Overview

… follows the structure of the STAR

- Introduction & Welcome (Carsten)
- Many-Light Rendering Concepts (Jan)
  - Basic Idea
  - Improved Virtual Lights Generation
  - Lighting with Virtual Lights
- Really Many Lights: Scalability (Carsten)
- Interactive and Real-Time Rendering (Carsten)
- Conclusions, Outlook, Q&A (Jan & Carsten)

Comparison

Reference	Abbreviated Paper Title	Category / Goal	Speed	Materials	Clustering	Remark
[Kel97]	Instant Radiosity	diffuse GI	real-time	D	no	basic method
[DS05]	Reflective Shadow Maps	single-bounce GI	real-time	D	no	no VPL visibility, importance sampling of VPLs
[DS06]	Splatting Indirect Illumination	single-bounce GI	real-time	D,(G)	no	no VPL visibility, importance sampling of VPLs
[LLK07]	Incremental Instant Radiosity	single-bounce GI	real-time	D	no	reuse VPLs over frames, for static scenes only
[NW09,10]	Multiresolution Splatting	single-bounce GI	real-time	D,(G)	yes	hierarchical shading, no VPL visibility
[DGRS09]	Clustered Visibility	reduce banding	real-time	D,(G)	k-means	reduce banding with virtual area lights
[PKD12]	Reflective Shadow Map Clustering	single-bounce, reduce banding	real-time	D	k-means	virtual area lights with no visibility computation
[KK04]	Illumination Presence of Weak Singularities	bias compensation	offline	D,G	no	bias compensation using final gathering
[NED11]	Screen-Space Bias Compensation	bias compensation	real-time	D,G	no	image-space technique for approximate bias compensation
[RSK08]	Unbiased GI with Participating Media	bias compensation	offline	PM	no	basic bias compensation technique for media
[ENSD12]	Approximate Bias Compensation	bias compensation	offline/interactive	PM	no	approximate bias compensation for participating media
[WKB12]	Bidirectional lightcuts	bias compensation	offline	D,G,SSS,PM	yes	short-range indirect illumination, uses Multidimensional Lightcuts
[HKWB09]	Virtual Spherical Lights	[illegible]id singul[illegible]	[illegible]	D,G	[illegible]es	inf[illegible]s to s[illegible]al lig[illegible]es MRCS for clustering
[DKH∗10]	Combining Global and Lo[illegible] Virtu[illegible]	[illegible]e singula[illegible]ies	offli[illegible]	D,G	[illegible]s	loc[illegible]light[illegible]or[illegible]e i[illegible]rect illumination
[NNDJ12b]	Virtual Ray Lights	reduce singula[illegible]ies	offli[illegible]	D,G,P[illegible]	[illegible]o	use[illegible]ht[illegible]n s[illegible]ents as v[illegible]ual ray lights
[NNDJ12a]	Progressive Virtual Beam Lights	avoid singularities	offline	D,G,P[illegible]	no	inf[illegible]e virtual ray lights
[HPB07]	Matrix Row-Column Sampling	scalability	precompute	D,G	yes	compute a global clustering of VPLs
[HVAPB08]	Tensor Clustering for Many-Light Animations	scalability	precompute	D,G	yes	compute a global clustering of VPLs, support for animations
[OP11]	Lightslice: Matrix Slice Sampling	scalability	precompute	D,G	yes	localized/clustered cuts
[WFA∗05]	Lightcuts	scalability	offline	D,G	yes	per-shading point local cut of VPL hierarchy
[WABG06]	Multidimensional Lightcuts	scalability	offline	D,G,PM	yes	cut of VPLs and sensor points for depth of field, motion blur
[DGS12]	Progressive Lightcuts for GPU	scalability	offline/interactive	D,G	yes	progressive, GPU-friendly variant of [WFA*05]
[SIMP06a]	Bidirectional Instant Radiosity	VPL generation	real-time	D,G	no	bidirectional VPL generation
[SIP07]	Metropolis Instant Radiosity	VPL generation	real-time	D,G	no	bidirectional VPL generation with Metropolis sampling
[GS10]	Iterative Importance Sampling of VPLs	VPL generation	real-time	D,G	no	rejection sampling of VPL paths
[GKPS12]	Importance Caching for Complex Illumination	VPL selection	offline	D,G	no	importance caching of VPL contributions and improved selection
[RGK∗08]	Imperfect Shadow Maps	visibility	real-time	D,G	no	fast approximate shadow maps for VPLs
[REH∗11]	Making ISMs View-Adaptive	visibility	real-time	D,G	no	extension of [RGK*08], view-adaptive ISMs and VPL placement
[REG∗09]	Micro-Rendering	visibility	interactive	D,G	dna	compute shadow maps for VPLs or final-gather from VPLs
[HREB11]	ManyLODs	visibility	real-time	D,G	dna	fast many-view rasterization
[PGSD13]	Adaptive Quantization Visibility Caching	visibility	offline/interactive	D,G	dna	general visibility cache

see the paper

FAQ

Are many-light algorithms biased?

- the technique is unbiased, but…
- bounding (clamping), some spreading of energy, or approximating visibility introduces bias

Can we use VPLs to compute direct illumination?

- by placing them on light sources

How do many-light techniques relate to photon mapping?

- both are two-pass techniques, VPLs usually use less "photons"
- density estimation vs. direct connection (adds an extra bounce)
- photon mapping with final gathering ~= virtual spherical lights
- photon beams with final gathering ~= virtual beam lights

FAQ

What are the biggest advantages of many-light techniques?

- basic method is relatively easy to implement
- great scalability (from real-time to high quality offline)
- low noise

What are the biggest challenges?

- specular surfaces need to be ray traced
- highly glossy surfaces are difficult
- structured artifacts, temporal stability

…thank you!