New Features in Radiance 2022

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Minor Fixes/Enhancements (1)

- New **pabopto2bsdf** "-s up" for 180° rotational symmetry and -g option for grazing sample culling
  - Also, finally wrote man pages for this and other BSDF interpolation tools
- Fixed minor inconsistency in BSDF rendering in cases where reciprocity is not strictly obeyed
- Made corrections to Klems half- and quarter-bases
- Added exposure preservation to **pcompos** where possible, and better handling of **pcomb** -o option
  - These changes allow more reliable interoperation with **evalglare**
- Added "-DSHARP_RGB" compile-time option for enhanced color accuracy
- Fixed floating point errors in ambient super-sampling

Minor Fixes/Enhancements (2)

- Added -O option to **pvalue** and **pextrem** to report radiometric values even when picture is XYZE format
- Implemented header alignment to enable memory-mapped loading of binary files, which is now used by **rmtxop** under Unix with "double" format
- Removed ambient-value sorting, which was overly complex and no longer beneficial in most cases
- Added **dctimestep** -x and -y options to control picture dimensions when result is plain vector
- Created **rcalc** -P option to pass unchanged input that does not satisfy "cond" (-p option still elides)

Major Changes/ Additions (1)

- Incorporated **ies2rad** upgrades from Randolph Fritz
- Improved behavior of -aw rendering option, so it does not tend to bias result as it did
- Added **getinfo** -r option, similar to -a but replaces or deletes specified header variable(s)
- Created **checkBSDF** tool for testing BSDF XML files for total transmission, reflection, and reciprocity
- Created **iso2klems** script to compute Klems BSDF files that obey reciprocity

Major Changes/ Additions (2)

- Created **rcrop** utility for cropping matrices and pictures more efficiently, correcting view information if present
- Added automatic overture calculation to **rtpict** with -n > 1 if ambient cache is on and shared file is used
  - Improves multi-processing speed-up in many cases
- Added **cnt** -s option to shuffle output order, used in updated **rtpict**
- Added support for depth-of-field blur in **vwrays**, also used by **rtpict**

ies2rad Improvements from Randolph Fritz

- Generates correct Radiance geometry for spheres in 1995, 2002, and 2019 IES files
- Generates correct *Radiance* geometry for vertical cylinders that are taller than they are wide
- Ignores the file source ("File Generation Type") field in the 2019 version of the file, which would otherwise be incorrectly used as an output multiplier

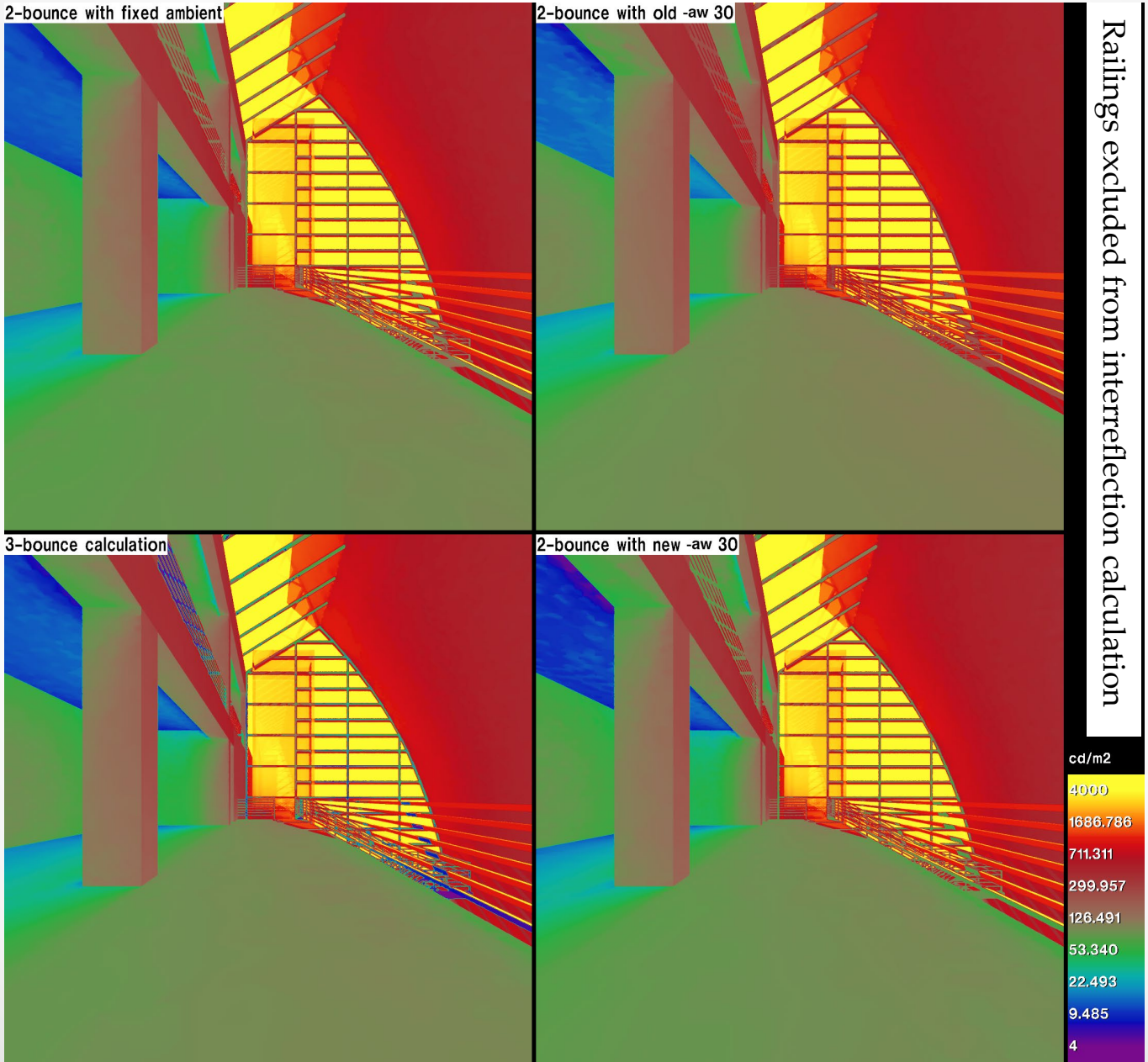
ies2rad Improvements (2)

- Shape information is included in the .rad file comments
- 1995, 2002, and 2019-version luminous opening geometry is accounted for
- The 2002 and 2019 IES file versions are recognized and processed appropriately
- Attempted to do something intelligent with less common "luminous opening" shapes in the 1995, 2002, and 2019 versions of the standard, but not implemented any support for new geometry; approximations are substituted and warning messages are issued
  - Code is untested, due to lack of IES files using these shapes

Improved -aw Option

- Improved behavior of little-used -aw rendering option
  - Estimates -av value from average of computed cache values
- New code avoids sea-level rise from adding its own estimate back into the ambient calculation
- We now derate the final average by the factor corresponding to mean surface absorption
  - effectively removes the average from the final bounce estimate

Improved -aw Option (2)



New **getinfo** -r Option (1)

- Existing -a option behavior:

Input

```
#?RADIANCE
oconv basic.mat diorama_walls.rad
rpict -av .5 .5 .5 @render.opt
EXPOSURE=5.1
FORMAT=32-bit_rle_rgbe
```

getinfo -a “EXPOSURE=0.17” “VIEW= -vp 10 15 9 -vd 0 -1 0” “rpict ”

Output

```
#?RADIANCE
oconv basic.mat diorama_walls.rad
rpict -av .5 .5 .5 @render.opt
EXPOSURE=5.1
EXPOSURE=0.17                    <= added
VIEW= -vp 10 15 9 -vd 0 -1 0     <= added
rpict                            <= added
FORMAT=32-bit_rle_rgbe
```

New **getinfo** -r Option (2)

- New -r option behavior:

Input

```
#?RADIANCE
oconv basic.mat diorama_walls.rad
rpict -av .5 .5 .5 @render.opt
EXPOSURE=5.1
FORMAT=32-bit_rle_rgbe
```

getinfo -r “EXPOSURE=0.17” “VIEW= -vp 10 15 9 -vd 0 -1 0” “rpict ”

Output

```
#?RADIANCE
oconv basic.mat diorama_walls.rad
EXPOSURE=0.17                    <= replaced
VIEW= -vp 10 15 9 -vd 0 -1 0     <= added
FORMAT=32-bit_rle_rgbe
```

<= rpict line deleted

New **checkBSDF** Tool (1)

- Example output:

```
File: 'aerc6220new.xml'
Manufacturer: ''
BSDF Name: ''
Dimensions (W x H x Thickness): 0 x 0 x 0 cm
Type: Klems_Full
Color: 0
Has Geometry: 0
Component  Lambertian XYZ (%) Max. Dir    Min. Angle
Interior Refl  34.0 34.0 34.0      19.8%      8.56 deg
Exterior Refl  34.0 34.0 34.0      19.8%      8.56 deg
Int->Ext Trans  0.0  0.0  0.0      10.0%      8.56 deg
Ext->Int Trans  0.0  0.0  0.0       9.9%      8.56 deg
Component  Reciprocity Error (min avg max %)
Interior Refl    0.0    0.0    0.1
Exterior Refl    0.0    0.0    0.1
Transmission     0.0    1.3   99.1
```

New **checkBSDF** Tool (2)

- Example output:

```
File: 'BIMSOL036_g7_t97-a.xml'
Manufacturer: 'Manufacturer'
BSDF Name: 'Mecho_shade_fabric_6216-63__(LBL)'
Dimensions (W x H x Thickness): 0 x 0 x 0 cm
Type: Isotropic_Tensor_Tree
Color: 0
Has Geometry: 0
Component  Lambertian XYZ (%) Max. Dir    Min. Angle
Interior Refl   0.0  0.0  0.0      29.3%      0.90 deg
Exterior Refl   0.0  0.0  0.0      52.8%      0.90 deg
Int->Ext Trans  0.0  0.0  0.0       1.7%      0.90 deg
Ext->Int Trans  0.0  0.0  0.0       1.8%      0.90 deg
Component  Reciprocity Error (min avg max %)
Interior Refl    0.0    47.1   100.0
Exterior Refl    0.0    42.0   100.0
Transmission     0.0    54.9    99.6
```

New **iso2klems** Script

- Takes tabulated isotropic diffuse and specular transmittance & reflectance values as a function of incident polar angle (0-180°)
- Produces a full-Klems XML file that matches input and generally obeys reciprocity, which is not true of previous IGDB data calculated by older methods
- Partial input (header row is optional):

theta (°)	Tspec	Tdiff	Rspec	Rdiff
0	.07	.1	0	.15
25	.06	.11	0	.14
55	.05	.13	0	.12
80	.005	.08	0	.18

- (should continue to theta=180°)

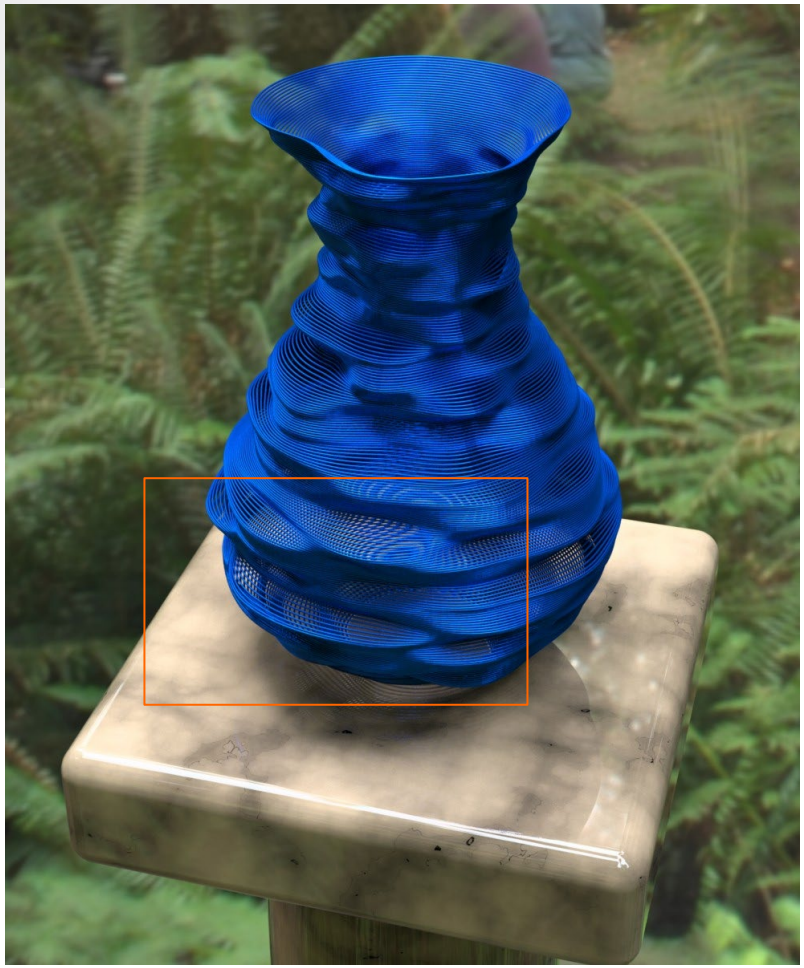
New **rcrop** Utility (1)

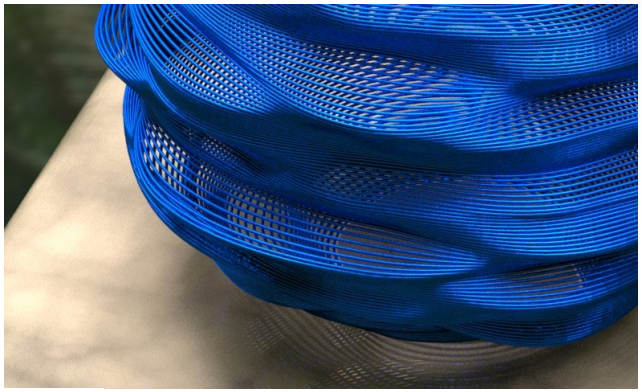
- General, efficient, robust tool for cropping matrices, *Radiance* pictures, normal and depth maps
- Preserves exposure and crops VIEW parameters in header where appropriate
- Uses fseek() on binary files if possible, and works on unparsed words in ASCII files (similar to **rcollate**)
- Usage:

  rcrop row0 col0 nrows ncols [input [output]]

- Note that rows are numbered from the top
  - If nrows or ncols = 0, then remaining rows/columns are included

New **rcrop** Utility (2)





rcrop header:

```
#?RADIANCE
oconv environ.rad pedestal.rad wavy_vase.rad
SOFTWARE= RADIANCE 4.2a lastmod Tue Aug  6 22:10:14 PDT 2013
CAPDATE= 2013:08:15 22:30:03
GMT= 2013:08:16 05:30:03
pfilt -x /3 -y /3 -m .2 -1 -e -1
EXPOSURE=5.000000e-01
rcrop 1030 315 479 790
VIEW= -vp -75.4 -20 60.2 -vh 11.81 -vv 7.17 -vs -.17 -vl -.51
FORMAT=32-bit_rle_rgbe
```

rtpict Ambient Cache Performance (1)

- Previously, multi-processing in **rtpict** with an ambient cache resulted in less than linear speed-ups
  - Problem: multiple **rtrace** processes working on the same scene regions
- Latest **rtpict** shuffles ray samples in a way that encourages different regions to be sampled by each sub-process
  - Uses new **cnt** -s option and calls Unix **sort** utility to reassemble the pixels in the correct order afterwards
- If output other than a picture is requested, **rtpict** performs an overture calculation instead to fill the irradiance cache prior to its normal run
  - Again, using **cnt** -s to shuffle the samples, but discarding **rtrace** output

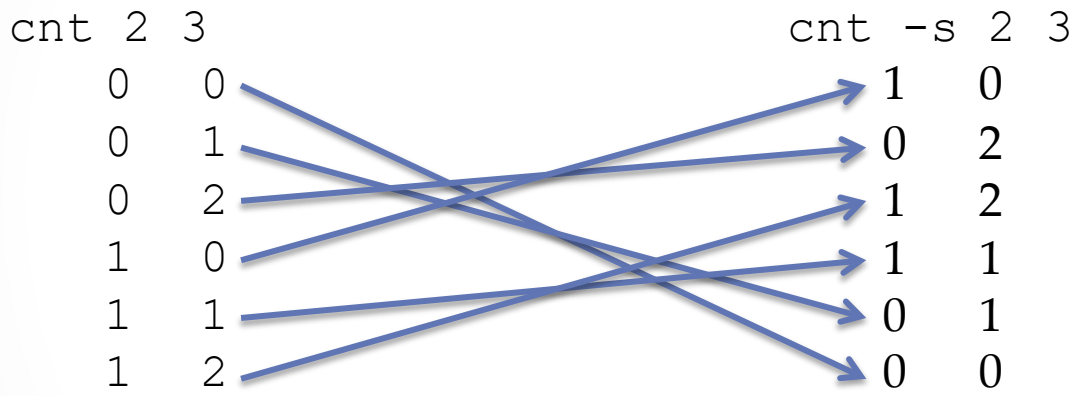
rtpict Ambient Cache Performance (2)

Method	#processes	CPU time	Wall time	Speed-up	#ambient
rpict	1	1180	1180	1	13.5 K
rpiece*	4	1380	345	3.4	12.4 K
old rtpict	4	1786	446	2.6	25.1 K
new rtpict*	4	1307	327	3.6	14.2 K
new rtpict	4	1218	305	3.9	10.4 K

- *Includes ambient cache overture calculation

New **cnt** -s option

- Originally one of the simplest tools in *Radiance*, **cnt** generates looped variable indices, e.g:

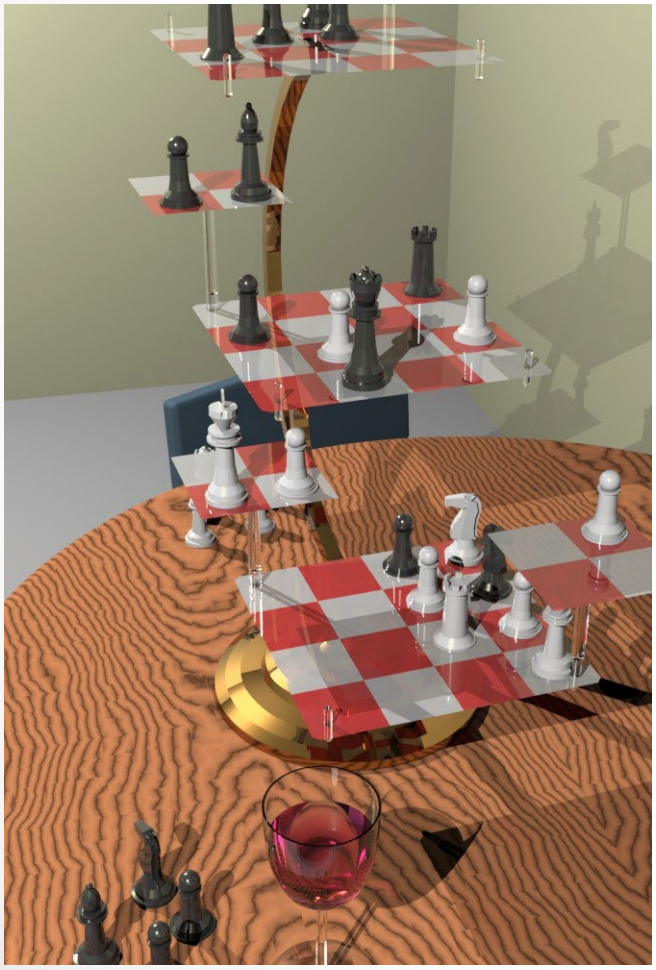


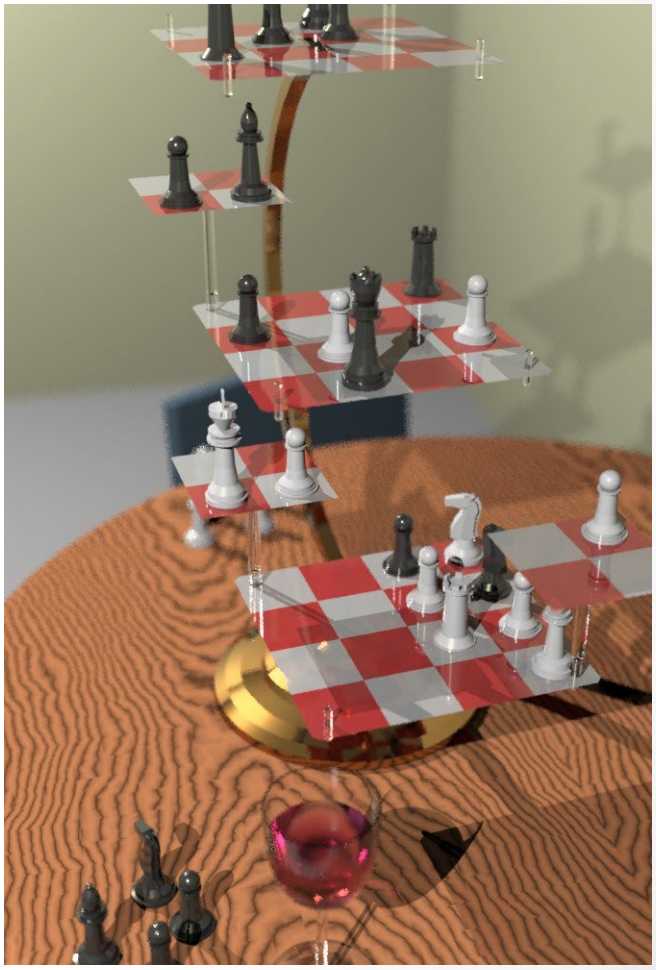
- New -s option shuffles the output, similar to passing through **sort** -R, but hundreds of times faster
- Employs memory-efficient allocation bitmap
  - Shuffles index lists of 2 billion entries in 250 MB of RAM

Depth-of-field Support in **vwrays** and **rtpict** (1)

- Implemented new jitteraperture() library call
- New function called by **vwrays** as well as **rpict**
  - previously, **rpict** implemented this in src/rt/rpict.c
- Standardizes depth-of-field sampling for bokeh
  - Samples random position on disk corresponding to lens aperture
- Enables **rtpict** to support -pd option, since it calls **vwrays** for ray generation

Depth-of-field Support in **vwrays** and **rtpict** (2)





-pd 2 (focus on king)

Questions?