0,0> <0,1,0>
```

## 1.38 sphere

SPHERE

```
Template:
  SURF/A, POS/A, RADIUS/A, ACTOR
Arguments:
  STRING SURF
    surface name
  VECTOR POS
    position
  FLOAT RADIUS
    radius
  STRING ACTOR
    name of actor
Description:
  Creates a sphere
```

## 1.39 triangle

TRIANGLE

```
Template:
  SURF/A, P1/A, P2/A, P3/A, N1, N2, N3, ACTOR
Arguments:
  STRING SURF
    surface name
  VECTOR P1
    first point
  VECTOR P2
    second point
  VECTOR P3
    third point
  VECTOR N1
    first normal
  VECTOR N2
    second normal
  VECTOR N3
    third normal
  STRING ACTOR
    name of actor
Description:
  Creates a triangle with corners at position P1, P2 and P3. If you specify
  the normals, a phong shaded triangle otherwise a flat triangle is created.
  Computing the normals by hand is a difficult task, and should be done by
```

---

utility programs.

## 1.40 ARexx-commands for setting attributes

### AREXX-COMMANDS FOR SETTING ATTRIBUTES

Every object must have a surface definition. With the following commands you can set the attributes of a surface. First you have to define the current surface with 'NEWSURFACE <name>'. Raystorm will set the attributes of the new surface to default values. Every following command such as AMBIENT or DIFFTRANS refers to the current surface and will override the corresponding default values.

The following examples define two surfaces:

```
NEWSURFACE RED
AMBIENT [255,0,0]
DIFFUSE [255,0,0]
```

```
NEWSURFACE WATER
DIFFUSE [0,0,255]
REFRINDEX 1.333
```

List of surface commands:

```
NEWSURFACE creates a new surface
AMBIENT sets ambient color
BRUSH adds a brush
DIFFTRANS sets diffuse transmission color
DIFFUSE sets diffuse color
FOGLEN sets the foglength
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
TRANSEXP sets the specular transmission exponent
TRANSLUC sets the specular transmittance
TRANSPAR sets the diffuce transmittance
```

## 1.41 ambient

AMBIENT

Template:

COLOR/A

Arguments:

STRING COLOR

color

Description:

Sets the ambient color of surface

Default:

---

AMBIENT [255,255,255]

## 1.42 brush

BRUSH

Template:

NAME/A, TYPE/A, WRAP/A, POS/A, ALIGN/A, SIZE/A, REPEAT/S, MIRROR/S, SOFT/S, ACTOR

Arguments:

STRING NAME

name of brush file

KEYWORD TYPE [COLOR|REFLECT|FILTER|ALTITUDE|SPECULAR]

Brush type

KEYWORD WRAP [FLAT|WRAPX|WRAPY|WRAPXY]

Brush wrapping method

VECTOR POS

position

VECTOR ALIGN

alignment

VECTOR SIZE

size of brush

KEYWORD REPEAT

if set brush is repeated like a tile

KEYWORD MIRROR

if set brush is mirrored

KEYWORD SOFT

if set brush color is softly interpolated

STRING ACTOR

name of actor

Description:

Adds a brush to surface. A brush is a bitmap which is wrapped around an object. The specified file will be searched for in the current directory. If not found and a brushpath is given, the file will be searched there. If an error occurs the command returns an error string.

Constants for type:

COLOR

Replaces the surface color of the object with the image (sets DIFFUSE and AMBIENT).

REFLECT

Map covers the surface and reflects environment (see REFLECT)).

FILTER

Uses the white color to pass colors and the black area to hold back color with a variance between two colors (see TRANSPAR).

ALTITUDE

The red values of the brush are used to give the surface an appearance of bumpiness.

SPECULAR

The rgb values set the specular color of the surface (see SPECULAR).

Constants for wrap :

FLAT

The brush is projected to X-Y plane, the axis is in the middle of the brush area, length is the distance from the middle to the border.

WRAPX

The brush is wrapped around the x-axis, like on a cylinder. The left edge of the brush begins at the positive X axis and wraps the brush around the cylinder from 'west' to 'east'.

WRAPY

Same as WRAPX, but wrapping is around the y-axis.

WRAPXY

Wrapping both: around X and Y axis. It is assumed, that the object is a sphere. The Y axis is the north/south pole of the spherical mapping. The left edge of the brush begins at the positive X axis and wraps the brush around the sphere from 'west' to 'east'. The brush covers the sphere exactly once.

## 1.43 difftrans

DIFFTRANS

Template:

COLOR/A

Arguments:

COLOR COLOR

color

Description:

Sets the diffuse transmission color of surface. Same as diffuse reflection, but only used if the lightsource is on opposite side of surface. Only applied if tranlucency is not set to zero.

Default:

DIFFTRANS [0,0,0]

## 1.44 diffuse

DIFFUSE

Template:

COLOR/A

Arguments:

COLOR COLOR

color

Description:

Sets the diffuse color of surface. 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).

Default:

DIFFUSE [255,255,255]

## 1.45 foglen

FOGLEN

Template:

---

VALUE/A  
Arguments:  
  FLOAT VALUE/A  
    foglength  
Description:  
  Sets the foglength of the surface. Fog color is set with TRANSPAR.  
Default:  
  FOGLEN 0

## 1.46 imtexture

IMTEXTURE

Template:  
  NAME/A, POS, ALIGN, SIZE, P1, P2, P3, P4, P5, P6, P7, P8, P9, P10, P11, P12, P13, P14, P15, P16, ↔  
  ACTOR  
Arguments:  
  STRING NAME  
    name of Imagine texture file  
  VECTOR POS  
    position  
  VECTOR ALIGN  
    alignment  
  VECTOR SIZE  
    size of texture axis  
  FLOAT P1, P2, P3, P4, P5, P6, P7, P8, P9, P10, P11, P12, P13, P14, P15, P16  
    texture parameters  
  STRING ACTOR  
    name of actor  
Description:  
  Adds a Imagine texture to surface  
Default:  
  defaults are taken from texture if not all paramters are given

## 1.47 newsurface

NEWSURFACE

Template:  
  NAME/A, BRIGHT/S  
Arguments:  
  STRING NAME  
    name  
  KEYWORD BRIGHT  
    if set the brightness of the surface is everywhere the same  
Description:  
  Creates a new surface with name 'NAME'

## 1.48 refexp

---

REFEXP

Template:

VALUE/A

Arguments:

FLOAT VALUE

specular reflection exponent

Description:

Sets the specular reflection exponent of surface. Determines the size of the specularly reflected highlights, the higher the smaller the highlight (hardness in Imagine).

Default:

REFEXP 12.

## 1.49 reflect

REFLECT

Template:

COLOR/A

Arguments:

COLOR COLOR

color

Description:

Sets the specular reflectivity of surface

Default:

REFLECT [0,0,0]

## 1.50 refrindex

REFRINDEX

Template:

VALUE/A

Arguments:

FLOAT VALUE

index of refraction

Description:

Sets the index of refraction of surface. Determines how the ray is refracted through transparent objects, the higher the more (index of refraction in Imagine).

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

## 1.51 spectrans

SPECTRANS

Template:

COLOR/A

Arguments:

COLOR COLOR

color

Description:

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

Default:

SETSPECTRANS [255,255,255]

## 1.52 specular

---

SPECULAR

Template:

COLOR/A

Arguments:

COLOR COLOR

color

Description:

Sets the specular color of surface. 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).

Default:

SPECULAR [255,255,255]

### 1.53 transexp

TRANSEXP

Template:

VALUE/A

Arguments:

FLOAT VALUE

specular transmission exponent

Description:

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

Default:

TRANSEXP 12.

### 1.54 transluc

TRANSLUC

Template:

VALUE/A

Arguments:

FLOAT VALUE

specular transmittance

Description:

Sets the specular transmittance of surface

Default:

TRANSLUC 0

### 1.55 transpar

TRANSPAR

Template:

---

COLOR/A  
Arguments:  
COLOR COLOR  
color  
Description:  
Sets the diffuse transmittance of surface  
Default:  
TRANSPAR [0,0,0]

## 1.56 ARexx-commands for animation control

AREXX-COMMANDS FOR ANIMATION CONTROL

ALIGNMENT sets alignment  
NEWACTOR creates a new actor  
POSITION sets position  
SIZE sets size

### 1.57 alignment

ALIGNMENT

Template:

FROM/A, TO/A, ALIGN/A, TYPE

Arguments:

FLOAT FROM, TO

time code

VECTOR ALIGN

alignment at time 'TO'

KEYWORD TYPE [LINEAR]

interpolation type (currently only linear)

Description:

Sets the alignment of the object. 'TYPE' can be one of the following identifiers:

LINEAR the interpolation is done in a straight way.

SPLINE the interpolation is done in a spline curve way. (NOT IMPLEMENTED YET)

### 1.58 newactor

NEWACTOR

Template:

NAME/A, POS, ALIGN, SIZE

Arguments:

STRING NAME

name of new actor

VECTOR POS

axis position

VECTOR ALIGN

```

    axis alignment (in degrees)
VECTOR SIZE
    axis size
Description:
    Creates a new actor
Default:
    NEWACTOR ??? <0,0,0> <0,0,0> <1,1,1>

```

## 1.59 position

POSITION

Template:

```
FROM/A, TO/A, POS/A, TYPE
```

Arguments:

```
FLOAT FROM, TO
```

```
    time code
```

```
VECTOR POS
```

```
    position at time 'TO'
```

```
KEYWORD TYPE [LINEAR]
```

```
    interpolation type (currently only linear)
```

Description:

Sets the position of the object. 'TYPE' can be one of the following identifiers:

```
    LINEAR the interpolation is done in a straight way.
```

```
    SPLINE the interpolation is done in a spline curve way. (NOT
            IMPLEMENTED YET)
```

## 1.60 size

SIZE

Template:

```
FROM/A, TO/A, SIZE/A, TYPE
```

Arguments:

```
FLOAT FROM, TO
```

```
    time code
```

```
SIZE
```

```
    size at time 'TO'
```

```
KEYWORD TYPE [LINEAR]
```

```
    interpolation type (currently only linear)
```

Description:

Sets the size of the object. 'TYPE' can be one of the following identifiers:

```
    LINEAR the interpolation is done in a straight way.
```

```
    SPLINE the interpolation is done in a spline curve way. (NOT
            IMPLEMENTED YET)
```

## 1.61 ARexx-errors

## AREXX-ERRORS

These values are returned when something went wrong, you can get the error string with the command GETERRORSTR.

## Application and parser errors

Here are the errors returned from the command parser and the application itself.

- 10 Wrong screen resolution  
Both components of the screen resolution have to be higher than one.
  - 11 Actor not defined  
The specified actor name does not exist.
  - 12 Surface not defined  
The specified surface name does not exist.
  - 13 Not enough memory  
Allocation of memory failed.
  - 14 Limitations of demo version reached  
The demo version is limited to a resolution of 160x128.
  - 15 Unknown brush mapping type  
You specified a unknown mapping method for the BRUSH command.
  - 16 Unknown brush wrapping method  
You specified a unknown wrapping method for the BRUSH command.
  - 17 Depth of octree too big (max. 6)  
The octree depth is limited to a depth of 6.
  - 18 Invalid time intervall  
One component of a time intervall was negative or the beginning time was later than the end.
  - 19 Antialiasing value too big (max. 8)  
The value of the ANTIALIAS command is limited to 8.
  - 20 Distribution value too big (max. 8)  
The value of the DISTRIB command is limited to 8.
  - 21 Unknown interpolation method  
You specified a unknown interpolation method for the POSITION, ALIGNMENT or SIZE command.
  - 22 No picture renderd  
There is no picture for SAVEPIC to save because you renderd none or called CLEANUP before.
  - 23 Can't open screen  
The DISPLAY command was unable to open the screen  
(!!! THIS COMMAND ISN'T RELEASED IN THIS VERSION YET !!!).
  - 24 Can't open iffparse.library  
RayStorm failed to open iffparse.library (at least version 37 is needed)
  - 25 Can't open graphics.library  
RayStorm failed to open graphics.library (at least version 33 is needed)
  - 26 Can't open intuition.library  
RayStorm failed to open intuition.library (at least version 37 is needed)
  - 27 Can't open window  
RayStorm failed to open the window.
  - 28 Can't open muimaster.library  
RayStorm failed to open muimaster.library (at least version 8 is needed)
-

- 29 Invalid vector definition  
The specified vector has the wrong format (must be '<x,y,z>').
- 30 Invalid color definition  
The specified color has the wrong format (must be '[r,g,b]').
- 31 Invalid region definition  
The specified region is out of range.

#### Internal errors

This are errors of the renderer.

- 101 Not enough memory  
Allocation of memory failed.
  - 102 Error in triangle definition  
It's impossible to generate a triangle with the specified coordinates (see TRIANGLE).
  - 103 The view and up directions are identical?  
You specified a view-up-vector for the CAMERA command which is identical to the view direction.
  - 104 Not enough memory for screen buffer  
The allocation of the screen buffer failed.
  - 105 The backdrop picture has the wrong size  
The backdrop picture must have the same resolution as the with SETSCREEN specified screen resolution.
  - 106 Can't open Imagine TDDD file  
RayStorm failed to open the specified Imagine TDDD file, check filename and path.
  - 107 Error reading TDDD file  
An error occurred while RayStorm read a Imagine TDDD file, maybe it was no TDDD file.
  - 108 Can't open Imagine texture file  
RayStorm failed to open the specified Imagine texture file, check filename and path.
  - 109 Can't open brush file  
RayStorm failed to open the specified brush file, check filename and path.
  - 110 Error initializing Imagine texture  
An error occurred as RayStorm tried to initialize a Imagine texture.
  - 111 Can't open picture  
RayStorm failed to open the specified picture file, check filename and path.
  - 112 Error reading picture  
An error occurred while RayStorm read a picture file.
  - 113 Can't open typefile  
RayStorm failed to open the typefile. The typefile is needed to identify the filetypes of the pictures and objects. The file 'modules/pictures/types' or 'modules/objects/types' can't be opened.
  - 114 Error reading typefile  
An error occurred while RayStorm read a typefile, maybe the file is damaged.
  - 115 Unknown picture format  
RayStorm was unable to recognize the format of the picture file.
  - 116 An error occurred while invoking picture handler  
The used picture handler returned a error.
-

## 1.62 Examples

### EXAMPLES

We have included several demos in the directories 'rexx' and 'examples' to show how to use RayStorm.

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.

Backdrop.ray

Demonstrates usage of backdrop picture.

Bounce.ray

Tutorial.

Brush.ray

Demonstrates usage of brush mapping.

Bump.ray

Test of bump texture.

Checker.ray

Test of checker texture.

Chess.ray

Chess scene.

Coin.ray

Jumping coin with motion blur.

Dof.ray

Test of depth of field.

Eight.ray

Billard scene.

Fog.ray

Fog demonstration.

Fog1.ray

Fog demonstration.

Im\_texture.ray

Example for usage of Imagine textures.

Marble.ray

Test of marble texture.

---

Randomsphere.ray  
Randomly colored sphere.

Simple.ray  
Tutorial.

Supersample.ray  
Demonstrates adaptive 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-programs 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.

## 1.63 Tutorials

TUTORIALS

Simple scene  
Bouncing ball

### 1.64 Simple scene

Tutorial: Simple scene

Now we will create a very famous scene. A sphere over a checkerboard! This might be boring, but it's good for the absolute beginner to get an impression of building a scene.

Here we go:

1. In the drawer 'ARexx' of the RayStorm directory there is a file named 'default.ray'. This is a default form for RayStorm ARexx scripts. You can use this form to write your own scripts.

We'll use this file as a default for our animation script. Copy this file to the file 'simple.ray'. After this load the file 'simple.ray' to your favorite text editor (e.g GoldEd or CygnusEd).

2. To view the scene, we need a camera. Insert after the command 'ADDRESS RAYSTORM' the lines:

```
'SETCAMERA <6,1.5,-1.5> <0,0,0> <0,1,0>'
```

This sets the camera to position <6,1.5,-1.5>. The camera points to <0,0,0> and the view-up vector is <0,1,0>. Note that you don't have to specify every single parameter. Every command has default values. Refer to the description of a command to find out the default values.

3. Nothing can be seen without a lightsource.  
Type:

```
'POINTLIGHT <0,50,0> [255,255,255] SHADOW'
```

The sphere is illuminated from above with white light.

4. Before placing the objects in the scene, you have to define their surfaces.  
Type:

```
'NEWSURFACE planesurf'
```

This creates a surface with name planesurf. The plane has a checkered surface, so type:

```
'IMTEXTURE /textures/checker.itx <0.1,0.1,0.1> <0,0,0> <2,2,2>'
```

5. That was the plane texture. Let 's go over to sphere texture.  
Type:

```
'NEWSURFACE spheresurf'
```

The sphere has a mirrored surface. To simulate a perfect mirror, type

```
'REFLECT [255,255,255]'
```

6. Now we can add the objects to the scene:

```
'SPHERE spheresurf <0,0.5,0> 1'
```

This creates a sphere on position <0,0.5,0> and radius 1.  
Add the plane:

```
'PLANE planesurf'
```

The default values for the position and the normal vector fit to our scene, so we can take them over.

7. Let's make an end to the definitions and render the scene!  
Type:

```
'STARTRENDER'
```

---

8. Finally we may not forget to save the picture, so add:

```
'SAVEPIC simple.iff'
```

which will save the rendered picture in the current directory as a IFF-ILBM file.

The last step is to free all the memory with the command 'CLEANUP'. Add:

```
CLEANUP'
```

9. Start the script from a shell-window with the sequence 'rx simple.ray'. RayStorm will now generate your picture. When RayStorm finished the work start your favourite viewer-program, load the file and have a look at it.

Looks very monochrome!!

To make the world colorful, we make a red checker and set the sky to blue. A blue sky can be done by setting the world's background color.

10. Before 'SETCAMERA' type:

```
'SETWORLD [30,30,255]'
```

Add

```
'DIFFUSE [155,0,0]'
```

to the surface planesurf (this defines one checker color), the other one must be set in the 'IMTEXTURE' command, so change it to

```
'IMTEXTURE checker.itx <0.1,0.1,0.1> <0,0,0> <2,2,2> 255 0 0'
```

(Note that '255 0 0' describes a color, but is not embedded in < >, because the checker color belongs to the texture parameters which are all floats.)

11. Render the scene once again, and view it.

That's the end of the tutorial! Make some changes to the scene file and play around with the parameters to see their effects.

## 1.65 Bouncing ball

Tutorial: Bouncing ball

The goal of this tutorial is to show you how to generate little animations. At the end of this tutorial you'll have a animation where the earth rotates and bounces on a rotating plane with a white checker texture on the top and a red checker on the bottom. If you have a fast computer you can also generate the animation with motion blur.

O.k. here we go:

1. In the drawer 'ARexx' of the RayStorm directory there is a file named 'default.ray'. This is a default form for RayStorm ARexx scripts. You can use this form to write your own scripts.

We'll use this file as a default for our animation script. Copy this file to the file 'bounce.ray'. After this load the file 'bounce.ray' to your favorite text editor (e.g GoldEd or CygnusEd).

2. First we define some values: the acceleration of the ball and the amount of frames to generate.

RayStorm has three commands to set the paths where it searches the files it needs. We use a brush for the surface of the ball and a texture for the surface of the ground.

To do this we have to insert after the command 'ADDRESS RAYSTORM' the lines:

```
g = .2
frames = 17

'BRUSHPATH /brushes'
'TEXTUREPATH /textures'
```

It's the same if you write the the commands in upper case or lower case. But it's important to enclose all commans in quotes because ARexx tries to interpret the line before it sends it to ARexx. It may happen that the line is changed and RayStorm don't do this what you want.

3. Next we set the screen resolution. For the first experiments we choose a low resolution of 160x128 pixels. Insert the line:

```
'SETSCREEN 160 128'
```

4. Now we set the camera parameters. The first three values determine the position of the camera. We want to place it so that we can see the ball all over the time. The next values set the viewpoint of the camera, this is the point the camera aims to. The next values determine the view up vector. And the last two values determine the field of view. To get a pixel aspect of 1:1 we have to set them to 25 and 20 degree.

```
'SETCAMERA 0 10 40 0 5 0 0 1 0 25 20'
```

5. We want to have a bright blue background for our animation. The background and the global ambient color is set with the 'SETWORLD' command. We want to set the ambient color to a dark gray, if this color is to bright the scene will look washed out and the objects appear flat. Insert the line:

```
'SETWORLD 10 30 200 10 10 10'
```

6. The illumination is an important part of a scene. We want to place a pointlight near the camera. Add the line:

```
'POINTLIGHT 5 10 50'
```

7. Now we define the actor for the plane. We want to rotate it around the Z-axis. Insert the lines:

```
'NEWACTOR groundactor'
'ALIGNMENT 0 ' frames+2 ' 0 0 360'
```

7. Now we define the surface for the plane and the plane itself. We make it

a little reflective and apply a checker texture. The surface 'groundtop' is for the top of the plane and the surface 'groundbottom' is for the bottom of the surface. The plane itself consists of four triangles. Two for the top and two for the bottom. Insert the lines:

```
'NEWSURFACE groundtop'
'DIFFUSE 255 255 255'
'SPECULAR 0 0 0'
'REFLECT 50 50 50'
'IMTEXTURE checker.itx 0 -1 0 0 0 0 10 10 10 ACTOR groundactor'

'NEWSURFACE groundbottom'
'DIFFUSE 255 0 0'
'SPECULAR 0 0 0'
'REFLECT 50 50 50'
'IMTEXTURE /checker/checker.itx 0 -1 0 0 0 0 1.5 1.5 1.5 ACTOR groundactor'

'TRIANGLE groundtop -2 0 -2 2 0 -2 2 0 2 ACTOR groundactor'
'TRIANGLE groundtop -2 0 -2 -2 0 2 2 0 2 ACTOR groundactor'
'TRIANGLE groundbottom -2 -.01 -2 2 -.01 -2 2 -.01 2 ACTOR groundactor'
'TRIANGLE groundbottom -2 -.01 -2 -2 -.01 2 2 -.01 2 ACTOR groundactor'
```

8. Next we define the motion of the ball. It starts at a height of 10 and accelerates until it bounces on the plane, changes its direction and the motion ends as the ball is back at its start point. Additionally the ball rotates around the Y-axis. Add the following sequence to your script:

```
speed = -g
pos = 10
'NEWACTOR ballactor 0 'pos' 0'
do i=0 to frames
  'POSITION ' i i+1 0 pos 0
  pos = pos+speed
  if pos<=1 & speed<0 then
    speed = -speed
  else
    speed = speed-g
  end
'ALIGNMENT 0 ' frames+2 ' 0 360 0'
```

9. Now we define the surface for the ball and the ball itself. The only thing we must do is to map an earth-styled brush map to a sphere. To reach this goal the position of the brush must be set to the middle of the sphere and the size must be small enough to be completely inside the sphere. These are the lines to define the ball:

```
'NEWSURFACE ball'
'BRUSH earth.iff COLOR WRAPXY 0 0 0 0 0 0 .1 .1 .1 ACTOR ballactor'

'SPHERE ball 0 10 0 1 ACTOR ballactor'
```

10. If your computer is fast enough you can insert the following lines:

```
'ANTIALIAS 1'
'DISTRIB 1'

'ANTIALIAS' improves the quality of the picture; 2 or 3 are normal values,
```

higher values don't improve the quality significant.

A value higher than one for 'DISTRIB' switches {"motion blur" link Motion Blur} ↔ on.

- At this the we have finished the definitions and now can render the single frames. If youn want the reflections of the ball on the plane you have to delete the keyword 'QUICK', because RayStorm renders no reflections in quick mode. The frame time is set with 'FROM' and 'TO'. We save the frames as IFF-ILBM pictures with the names 'bounce0001.iff' ... 'bounceXXXX.iff'. The last step is to free all the memory with the command 'CLEANUP'. Add these lines:

```
do i=0 to frames
  'STARTRENDER QUICK FROM 'i' TO 'i+1
  'SAVEPIC bounce' || RIGHT(i,4,0) || '.iff'
end

'CLEANUP'
```

- Start the script from a shell-window with the sequence 'rx bounce.ray'. RayStorm will now generate your frames. When RayStorm finished the work you must glue the pictures together to get the animation.

That's all. Have fun!

## 1.66 Tips&Tricks

Tips&Tricks

- It's faster not to use planes in scenes with motion blur.

## 1.67 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
- Radial
- Stars
- Wood

## 1.68 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.

Example:

```
IMTEXTURE bump.itx <0,0,0> <0,0,0> <.002,.002,.002> 1 1 1
```

Picture

## 1.69 Checker

### CHECKER

This texture applies a normal checks pattern to the surface.

Attention!

If you apply a checker texture to a plane, the plane may not be at the same position on which the checker changes its color. Otherwise you get a noisy texture due to rounding errors.

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.

Example

## 1.70 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 interpolate to.

Reflect Red - Reflect Green - Reflect Blue

---

Reflect to interpolate to.

Filter Red - Filter Green - Filter Blue  
Filter to interpolate to.

Example

## 1.71 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  
The higher the octave the noisier are the wood rings.

Frequency  
The higher the frequency the smaller the wood rings.

Example

## 1.72 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

---

The higher the octave the noisier is the texture.

Example

## 1.73 Radial

RADIAL

This texture varies the color of the object radial around the texture axis.

Parameters:

Start radius

Interpolation start radius.

End radius

Interpolation end radius.

Color Red - Color Green - Color Blue

Color to interpolate to.

Reflect Red - Reflect Green - Reflect Blue

Reflect to interpolate to.

Filter Red - Filter Green - Filter Blue

Filter to interpolate to.

Example

## 1.74 Stars

STARS

This texture applies randomly stars to the surface.

Parameters:

Color Red - Color Green - Color Blue

Color of the stars.

Density

Star density. The higher the more stars (0. - 1.).

Example

## 1.75 Known Bugs

KNOWN BUGS

- Bump doesn't work properly.

---

- Problems to animate Imagine objects with brushes on them.

## 1.76 Legal Stuff

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## 1.77 Credits

### CREDITS

We want to thank the following persons:

- Stephan Dorenkamp & Marcus Ritter - for testing

## 1.78 Register

### REGISTER

If you like RayStorm use the registration programm to register.

---

Fill out the registration form and press the Print button.  
If the printer is installed correctly, the registration is printed out.  
You can get information about the current agreements by pressing the Info button.

## 1.79 Author

### AUTHORS

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## 1.80 History of Changes

### HISTORY

version 1.0 (09-July-95)

- first release.

version 1.01 (15-August-95)

- added soft shadows  
- added random jitter  
- added brush repeat and mirror

version 1.02 (16-August-95)

- bugfix: altitude mapping -> black object: fixed  
- bugfix: loading of TDDD-objects with brushes crashed: fixed  
- added backdrop picture  
- added BRIGHT-flags for surface  
- added fog  
- deleted TRANSATTU

version 1.03 (17-August-95)

- bugfix: sphere intersection test: fixed

version 1.04 (21-August-95)

- added global fog

---

version 1.05 (28-August-95)

- added animation commands

version 1.06 (01-September-95)

- added motion blur

version 1.07 (10-September-95)

- added specular brush mapping

version 1.08 (11-September-95)

- added rendering box

version 1.081 (08-October-95)

- added listview for history
- added global reflection map
- changed error messages

version 1.082 (11-October-95)

- improved memory management for Imagine objects

version 1.083 (12-October-95)

- changed spotlight direction to lookpoint and added actor for lookpoint
- new form for vectors '<x,y,z>'
- new form for colors '[r,g,b]'

version 1.1 (18-October-95)

- next official release

version 1.11 (19-October-95)

- bugfix: Imagine fog objects are now loaded properly
- added parameter check for field rendering

version 1.12 (21-October-95)

- speedup of motion blur

version 1.13 (01-November-95)

- now more than one path with PATH-commands possible
- bugfix: spotlight look point changed camera view point
- added soft interpolation of colors for brushmapping
- bugfix: objects behind light sources casted shadows

version 1.14 (03-November-95)

- changed default gaussian filter width from 1.8 to 1.3
- bugfix: problem with global fog
- plane can now be animated
- changed axis position in flat brush mapping
- added 'Time spend' and 'Time left'

version 1.15 (28-November-95)

- added PNG- and ILBM-modules
- added radial texture

version 1.16 (09-January-96)

- bugfix in PNG-module: had problems with palette pictures
  - bugfix motion blur: had a problem with voxel calculations
  - bugfix motion blur: had no motion blur in scenes with planes
-

- added TGA-module
- added 'SOFTSHADOW' to 'DISTRIB'
- optimized octree (up to 10% faster)
- added 'FALLOFF' for 'POINTLIGHT' and 'SPOTLIGHT'
- bugfix can now load plane
- bugfix can now load multiple planes or perfect spheres

## 1.81 PC-version

### PC-VERSION

The PC version is available on the Internet.

The most import differences between the PC-Version and the Amiga-Version are:

- the Amiga-Version is able to load Imagine texture-files
- the PC-Version uses its own script language, whereas the Amiga-Version uses ARexx

## 1.82 Homepage

### HOMEPAGE

Come and visit our RayStorm-Homepage! There you can always get the latest version of RayStorm and can see some example pictures.

The address:

<http://sol.wohnheim.uni-ulm.de/~calvin/raystorm.html>

## 1.83 Future

### FUTURE ADDITIONS

- modeler
  - more objects (torus, cylinder, ...)
  - JPEG-saver
  - use Imagine staging files
  - animation language (ALAN)
  - shadow caching
  - more textures
  - don't allocate whole picture buffer at once
  - diffuse reflectivity
  - diffuse transparency
  - better light FX
  - log file
  - apply post-2D-FX
  - spline interpolation
  - load Lightwave format
  - load 3DS format
-

- CSG (Constructive Solid Geometry)