(Optimizing) Realistic Rendering with Many-Light Methods

Improved VPL Distribution

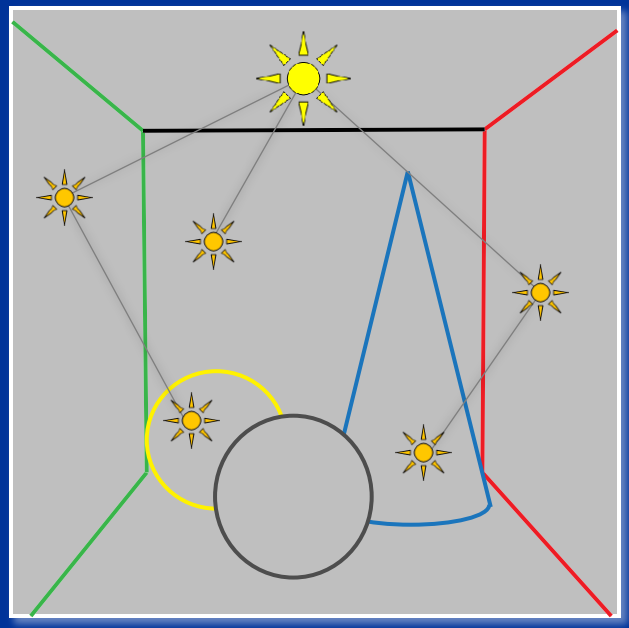
(part of the "Handling difficult light paths" section)

Jaroslav Křivánek

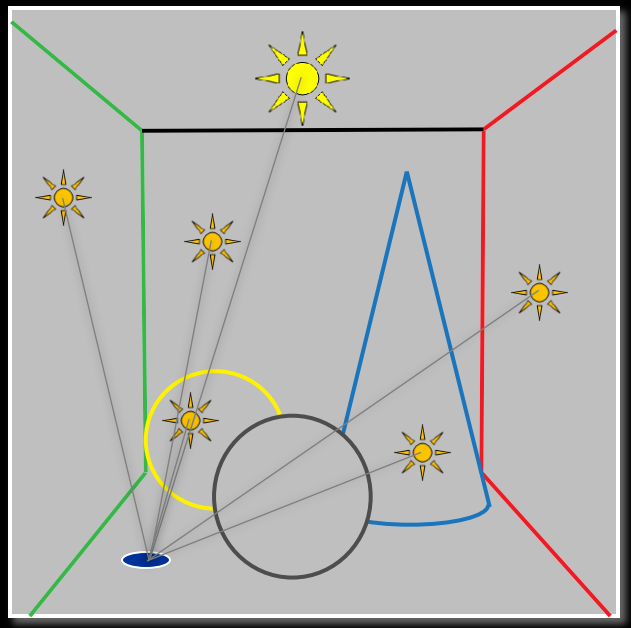
Charles University in Prague

VPL rendering

1. Distribute VPLs



2. Render with VPLs

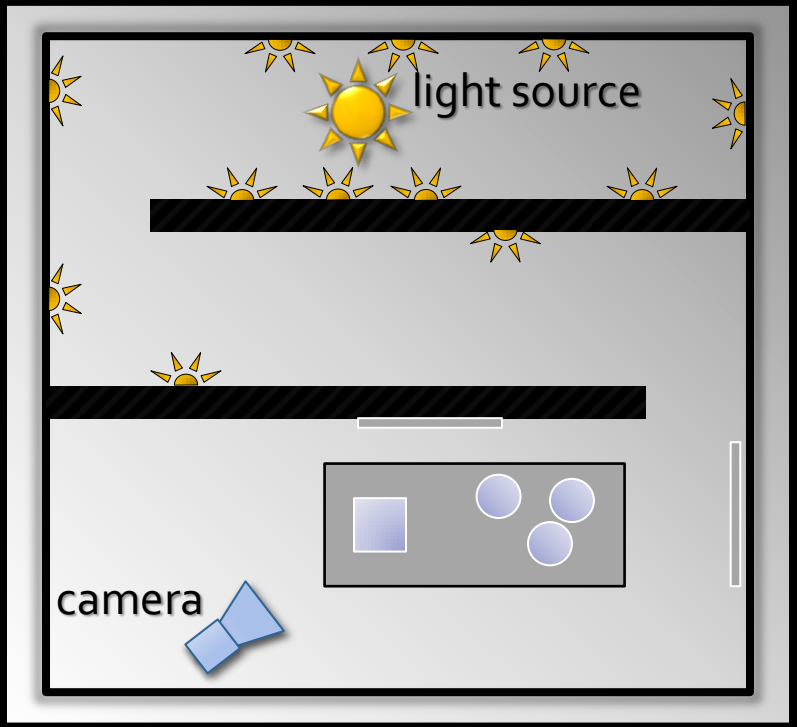


Why alternate VPL distribution?

- VPLs may not end up where needed

Example: Large environments

scene



Images courtesy of Ben Segovia and Bernard Péroche

Example: Local light inter-reflections

artifacts

no local light inter-reflections

Purpose & approach

- Purpose
  - Ensure VPLs end up where needed
- Approaches
  - Rejection of unimportant VPLs
  - Metropolis sampling for VPL distribution
  - Distribute VPLs by tracing paths from the camera

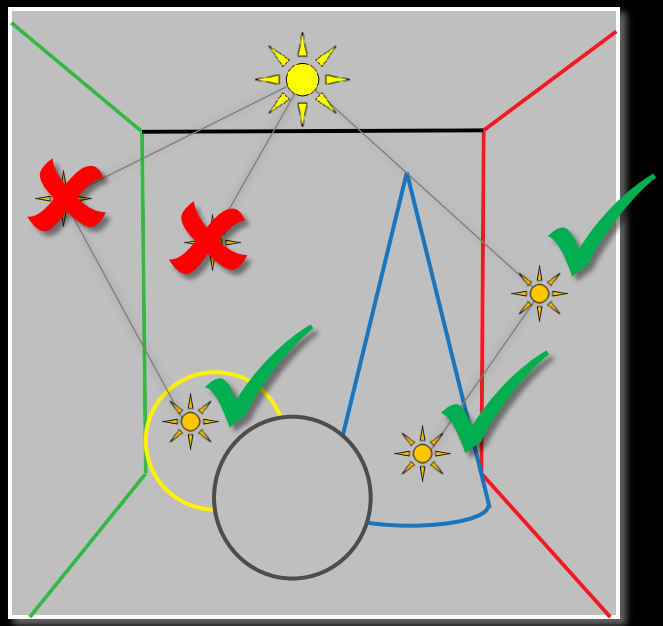
Rejection of unimportant VPLs

Rejection of unimportant VPLs

- Autodesk 360 Rendering
  - Covered by Adam later in the course
- [Georgiev et al., EG 2010]
  - Covered on the following slides (courtesy of Iliyan Georgiev)
- Good for large environments but not for local interactions

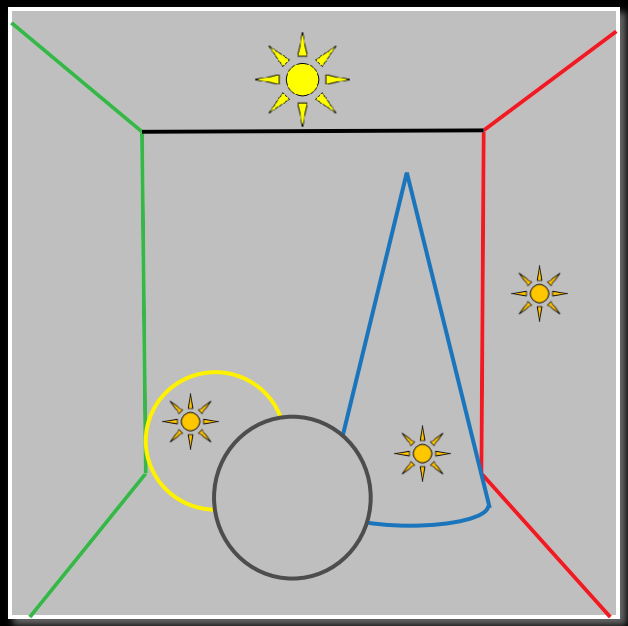
VPL rejection – Idea

- Accept VPLs proportionately to their total image contribution
  - Reject some of those that contribute less than average



VPL rejection – Idea

- Accept VPLs proportionately to their total image contribution
  - Reject some of those that contribute less than average



VPL rejection – Algorithm

- Want VPLs with equal image contribution Φ_v
- For each VPL candidate i
  - Estimate total image contribution Φ_i
  - Accept w/ probability $p_i = \min\left\{\frac{\Phi_i}{\Phi_v} + \varepsilon, 1\right\}$

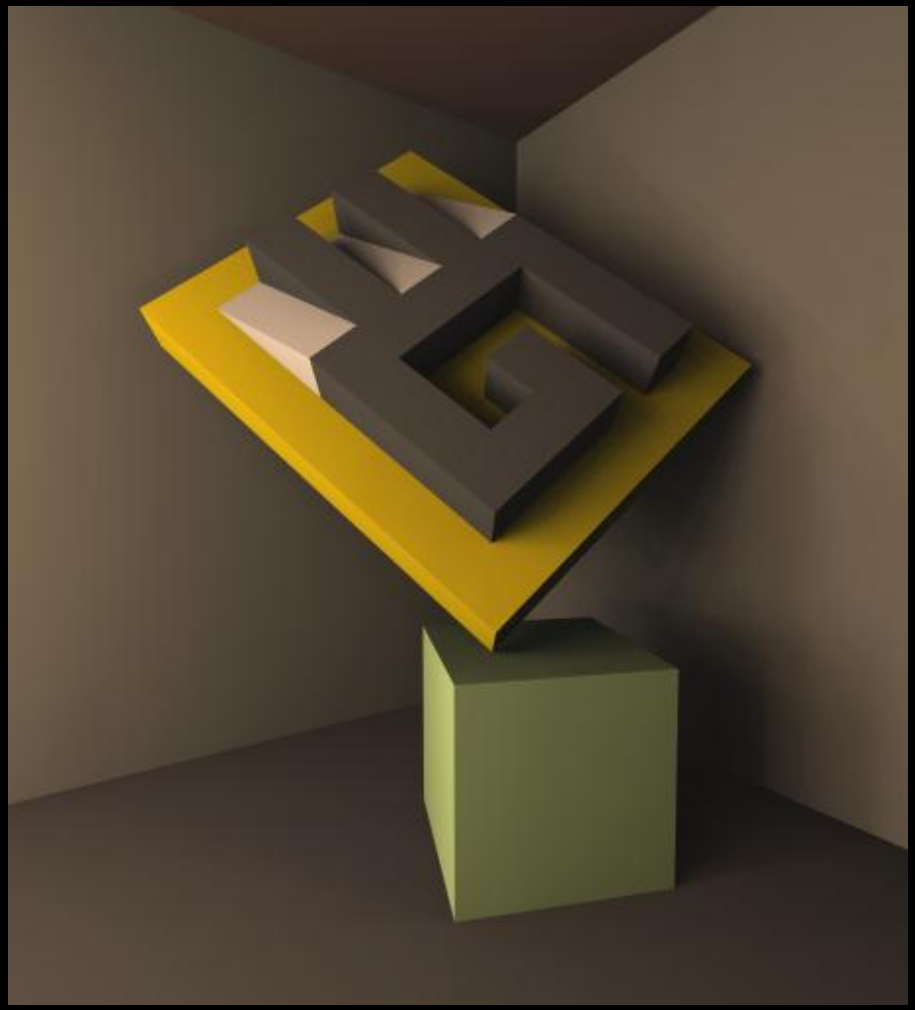
    (divide energy of an accepted VPL by p_i)

Estimating image contribution

- No need to be accurate
- Estimating Φ_v (average VPL contribution)
  - Based on a few pilot VPLs
- Estimating Φ_i (contribution of VPL candidate i)
  - Contribution to only a few image pixels

VPL rejection – Results

Instant Radiosity



[Georgiev et al. 2010]
(7% acceptance)

VPL rejection – Conclusion

- Cheap & simple
- Can help a lot
- "One-pixel image" assumption
  - Not suitable for local light inter-reflections

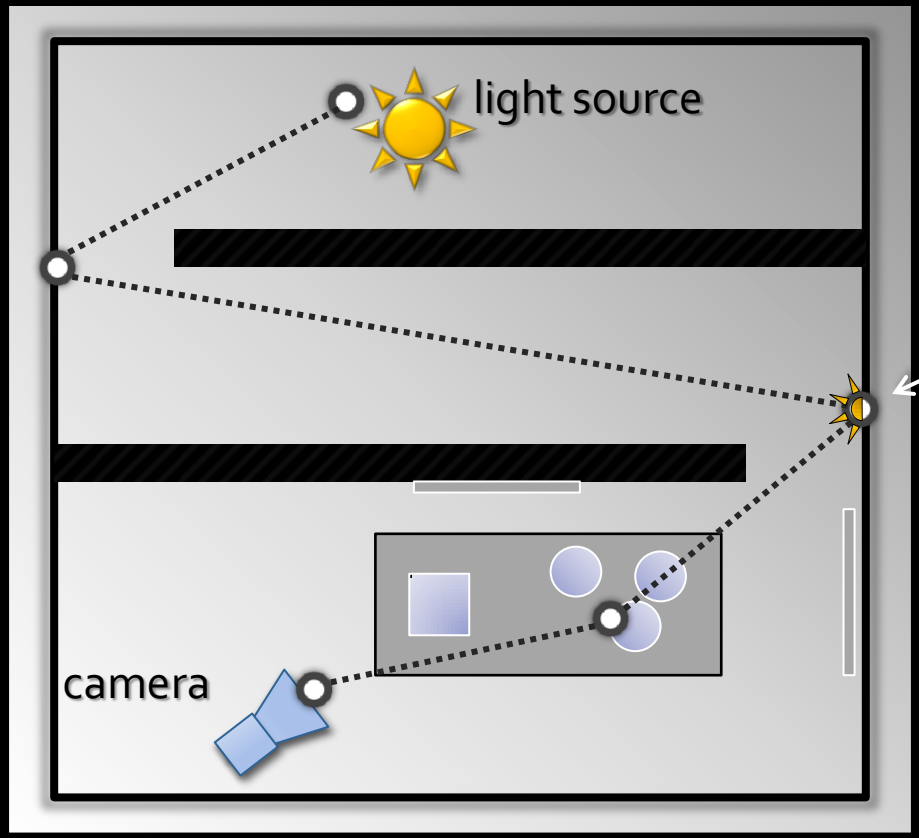
Metropolis sampling for VPL distribution

Metropolis sampling for VPL distrib.

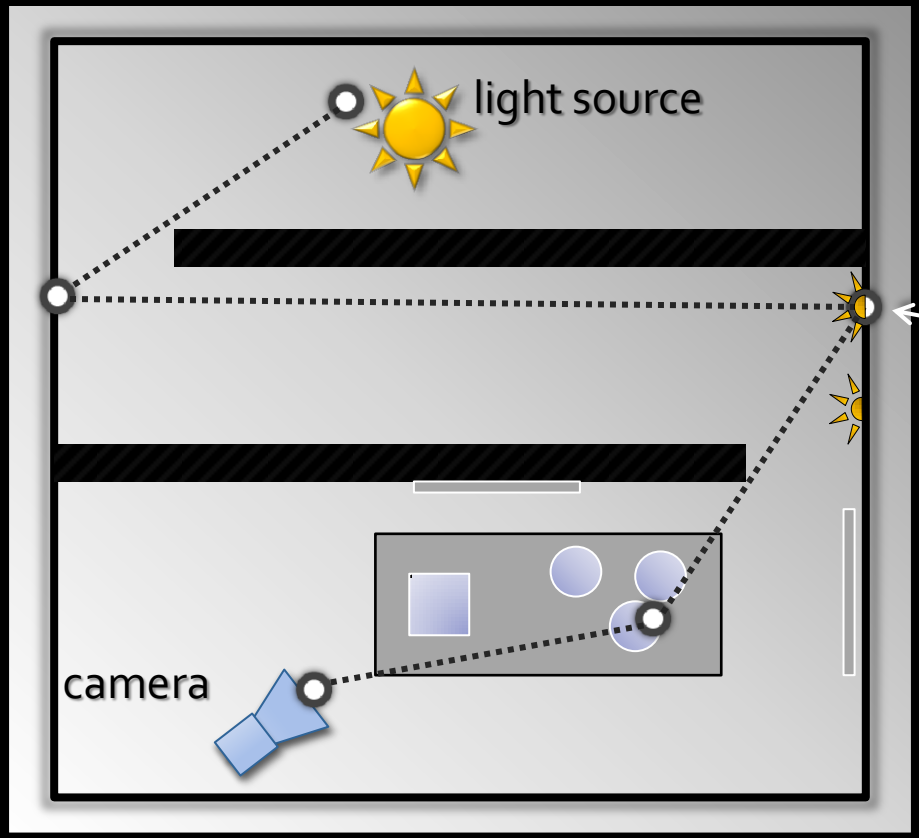
- "Metropolis instant radiosity" [Segovia et al., EG 2007]

- Good for large environments but not for local interactions

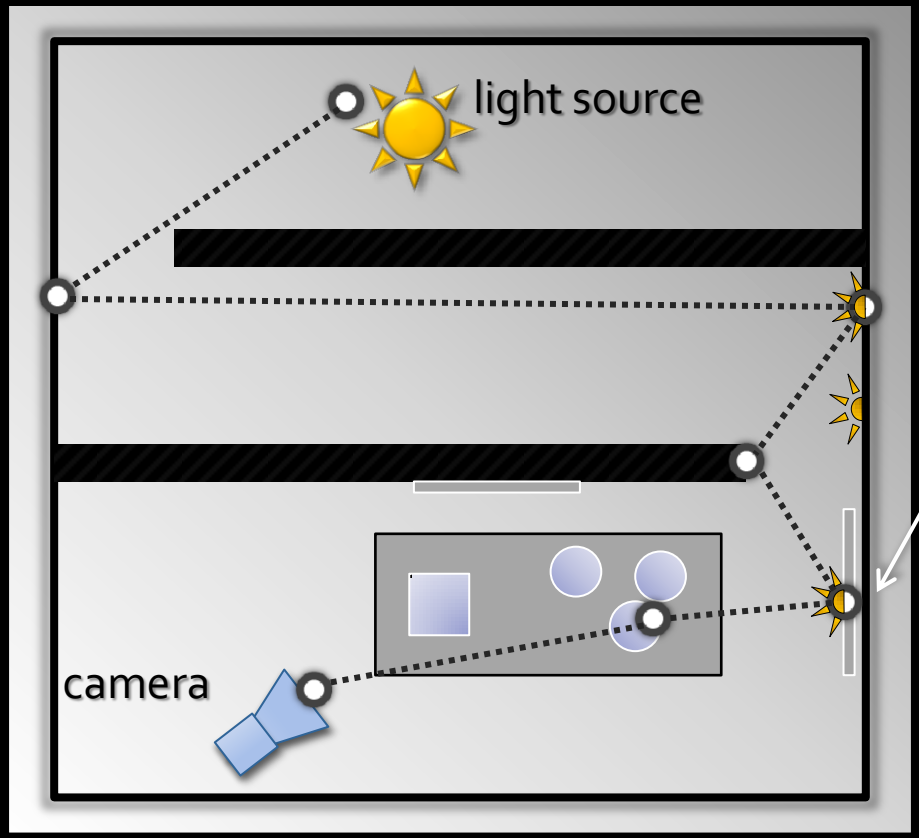
Metropolis IR – Path mutation



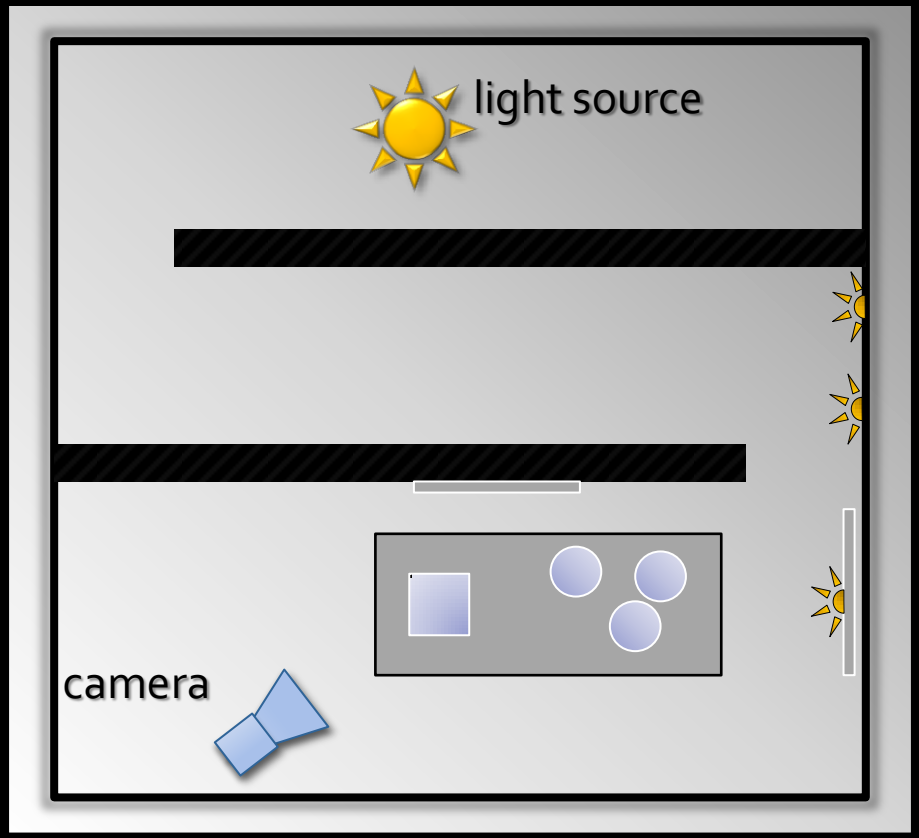
Metropolis IR – Path mutation



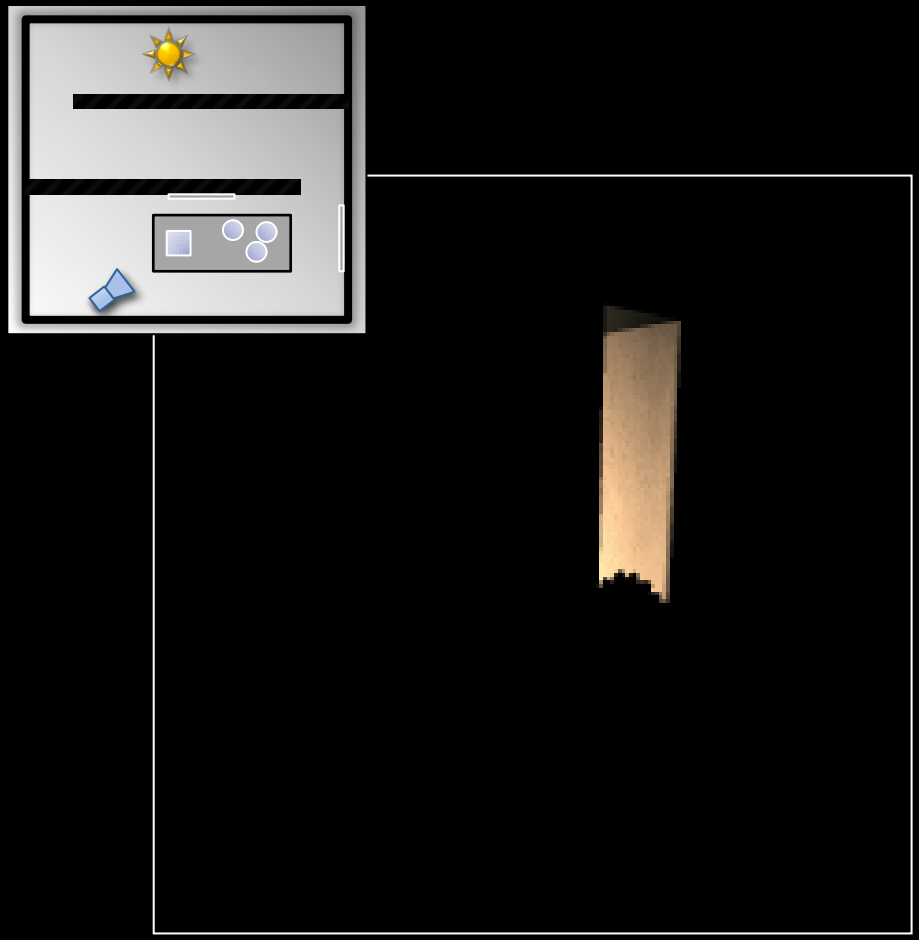
Metropolis IR – Path mutation



Metropolis IR – Resulting VPL set



Metropolis IR – Results



Instant Radiosity

Metropolis Instant Radiosity

Images courtesy of Ben Segovia and Bernard Péroche

VPL rejection vs. Metropolis IR

- Same goal: VPLs with same image contribution
- Similar VPL set quality

	VPL rejection	Metropolis IR
Performance (not-so-complex cases)		
Performance (difficult cases)		
Implementation		

Sampling VPLs from the camera

(Local VPLs)

Sampling VPLs from the camera

- Address the local inter-reflection problem

- Guaranteed to produce VPLs important for the image

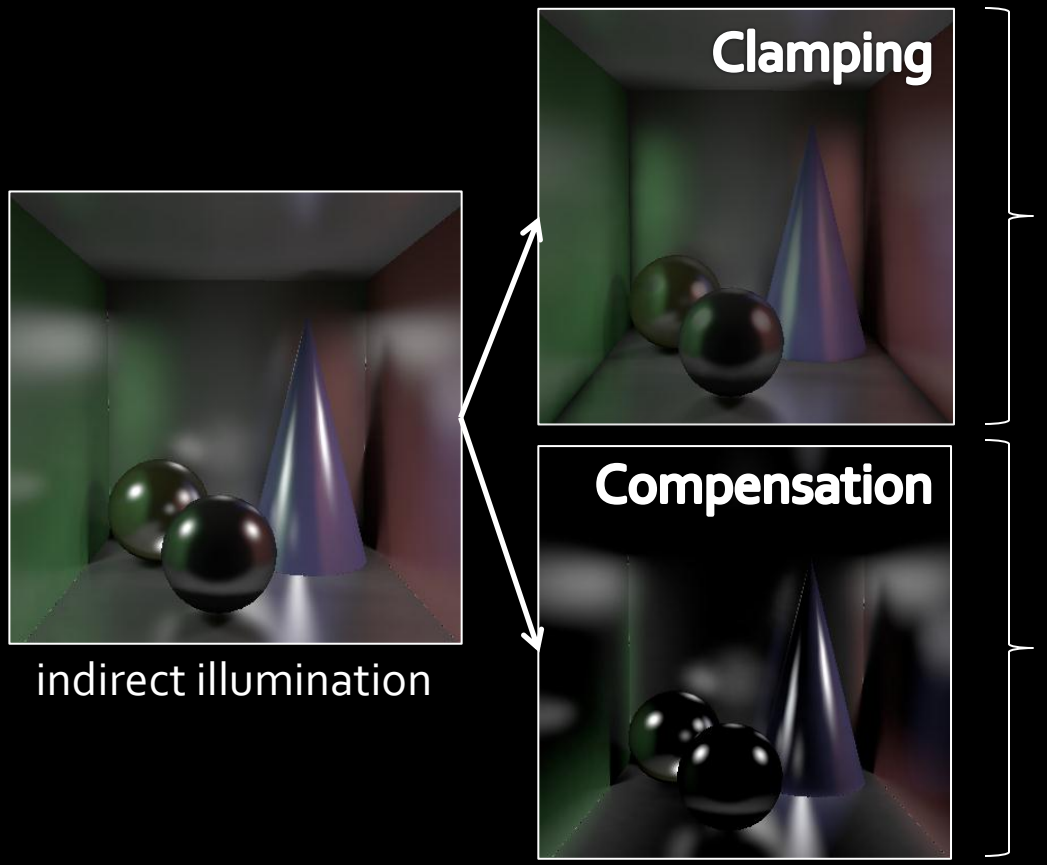
Sampling VPLs from the camera

- "Bidirectional instant radiosity"
  [Segovia et al., EGSR 2006]

- "Local VPLs"
  [Davidovič et al., SIGGRAPH Asia 2010]

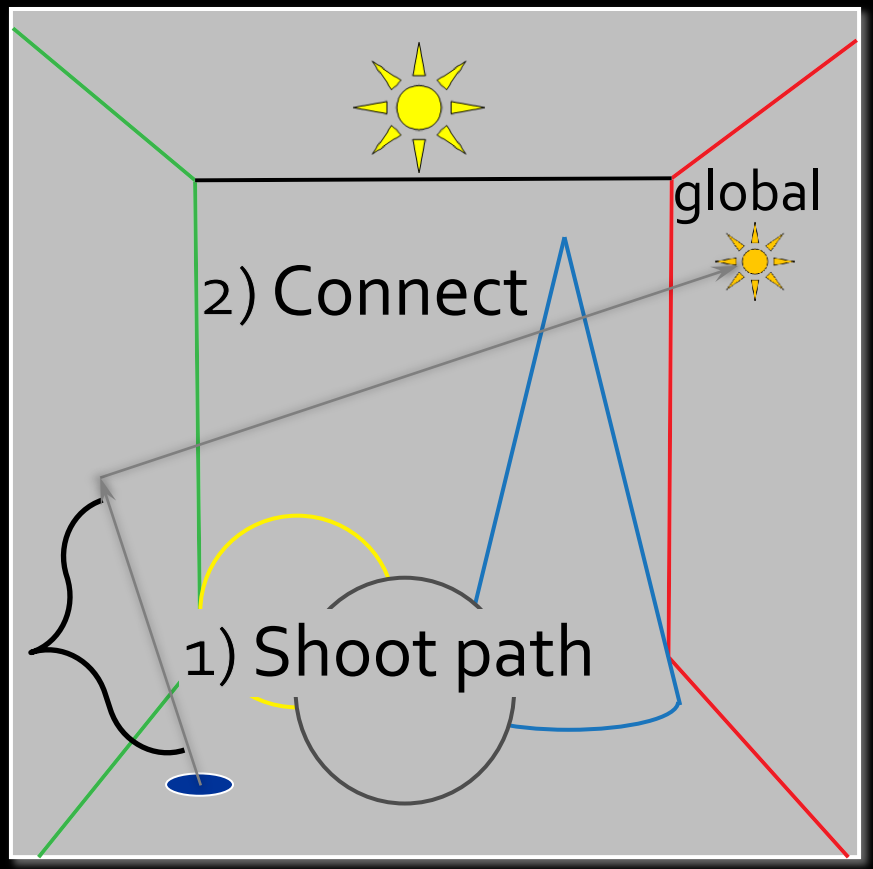
[Davidovič et al. 2010]

- Split illumination



Review of compensation

- Kollig & Keller compensation

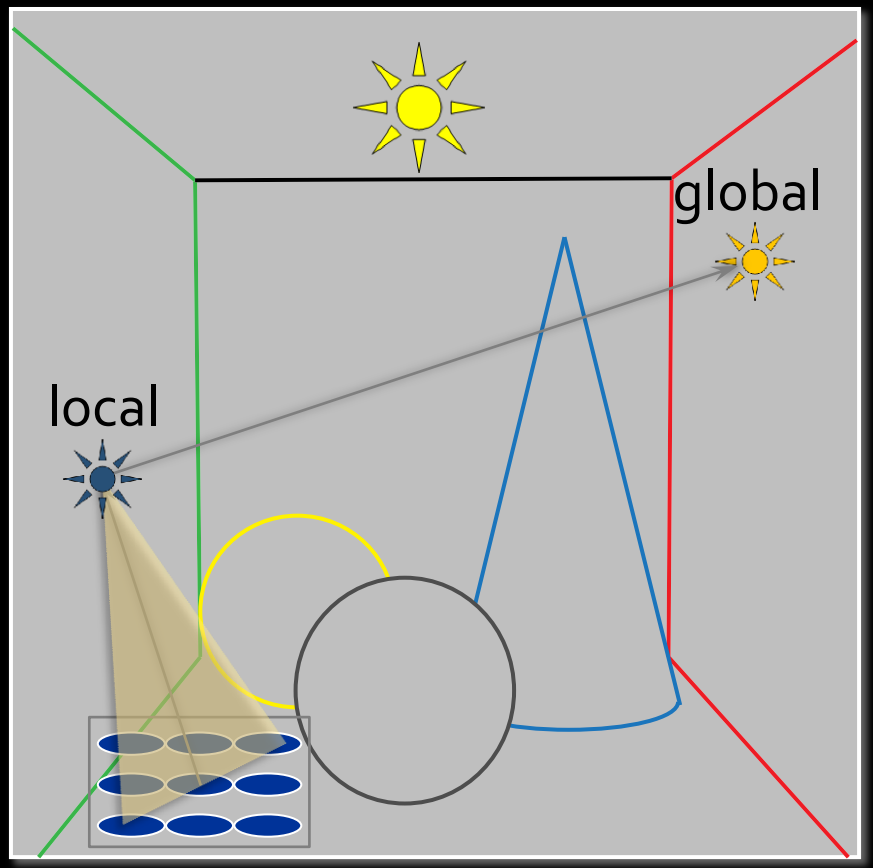


Local VPLs – Idea

- [Davidovič et al. 2010]

Create **local light**

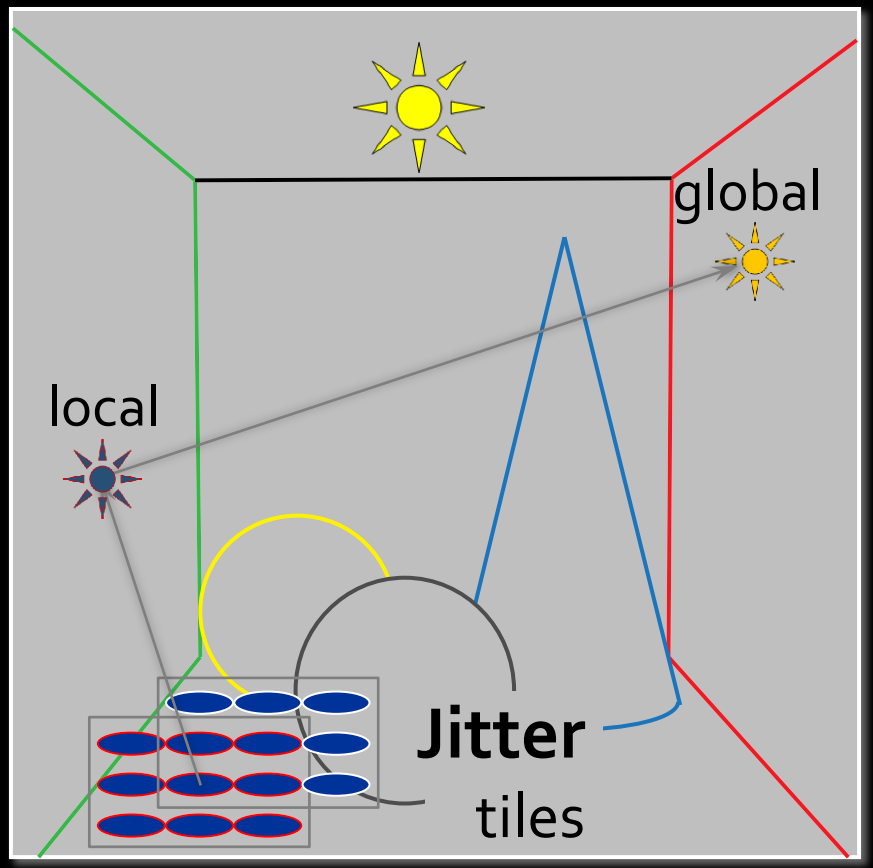
Contribute to a **tile**



Local VPLs – Technical solution

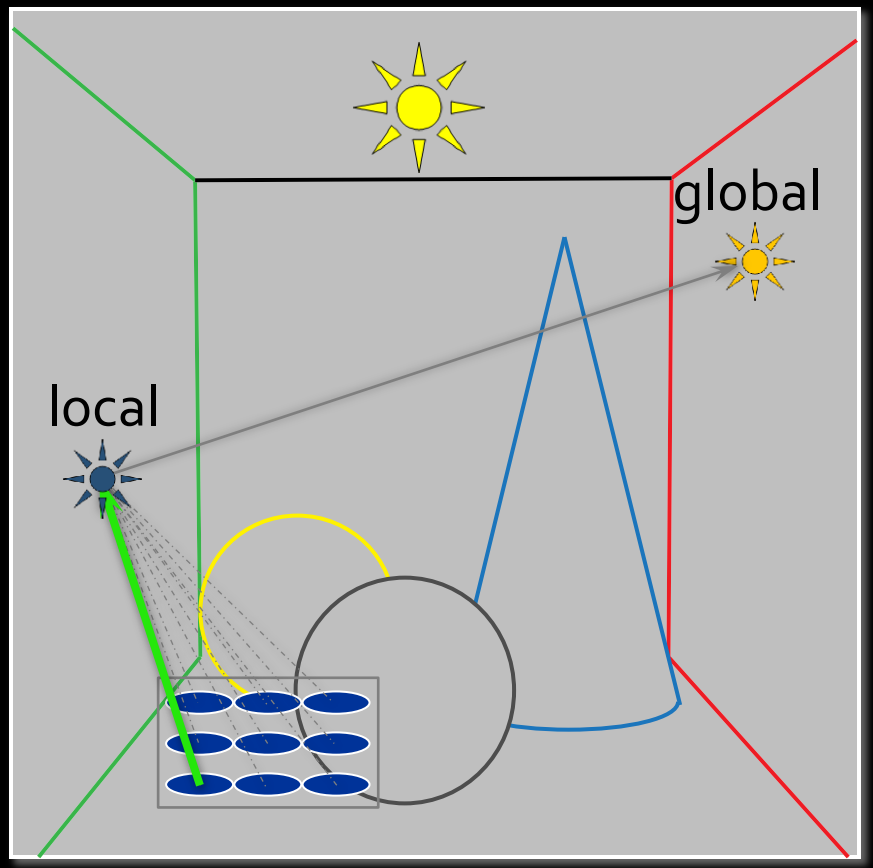
- [Davidovič et al. 2010]

Probability density from **tile** pixels



Local VPLs – Technical solution

- [Davidovič et al. 2010]

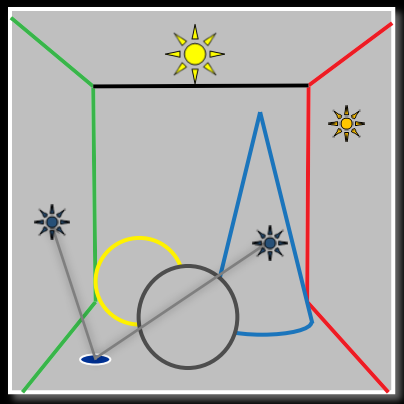


One-sample visibility

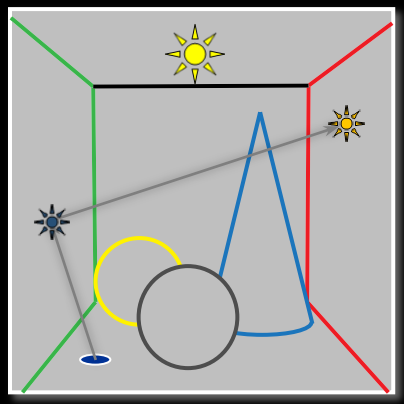
- Key idea: Tile visibility approximation

The complete local solution

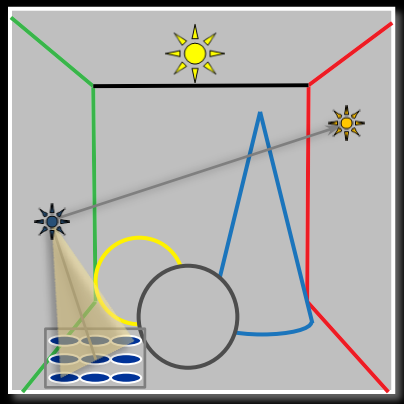
Generate local lights



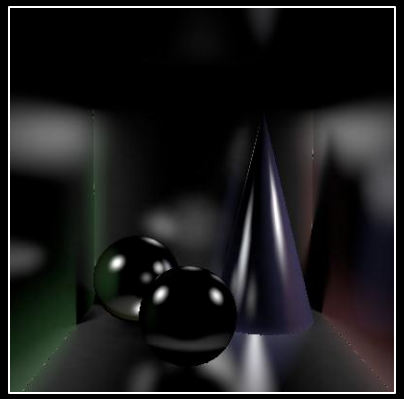
Connect to global lights



Contribute to a tile

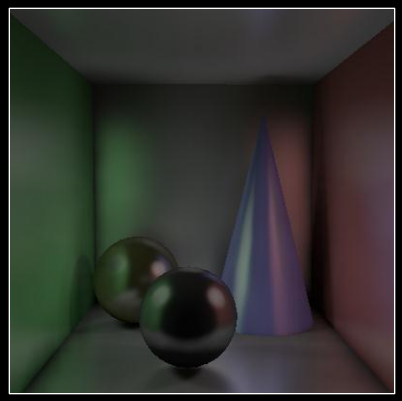


Local solution (compensation)

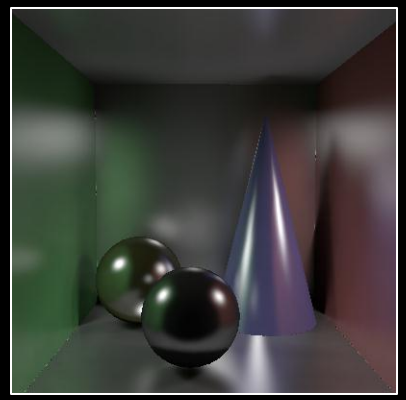


The complete local solution

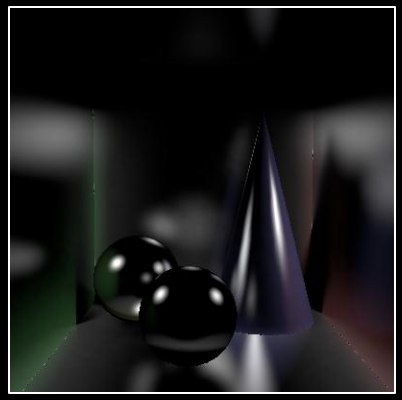
Global solution
(clamped)



Indirect illumination
solution



Local solution
(compensation)



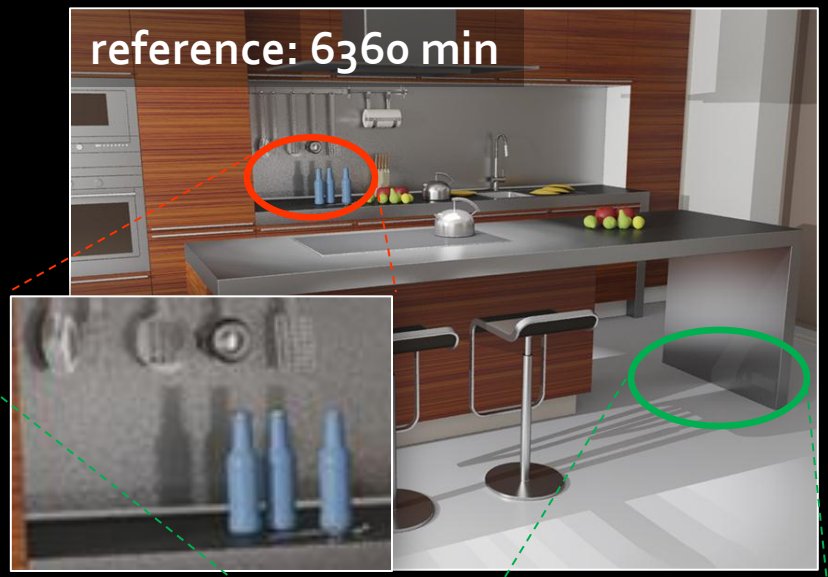
Local VPLs – Results

- local lights: 17,100,000

Local VPLs – Results

- local lights: 17,100,000

Local VPLs – Limitations



- Loss of shadow definition
- Small loss of energy

Local VPLs – Conclusions

- Good for local inter-reflections
- Really useful only when used in conjunction with a separate "global" solution

Thank you