Iray in Omniverse
New Features for Light Transport Simulation and Rendering (S31739)

Carsten Wächter
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What is *Iray*?

**Production Rendering on CUDA**

Bring ray & path tracing based production / simulation quality rendering to GPUs

New paradigm: *Push Button* rendering (open up new markets)

Without sacrificing artistic freedom: Full *Material Definition Language (MDL)* support

**Plugins for**

3ds Max  Maya  Rhino  SketchUp  ...

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**In Production for > 12 Years**

> 5M active users install base with even more active users in the cloud
建築に、温度を。
NVIDIA Ampere
Native support for SM 8.x GPUs

PTC benchmark
“.. Ampere is giving around a 1.4x speedup over Volta when comparing similar cards (the *Tesla V100* and the *NVIDIA A100*) and an even larger speedup of around 2.4x over *Turing* with a similar generation card (e.g. the *GeForce RTX 2080 Ti* compared to the *GeForce RTX 3090").”

NVIDIA benchmark
Comparing *RTX 6000* to the *RTX 3080*: 1.7x up to 2.6x speedup! (average 2.1x)
Arm

Native support incl. NVIDIA RTX Arm PC Developer Kit

CUDA, OptiX, IndeX just work

Also see https://developer.nvidia.com/arm

All tested configs:
- RTX Arm PC Developer Kit
  2x CN9980 Arm Server
  i7-7820X x86 Workstation

Solely performance limited by the used RTX 6000 GPU

Rendertime in seconds (lower is better)
Performance Improvements

\textit{RTX} accelerated interactive rendering accelerates even more

Improved interactivity at the cost of slight \textit{temporary} bias

- Turntable (and similar) scenes: \(-5\%\) faster
- Wavefront-rendering-architecture-unfriendly scenes: up to \(-50\%\) faster

In addition, many many improvements all over the place, e.g.

- Preprocessing time of scenes with a large amount of instanced geometry or lots of different materials
- Instance transformation changes especially in combination with many materials
- Rendering performance of JIT compiled \textit{MDL} materials
- Full \textit{CUDA} and \textit{OpenGL} canvas support, incl. accelerated color conversions
- Interacting with IBL/environment maps and procedurals

Images courtesy of \textit{Siemens Digital Industries Software} (NX Ray Traced Studio)
Improved Fiber support

New OptiX 7.3 RTX accelerated curve intersector

Improved Performance, comparing overall Rendertime

Experimental, i.e. not productized yet performance in ( )
(hopefully gained via upcoming driver updates)

Also see OptiX Advanced Topics [S31752] & What’s New in OptiX [S31736]

Also upcoming: Native support in Omniverse

+8% (+85%)
+20% (+45%)
+2% (+3%)

Image courtesy of [0x1] (Iray for Maya)
AI Denoiser

Improved performance and quality

AI Denoiser library is now employed via the OptiX driver
i.e. reduced size of the Iray SDK and always state of the art quality
Due to improvements now able to use the Normal auxiliary/AOV buffer
Work ongoing to include new OptiX 7.3 temporal mode
better quality while interacting and when rendering animations

Also see OptiX Advanced Topics [S31752] & What's New in OptiX [S31736]
Same time GPU A6000 (16bpp) + Temporal AI Denoiser
Optional Volume Priorities

Optional `volume_priority` can be set to define which object's volume properties take precedence in case of an overlap. Helps solving the “icecube-problem” and volume hulls with fine scale details.
Heterogeneous Volume Support

via IndeX Direct

Includes OpenVDB & NanoVDB support
Support for Flow (& other volume/simulation data) within OV (WIP)

Strong focus on simulation quality

Features

Heterogeneous (Oil/Water) &
  Inhomogeneous (Density variation, e.g. Clouds) volumes supported

Nested volumes
Additive Mix of volumes
Mesh Clipping Support (both ways)

Limitations

No support for giant datasets (yet)
No emission (yet)
Heterogeneous Volume Support

via *Index Direct*

Includes *OpenVDB* & *NanoVDB* support

Support for *Flow* (\& other volume/simulation data) within *OV* (WIP)

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**Features**

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  - Inhomogeneous (Density variation, e.g. Clouds) volumes supported
- Nested volumes
- Additive Mix of volumes
- Mesh Clipping Support (both ways)

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Prominent *MDL 1.7 Features*

**Improved volume support**

- *OpenVDB* support as 3D texture
- Add a tint modifier for volumes (effectively changing scattering coefficient)
- Volume mixing

*Parts of the scene courtesy of Disney*
Prominent MDL 1.7 Features

Backscatter BSDF (Sheen) revised as modifier

Can have a multi-scatter component now for "sheen" coatings on arbitrary base materials

"Revisiting Physically Based Shading at Imageworks" (Christopher Kulla and Alejandro Conty)
Measured Materials / Spectral Textures

Digital Twin examples scanned with the X-Rite TAC7

Dark Green Car Effect Paint       Blue Car Effect Paint       Color Flop Car Effect Paint       Hounds Tooth Textile

Images courtesy of X-Rite
Measured Materials / Spectral Textures

Digital Twins

Iray supports both

- X-Rite AxF 1.8.1
- caddon AIX 1.6.2 spectral textures

New AxF 1.7 and 1.8.1 feature support

- EPSVBRDF representation (Energy Preserving Spatially Varying BRDF)
- & refracting clearcoats (via SDK provided conversion to SVBRDF)
- SVBRDF representation with color transmission
- Spectral color and texture data in SVBRDF, carpaint, and volumetric representations

Measured, but still able to create variants of AxFs

Or to combine only certain aspects of different scans
  e.g. Surface structure, color, coating layer

On top: Full flexibility of MDL
Measured Materials / Spectral Textures

Digital Twins

Spectral Rendering extremely important to reliably judge and select both lighting conditions and materials

Example: Pantone D65 Lighting Indicator Sticker
2 regions with different colors
Using D65 (6500K daylight) both regions “match”
Other lighting setups will result in visible differences
**Iray in NVIDIA Omniverse**

Light transport simulation quality in *Create* & *View*

Current *OV Create* release still needs *Iray* to be enabled externally next major releases of *OV Create* and *View*: on by default along with vastly improved integration into *OV* (features & performance)

*RTX Realtime* & *RTX Path tracing* rendering modes  
 sacrifice reliability and quality/precision for progressive performance more (non-physical) knobs to tweak

*Iray Photoreal* rendering simulation mode  
 brings trusted & *CIE 171:2006*-verified light transport simulation to *OV* at the *Push of a Button*
Iray in NVIDIA Omniverse

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Iray Photoreal rendering simulation mode brings trusted & CIE 171:2006-verified light transport simulation to OV at the Push of a Button

But, as with all other Iray integrations, not limited to only light transport simulation features
..and even more new stuff

Iray 2020.1.1++ and 2021.0

AI quality prediction / automatic stopping criterion

Primitive Variables support (Vertex Colors, etc.)

Motion Vectors auxiliary buffer / AOV

Improved normal/bump mapping support
  incl. optional high quality B-spline interpolation

CUDA render targets (and improved support for OpenGL targets)
  incl. CUDA color conversions

Improved DDS compressed image support

Extended message tagging functionality

Via MDL 1.7, Unbounded mix:
  Convenient for EDFs & VDFs, user needs to ensure energy conservation (BSDFs)

Via MDL 1.7, Textured EDF mixer weights, more freedom for textured lights:
  More than just a single EDF is supported, any EDF hierarchy will work
  Spectral values everywhere (not just the intensity slot)
  Texturing of EDF parameters will work

Via MDL 1.7, Directional factor for EDF: allows for “under-coat emission”

... ...

Image courtesy of Zhelongxu (zhelongxu.com)
..upcoming attractions

*Iray 2021.1 ++*

Improved sampling for many of the used algorithms
resulting in faster convergence (at least) when batch rendering
and less visible noise in interactive use

Improved interactivity / optimized preprocessing

Even better Omniverse integration

Native use of GPU texture compression (hopefully)

More optimal Arm CPU usage

Quite some more secret things ;)

Images courtesy of Daz 3D
Questions?

Acknowledgments

The Iray Team / NVIDIA ARC Berlin

More Information

Techreport: The Iray Light Transport Simulation and Rendering System

Images courtesy of Zhelongxu (zhelongxu.com) / Siemens Digital Industries Software (NX Ray Traced Studio)
Other sessions featuring *Iray* tech

*SOLIDWORKS Visualize: Recent Developments* [S31988]
Mike Sande, Sr. Tech. Sol. Consul. Dassault Systèmes

Learn how NVIDIA *Iray* Physically-Based Rendering and RTX is Driving Enhancements to Consumer Products & Retail [S31751]
David Hutchinson, Product Manager Siemens NX Vis.

Rendering Realistic Figures: A Detailed Look at Skin Shaders Using *Iray* and MDL [S31893]
Christopher Jones, Daz 3D

Sharing Physically Based Materials Between Renderers with MDL [S31207]
Lutz Kettner & Jan Jordan, NVIDIA

Integrating the NVIDIA Material Definition Language in Your Application [S31241]
Sandra Pappenguth & Joachim Reichel & Moritz Haenke de Cansino, NVIDIA

Real-Time, High-Fidelity Visual Experience of Large-Scale Scientific Simulations in Omniverse using NVIDIA InDeX [S32064]
Marc Nienhaus, NVIDIA