The RAD Executive Program

- C program for controlling **oconv**, **mkillum**, **rview**, **rpict** and **pfilt**
- Keeps track of what needs to be run and when based on file dates, similar to **make**
- Sets program options and rendering parameters intelligently based on qualitative information
- Maintains multiple views (i.e. pictures) of a particular simulation ZONE
- Input is a small file of variables specifying:
  - *Radiance* scene files and dependencies
  - simulation zone
  - exposure compensation
  - desired view(s)
  - desired rendering quality
  - qualitative scene information
  - files for ambient values, output, etc.
  - program-specific options

Example RAD Input File:

```
# This is a rad input file for a bathroom.
# The input octree already exists with the default name.

ZONE= Interior  0 50  0 100  0 99
EXPOSURE= 7.5

QUALITY = Medium
PENUMBRAS = True
VARIABILITY = Medium
render = -dj .3

UP=Z
view= van -vp 60 6 62 -vd -0.79231 0.554513 -0.254481 \
     -vh 36.38 -vv 51.81
view= mir -vp 39 92 60 -vd -0.707107 -0.707107 0 \
     -vh 36.38 -vv 51.81
view= sink -vp 39 92 60 -vd -0.429078 -0.829068 -0.358522 \
     -vh 36.38 -vv 51.81
```

- one variable assignment per line, but newlines may be escaped
- comments begin with a # and continuing to newline
- spaces and tabs are generally used as delimiters

Command Example: Run **rview** under *X11*

```
% rad -o x11 -v mir orig_night.rif
        rview -vu 0 0 1 -vp 39 92 60 -vd -0.707107
-0.707107 0 -vh 36.38 -vv 51.81 -ps 3 -pt .08 -dp 512 -ar
21 -ds .2 -dj .5 -dt .1 -dc .5 -dr 1 -sj .7 -st .1 -aa .2
-ad 400 -as 64 -av 0.067 0.067 0.067 -lr 6 -lw .002 -dj .3
-R orig_night.rif -o x11 -pe 7.5 orig_night.oct
```

- the output in italics is the actual command run by **rad**
- normally, we would leave many **rview** parameters to their defaults
- **rad** assigns more intelligent defaults based on this scene
- in general, **rad** will run **oconv** and whatever else is needed

Variables and Settings

- Variable names may be abbreviated by three or more letters

- The entire input file is read and closed before **rad** takes any action, so assignments may appear in any order, except...

- Upper case variables are single-valued, and the last assignment made is the one used

- Most multi-valued variables get their values concatenated in a list, as in a list of filenames for **oconv**, for example

- The only exception to the above rule is the view variable, for which each assignment results in another picture

- The following chart lists each variable by category, giving its name, meaning, and default value

RAD Variables

Name	Meaning	Default
OCTREE	octree file name	input file root + .oct
scene	scene description files	-
materials	material (only) files	-
illum	secondary source files	-
objects	scene dependencies	-
ZONE	region of interest	bounding cube, exterior
EXPOSURE	brightness multiplier	- (automatic)
view	view specification	X (from maximum X)
UP	view up axis	- (effectively +Z)
RESOLUTION	final picture size	512
QUALITY	desired picture quality	Low
PENUMBRAS	soft shadows?	False
VARIABILITY	variation in illumination	Low
INDIRECT	# important reflections	0
DETAIL	geometric complexity	Med
PICTURE	root picture file name	input file root
AMBFILE	ambient file name	-
OPTFILE	option file name	-
REPORT	report interval and file	-
oconv	oconv options	-
mkillum	mkillum options	-
render	rendering options	-
pfilt	pfilt options	-

- the underlined part of the variable is enough for recognition
- at least one of OCTREE, scene or illum must exist
- the "input file root" is the **rad** file name, excluding any suffix

RAD Variables

Radiance Scene Files and Dependencies

- OCTREE
  - the name of the scene octree, usually with a ".oct" suffix
  - if no scene or illum values are given, this file must exist
  - if the file doesn't exist or has an earlier date than a scene, illum or object file, then the octree will be rebuilt
- scene
  - the scene description files to be given to **oconv** command
  - as many files may be given in a single assignment as desired
  - multiple assignments result in list concatanation
  - the file order given to **oconv** will follow the assignment order
  - any changes to any scene file will cause the octree to be rebuilt
- materials
  - scene description files containing only material definitions
  - these files will be handed to **oconv** in the order given, but always before any scene files
  - changes to these files will not result in the octree being rebuilt, but will cause rerendering of pictures

RAD Variables

Scene Files

- illum
  - these are files containing objects to be made into secondary light sources by **mkillum**
  - after the main octree is built, these objects are added
  - then, **mkillum** is run on this octree with these files as input
  - finally, the output of **mkillum** is used to build the final octree
  - the intermediate and final octree names will be derived from the OCTREE variable setting by inserting '0' and '1', respectively, before the file suffix (if any)
  - the user must take care to assign the mkillum variable correctly, and put appropriate control lines into the illum files

- objects
  - these are files that are not given directly to **oconv**, but matter still
  - they affect the scene geometry via command-line expansion
  - a change to any of these files will cause the octree to be rebuilt
  - the order and type of these files is irrelevant

RAD Variables

Zone and Exposure

- ZONE
  - the first word of this setting is either "Interior" or "Exterior"
  - any abbreviation or capitalization may be used
  - the second through seventh words are the Xmin, Xmax, Ymin, Ymax, Zmin and Zmax values, respectively
  - the extrema define the region in 3-space in which we are interested
  - an Interior zone means that renderings will be from inside the region
  - an Exterior zone means that renderings will look from outside
  - the zone is used for setting standard views and rendering parameters
  - if the region is not exact, it will only affect the standard views
  - the default zone is the scene bounding cube, and is type Exterior

- EXPOSURE
  - the value passed to **pfilt** with the **-e** option to set the exposure
  - also used to adjust the ambient value (**-av**) parameter
  - the specification follows the usual conventions, where a regular number is used as a multiplier, and a number preceeded by a plus or minus sign is interpreted as f-stops (powers of 2)
  - the same exposure value is applied to all renderings in this zone
  - if no value is given, automatic exposure is used and **rad** will use a fixed ambient value based on the zone type

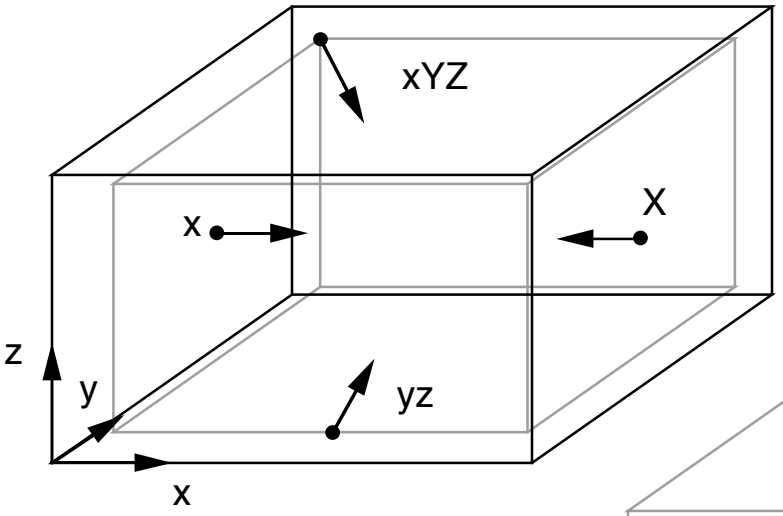
RAD Variables

Views

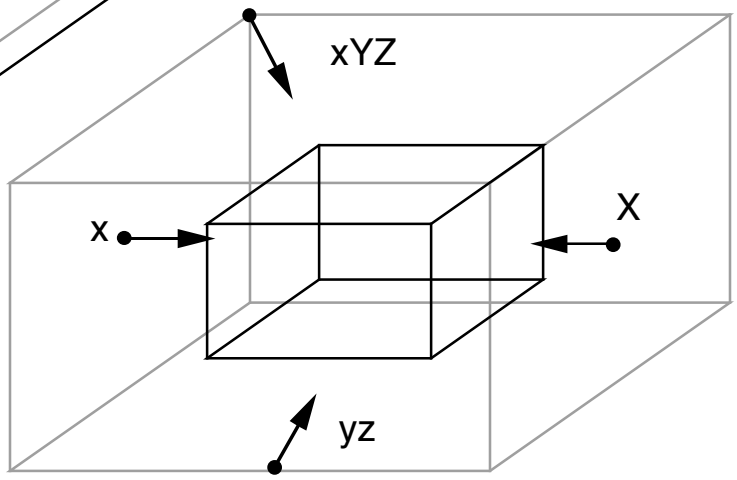
- view
  - general format is (optional) name followed by view parameters
  - the name may be one of 107 predefined standard views
  - the name is also used in determining the final picture file name
  - the parameters may be anything, including **-vf** viewfile
  - if parameters are added to a standard view, they simply modify it

- Standard views are of the form:
  [Xx]?[Yy]?[Zz]?[vlah]?

Interior Zone:



Exterior Zone:



RAD Variables

Views

- UP
  - defines the up vector for this scene
  - the specification is one of the letters X, Y or Z, optionally preceeded by a plus or minus sign to indicate orientation
  - the axis letters may be either upper or lower case
  - there is no default, but the default used by the renderers is +Z

- RESOLUTION
  - sets the final image resolution for **rpict** renderings
  - this will be the resolution after reduction by **pfilt**
  - if only one argument is present, it is taken as the maximum width or height of the picture
  - if two arguments are given, they are taken as the maximum width and height, respectively
  - if three arguments are given, the third (real) argument is the pixel aspect ratio for the final picture
  - if a pixel aspect ratio of zero is specified, then the final picture will have exactly the resolution given regardless of the other view parameters (i.e. **-vh** and **-vv**)

RAD Variables

Rendering Quality

- QUALITY
  - controls rendering quality (i.e. physical accuracy + beauty)
  - setting must be one of "High", "Medium" or "Low"
  - settings may be abbreviated by one letter, upper/lower case
  - many rendering parameters are affected by this one setting
  - Low quality is meant for quick preview
  - Medium quality is meant for draft work
  - High quality is meant for final, publishable results
  - defaults to Low

- PENUMBRAS
  - indicates the presence/importance of soft shadows
  - boolean variable (i.e. "True" or "False)
  - set to True if soft, smooth shadows are desired from large sources
  - set to False if sharp shadows are acceptable, or sources are small
  - even if set to False, some source substructuring will take place for Medium and High quality settings
  - penumbras will never be generated in Low quality renderings
  - penumbras are rather expensive to compute
  - defaults to False

RAD Variables

Qualitative Scene Information

- VARIABILITY
  - tells **rad** how much light varies in this zone
  - set to "High", "Medium" or "Low"
  - Low variability means lighting is fairly uniform throughout
  - Medium variability means some areas are significantly brighter than others
  - High variability means some areas are much brighter than others (e.g. solar patches)
  - defaults to Low

- INDIRECT
  - indicates the number of diffuse reflections typically needed to illuminate objects in this zone
  - the default value of 0 indicates that most objects receive light directly from the light sources
  - a setting of 1 would be appropriate for a ceiling-directed indirect lighting system
  - a setting of 2 might be needed for a diffuse light shelf
  - settings higher than 2 should be extremely rare
  - this variable affects the number of "ambient bounces" computed during rendering
  - a Low quality rendering will never compute interreflections
  - a Medium quality rendering will set **-ab** to this setting
  - a High quality rendering will set **-ab** to this setting plus one

RAD Variables

Scene Information

- DETAIL
  - indicates the level of geometric detail in this zone
  - Low detail means there is little more than the walls and perhaps some partitions or large objects
  - Medium detail means there is some furniture and/or small objects in the room
  - High detail indicates a fair amount of clutter and/or a lot of small fiddly-bits
  - note that detail is relative to the ZONE
  - a scene may contain a lot of geometry, but the detail may still be low within this particular zone
  - **rad** should use this setting to affect the **-r** option of **oconv**, but it does not -- it must be set manually!
  - DETAIL defaults to Medium

RAD Variables

Output Files

- PICTURE
  - sets the root name for output pictures
  - the actual name will be this plus an underscore plus the view name (or number if none) plus ".pic"
  - defaults to the root of the **rad** input file name
- AMBFILE
  - the name of the ambient value file
  - this variable must be specified if ambient value information is to be shared between views (usually desirable)
  - if set, **rad** will perform an overture calculation for each view rendered by **rpict** when interreflection is used to improve image quality (also desirable)
  - there is no default value for this variable
- OPTFILE
  - the name of the file used to hold rendering parameters
  - useful for accessing rad-set parameters in manual runs
  - this file is created even when **-n** option given to **rad**
  - there is no default value, hence values will appear on the rendering (**rview** or **rpict**) command line only
- REPORT
  - the number of minutes between **rpict** progress reports
  - if a second argument is given, it is taken as the error output file (given to **rpict** with **-e** option)
  - it is usually better to redirect the output of **rad** rather than use an error file

RAD Variables

Program Options

- oconv
  - command-line options to **oconv**
  - should be used to specify **-r** (octree resolution) for scenes with large max/min dimension ratios
- mkillum
  - command-line options for **mkillum**
  - since **rad** doesn't assign any of its own command line options to **mkillum**, this setting is very important
- render
  - additional command-line options to **rview** or **rpict**
  - these will override other options set by **rad** since they will appear last on the command line
- pfilt
  - additional command-line options to **pfilt**
  - these will override other options set by **rad** since they will appear last on the command line
  - certain **pfilt** options require two passes, which conflicts with the use of the EXPOSURE variable (see **BUGS** section of **rad** man page)