RayStorm Documentation

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1.2 RayStorm Documentation

28 ↩
November ↩
1995

R a y S t o r m
v1.15
Demoversion
by Andreas Heumann and Mike Hesser

Introduction
What is RayStorm?

Requirements
What do I need to run it?

Features
What can RayStorm do?

Installation
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Which commands doe it have?

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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.

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

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.

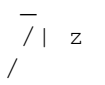
1.5 Octree

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:



```
     /-------/-------/|
 ^ 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 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 succesfully with VMM 3.1 from Martin Apel. If you
want use RayStorm with virtual memory notice follwing 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, 68882/50, 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.
- Tranparency 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 realictic 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 formates: IFF-ILBM, PNG.
- 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 completly 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

-A-

ALIGNMENT

AMBIENT

ANTIALIAS
-B-

BRUSH

BRUSHPATH
-C-

CLEANUP
-D-

DIFFTRANS

DIFFUSE

DISPLAY

DISTRIB
-F-

FOGLEN
-G-

GETERRORSTR
-I-

IMTEXTURE
-L-

LOADOBJ
-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

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
   squareroot 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/A
Arguments:
 NUMBER SAMPLES/N/A
   squareroot of number of samples per pixel for distributive sampling
   (max. 8)
Description:
 Sets number of samples per pixel for distributive sampling (used for

Default:
 DISTRIB 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
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
Description:
 Creates a point lightsource
Default:
 POINTLIGHT <0,0,0> [255,255,255] 0
```

1.26 quit

```
QUIT

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

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 occures there is a error string
 returned.
```

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
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
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
```

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 renderd 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 mirrord
 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 occures there is a error string returned.

 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 appearence 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 posititve 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 occured 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 occured as RayStorm tried to initialize a Imagine texture.
111   Error reading ILBM file
      An error occured while RayStorm read a IFF-ILBM file, maybe it is no
      IFF-ILBM file.
112   Only ILBM files with 24 planes are supported
```

```
      Currently RayStorm only supports true color IFF-ILBM files.
113   Error writing ILBM file
      An error occured while RayStorm wrote a IFF-ILBM file, maybe the disk
      is full or a wrong path was specified.
114   Can't open picture
      RayStorm failed to open the specified picture file, check filename
      and path.
115   Error reading picture
      An error occured while RayStorm read a picture file.
116   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.
117   Error reading typefile
      An error occured while RayStorm read a typefile, maybe the file is
      damaged.
118   Unknown picture format
      RayStorm was unable to recognize the format of the picture file.
119   An error occcured 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 renderd 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 searchs 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 an 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 consits of four triangles. Two fo the to 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 it's direction and the motions ends as the ball is back at he start point. Additional 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 a 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. This 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 follwing lines:

```
  '
               ANTIALIAS
                1'
  '
               DISTRIB
                1'
```

'ANTIALIAS' improves the quality of the picture; 2 or 3 are normal values, higher values don't improve the qulity significant.

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

11. 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
                '

12. 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 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
```

1.67 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
```

1.68 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
```

1.69 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
```

1.70 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
```

1.71 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

1.72 Radial

RADIAL

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

Parameters:

Start radius
Interploation start radius.

End radius
Interploation 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

1.73 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

1.74 Known Bugs

KNOWN BUGS

- Bump doesn’t work properly.
- Stars doesn’t work properly.

1.75 Legal Stuff

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1.76 Credits

CREDITS

We want to thank the following persons:

- Stephan Dorenkamp & Marcus Ritter - for testing

1.77 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.
```

1.78 Author

```
AUTHORS

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

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            89075 Ulm
            Germany
```

1.79 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 offical 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
```

1.80 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
```

1.81 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
```

1.82 Future

```
FUTURE ADDITIONS

- more objects (torus, cylinder, ...)
- JPEG-saver
- use Imagine staging files (animation possibility)
- animation language
- shadow caching
- more textures
- light sources distance dependent brightness
- 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)
```