New Features in *Radiance* 6.0

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Minor Fixes/Enhancements (1)

- New **gensurf -i** option to invert surface normals
  - mostly useful for height field input, where reversal is more difficult
- Crude hyperspectral➔RGB conversion added to **ximage**, **ra_bmp**, **ra_ps**, **ra_rgbe**, **normtiff**, **pextrem** and **pvalue** tools
- Accurate hyperspectral➔RGB conversion added to **ra_tiff** and **ra_xyze**
- Switched default in-core matrix element type from double to float to reduce memory footprint
  - matrix transpose now in-situ to save RAM with **rmtxop -t**
- Latest **genBSDF** command enables spectral calculations internally for more accurate results

Minor Fixes/Enhancements (2)

- Added **-e** *expr* and **-f** *file.cal* options across rendering tools, formerly just in **rcontrib**
  - requested by Peter A-B to support scripted materials
- Changed **rvu** "origin" command to allow shifts up/down and right/left as well as forward/back
- Added **bsdfpeaks** utility to measure FWHM peaks in SIR and HTML representations of BSDFs
- Fixed issue with alternate material type in *mirror* primitive, which wasn't permitting transmission
  - thanks to Jon Sargent for pointing out issue and helping resolve it
- TW added **genssky -L** option to support direct illuminance specification on command-line

Major Changes/ Additions (1)

- New facility in **gendaymtx** and **gensdaymtx** to ingest **EPW** files directly; **WEA** input still supported
  - Supports average dewpoint temperature recommended by David G-M
  - Also provides atmospheric data needed by **gensdaymtx** (**epw2wea -a**)
  - New **gensdaymtx** also uses global and horizontal illuminance input
- TW wrote new Python tool **genglaze** to create spectral glazings from CGDB models
- New **pvsum** tool, similar to **dctimestep** but handles HSR inputs
  - Supports mapped input pictures & multi-processing

Major Changes/ Additions (2)

- New C++ RcontribSimulManager class in src/rt
  - Applied in experimental **rxcontrib** tool
  - May be more efficient than standard method
  - Class supports more general i/o model for memory-mapped files and data manager APIs
- New **rxpiece** rendering tool, similar to **rpiece** but uses memory-mapped output for efficiency
  - Based on C++ RpictSimulManager class In tiled output mode
  - Supports spectral picture and encoded depth map output
- New *WGMDfunc* programmable material type
  - Supports separate modifier paths, like a more flexible *mixfunc*
  - Updated **mgf2rad** uses this primitive for more general materials

EPW input

- Previously, Christoph Reinhart's **epw2wea** tool was needed to convert EPW files to WEA for **gendaymtx**
  - Sadly, some information we need is not transferred by this tool
  - Even sadder, the EPW format is a confusing mess to read and to parse
- New loadEPW interface in src/gen handles this type of input in a general way
- Updated **gendaymtx** and **gensdaymtx** now read EPW files directly

LOCATION,Ottawa Int'l,ON,CAN,WYEC2-B-04772,716280,45.32,-75.67,-5.0,114.0
DESIGN CONDITIONS,1,Canada Climate Design Data 2001 ASHRAE Handbook,HEATING,-24.8,-22.2,10,8.8,7.7,11.9,-8.5,10.3,-9.3,3.9,290,4.5,250,33,-28.4,1.5,2.8,COOLING,30.1,21.3,28.5,20.5,26.8,19.5,22.8,28,21.8,26.4,20.8,25.3,21.1,16,25.5,20.2,15.1,24.6,19.2,14.2,23.7,10.3
TYPICAL/EXTREME PERIODS,6,Summer - Week Nearest Max Temperature For Period,Extreme,7/13,7/19,Summer - Week Nearest Average Temperature For Period,Typical,6/29,7/ 5,Winter - Week Nearest Min Temperature For Period,Extreme,1/27,2/ 2,Winter - Week Nearest Average Temperature For Period,Typical,1/20,1/26,Autumn - Week Nearest Average Temperature For Period,Typical,10/13,10/19,Spring - Week Nearest Average Temperature For Period,Typical,4/19,4/25
GROUND TEMPERATURES,3,.5,,,,-7.35,-8.56,-6.13,-0.54,6.73,13.71,18.51,19.85,17.32,11.63,4.34,-2.59,2,,,,-2.69,-4.85,-4.31,-1.15,3.85,9.34,13.83,16.14,15.58,12.33,7.29,1.81,4,,,,1.20,-1.01,-1.52,-0.16,2.78,6.49,9.97,12.32,12.83,11.40,8.43,4.71
HOLIDAYS/DAYLIGHT SAVINGS,No,0,0,0
COMMENTS 1,WYEC2-Canadian Weather year for Energy Calculations (CWEC) -- WMO#716280
COMMENTS 2, -- Ground temps produced with a standard soil diffusivity of 2.3225760E-03 {m**2/day}
DATA PERIODS,1,1,Data,Sunday, 1/ 1,12/31
1966,1,1,1,60,__Q_M_Q_Q_Q_9_____A_A__*A_____*,0.3,-1.8,84,99420,0,9999,286,0,0,0,0,0,0,999900,225,5.3,10,10,11.3,300,0,999999999,0,0.0000,0,0
1966,1,1,2,60,__Q_M_Q_Q_Q_9_____A_A__*A_____*,3.9,0.9,81,99200,0,9999,290,0,0,0,0,0,0,999900,248,4.4,9,8,12.9,300,0,999999999,0,0.0000,0,0
…

genssky & gensdaymtx

- **genssky** added **–L** option to specify direct normal and diffuse horizontal illuminance
- **gensdaymtx** will use the direct normal and diffuse horizontal illuminance data from a **.epw** file for calibration as well

genglaze (1)

- **Multi-layer glazing optics calculator** that computes angular-dependent optical properties (transmittance and reflectance) for window systems with multiple glass layers
- **Handles two types of glazing layers**: monolithic (uncoated) glass requiring thickness specification, and coated/laminated glass with pre-defined optical properties
- **Performs spectral calculations across customizable wavelength ranges** (default 380-780 nm) with user-defined intervals, interpolating input data to standard wavelengths
- **Generates angular optical data at 59 standard angles** from 0° to 90°
- **Implements LBNL WINDOW methodology** using established equations for optical calculations, including refractive index determination, absorption coefficient calculation, and multi-layer system interactions

genglaze (2)

- **Outputs two data files** containing transmittance and reflectance values formatted for use in lighting simulation software, with reflectance data covering both front and back surface reflections
- **Command-line interface** allows flexible specification of multiple layers in order, with options for monolithic layers (**-m** flag with thickness) or coated layers (**-c** flag)
- **Supports complex glazing systems** by calculating inter-reflections between layers and properly accounting for multiple internal reflections within the system
- **Produces simulation-ready output** including formatted data files and material definitions compatible with radiance/lighting simulation workflows
- **Wavelength customization** through **-s** flag allows users to specify start, end, and interval for spectral calculations to match specific analysis needs

genglaze example (1)

- Input file (.dat):

```
2
0 2 3
0 0 369 300 305 310 315 320 325 330 335 340 345 350 355
360 365 … 2500
{reflectance_front data}
{reflectance_back data}
{transmittance data}
```

- `genglaze -m mono.dat 0.05 -c coated.dat`

genglaze example (2)

- Output:

```
void specdata refl_spec_unnamed
4 noop unnamed_r.dat . 'Acos(Rdot)/DEGREE'
0
0

void specdata trans_spec_unnamed
4 noop unnamed_t.dat . 'Acos(abs(Rdot))/DEGREE'
0
0

void WGMDfunc glaze_mat_unnamed
13
        refl_spec_unnamed 1 0 0
        trans_spec_unnamed 1 0 0
        void
        0 0 1 .
0
9 0 0 0 0 0 0 0 0 0
```

```
# genglaze.exe -m mono.dat 0.01
2
0 0 59 0 5 10 15 20 25 30 35 40
41 42 43 44 45 46 47 48 49 50
51 52 53 54 55 56 57 58 59 60
61 62 63 64 65 66 67 68 69 70
71 72 73 74 75 76 77 78 79 80
81 82 83 84 85 86 87 88 89 90
380 780 81
0.752000
0.777000
0.815000
0.840000
0.852000
0.854000
0.852000
0.849000
…
```

New **pvsum** Tool

- Sums together *Radiance* pictures, which may be matrices, RGBE, XYZE, or hyperspectral (HSR) format
- Applies n-coefficient vector or matrix
  - Single-component vectors and matrices are always allowed
- Uses memory-mapped input for efficient multi-processing with **-N** option
- Can specify float or common-exponent output
- Can send output to one or more commands
- Duplicates some functionality of **dctimestep**, but specialized for efficient picture summation

Example **pvsum** Run

```
pvsum  -N 14  -o anim/frm%04d.hsr  sky_spec_r4/comp%04d.hsr  skySPEC4.mtx
```

output frames — input sky components — sky coefficients/time

Take a set of 2305 Reinhart sky component hyperspectral radiance (HSR) pictures and genera te a time-lapse animation using a matrix of spectral sky vectors over the course of a day

Uses 14 cores with shared, read-only memory maps on input pictures

Example given in IEA Task 70 presentation

C++ *RtraceSimulManager* (Review)

- Built on top of *RadSimulManager* base class
  - Scene/octree loading, starting multiple processes, basic ray-tracing
- *RtraceSimulManager* class adds FIFO ray queuing & call-back protocol for finished results or traced rays
- New **rxtrace** tool adds stdio input/output and replicates features of **rtrace**
- Optional build in src/rt subdirectory, supported by Rmakefile

RpictSimulManager (Review)

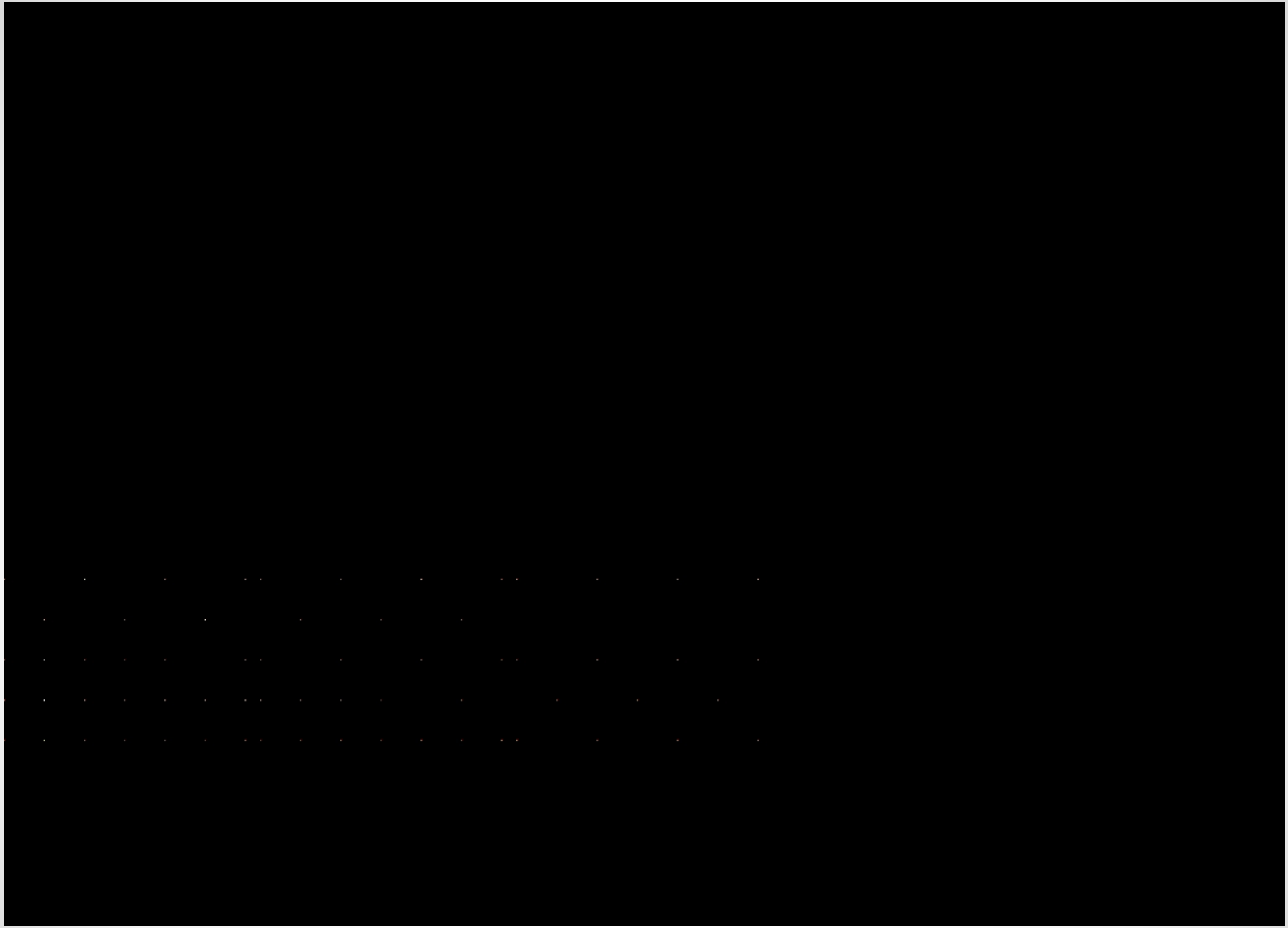
- Inherits from private *RtraceSimulManager* class
  - Instead of FIFO mode, uses call-backs for completed rays
- Adds functions for starting new frames, recovering old frames, and rendering by tiles or scanlines
- Output options for RGB or spectral results as HSR images or floating-point matrices
  - Additional options for depth files as 16-bit maps or float matrices
- **rxpict** tool adds these new output options and multi-processing to standard **rpict** functionality
  - Uses a more robust quincunx image-sampling technique
- **rxpiece** tool uses memory-mapped image tiling

RcontribSimulManager (New)

- Also inherits from private *RtraceSimulManager* class
  - Uses its own process management, since trace call-backs are needed
- Flexible output to results matrices using abstract *RdataShare* class
- More efficient implementation due to simplified inter-process communication that relies on children managing their own results output
- New **rxcontrib** tool built on class is optional compile in src/rt, same as **rxtrace** and **rxpict**

rxpiece Rendering Tool

- Employs memory-mapped outputs for more efficient rendering process coordination
- Supports hyperspectral pictures and encoded depth maps as well as standard RGBE, XYZE, & float
- Uses tiling similar to **rpiece**, but coordinates operations using a small table after the last scanline to keep track of who is working on what
- A single invocation with **-n** to set number of processes, or multiple process starts on same machine both work
- Recovery of abandoned tiles is more reliable



New *WGMDfunc* Material

- **Idea**: provide an empirical BSDF model with programming capabilities similar to *BRTDfunc* but using separate modifier paths
  - Better correspondence to existing types such as *trans2*
- Provides *mixfunc*-like control over specular and diffuse reflection components with individual modifier paths
  - Facilitates separate spectra, patterns, textures for each component
- Leaned on suggestions and feedback from David Geisler-Moroder (the "GM" in "WGMD")

Credit to Taoning Wang for basic idea

Unfinished Pieces

- Currently, photon map does not work in hyperspectral calculations
  - Not even sure how it fails, as it hasn't been tested -- best to leave it off with -cs > 3
- Photon map does not as yet support new *WGMDfunc* primitive

Questions?