Photon Map Integration in *Radiance 5.0*

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PMAP History

- Photon-map has been available as a *Radiance* add-on since Roland Schregle’s Ph.D. at ISE in 2004, but...
  - Implemented as a set of `#ifdef`’s in source code
  - Not fully compatible with standard tool function
  - Updates generally followed official release by months to years depending on demand & Roland’s availability
- Effort to integrate with main distribution began at HSLU approx. two years ago
- Currently in CVS HEAD, will be part of *Radiance 5.0* release later this year
To Map or Not To Map…

- Photon mapping is valuable in cases where:
  - Caustics (reflection & refraction) from curved, specular surfaces such as mirrors or lenses
  - Complex optical systems lacking simple input & output apertures
  - Concentrated secondary sources (scattered by diffuse or glossy surfaces)

- What about compatibility with other Radiance tools & options?
PMAK Compatibility

**Photon mapping compatible with:**
- rtrace, rpict, rvu, rsensor, rpiece
- and **rcontrib**

**PMAP not compatible with:**
- mkillum†
- or genBSDF
- 3-phase, 5-phase methods

**How do we decide which method(s) to apply?**

*Can improve contribution calculations for caustics and strong secondary light sources

†Incompatible more in concept than actual function
Radiance Simulation
Decision Tree

Annual simulation?

Complex fenestration?

Operable complex fenestration?

Curved, specular elements?

Important caustic paths/shadows?

Use genBSDF

Use mkpmap

Use mkillum

Use genBSDF

Use mkpmap

rcontrib & dctimestep

Critical direct solar component?

3-phase method

5-phase method

Standard tools: rpict, rvu, rtrace

No    Yes

No    Yes

No    Yes

No    Yes

No    Yes

No    Yes

No    Yes

No    Yes
PMAP Integration Process

- Moved PMAP calls to 15 independent modules
- Convert photon mapping from compile-time to run-time option
- Added photon map support to rad & trad
- Tests & validation to check for consistent behavior
- Added support for rcontrib & BSDF materials
- Bug fixes for Windows™*

*Tragic Mistake
Support for PMAP in rad

- New settings: PGMAP, PCMAP, and mkpmap
  - PGMAP and PCMAP specify file, # photons and bandwidth for global and caustic maps
  - mkpmap specifies additional options
- rad runs mkpmap after scene changes before rendering
- PMAP can be combined with mkillum, but as we said, this is probably not useful
Support for PMAP in `trad`

OPTIONS PGMAP

The "Pgmap" specifies the file to hold the global photons computed by the "mcpgmap" command, followed by the number of photons to generate (required). A typical photon count for a global map is on the order of 100-200K. (A 'K', 'M', or 'G' may follow the value to indicate 1000's, millions, or billions of photons.) By convention, photon map files are given a ".pmp" suffix. An optional third parameter specifies the bandwidth to use for the global photons during rendering, and this value should be around 50.

Next: Options PgmDelete
Photon Mapping Tests

twin skylights use hole and antimatter
dielectric
glass

trans with scattering
“Classic” Radiance
Global & Caustic Maps
Caustic Map Only
Global Map Only
More Interesting Example

Radiance Classic

Photon Mapping
Funding & Credits

• Fraunhofer Institute for Solar Energy Systems in Freiburg (Germany) funded Roland’s original research & validation

• Roland himself donated countless hours of personal time to maintain & update code over years
  • Lars, Carsten & others have kept interest alive

• Current effort funded by Swiss National Science Foundation through HSLU

• US Dept. of Energy providing in-kind funding at LBNL for integration effort