Interactive Direct Volume Rendering with Many-light Methods and Transmittance Caching

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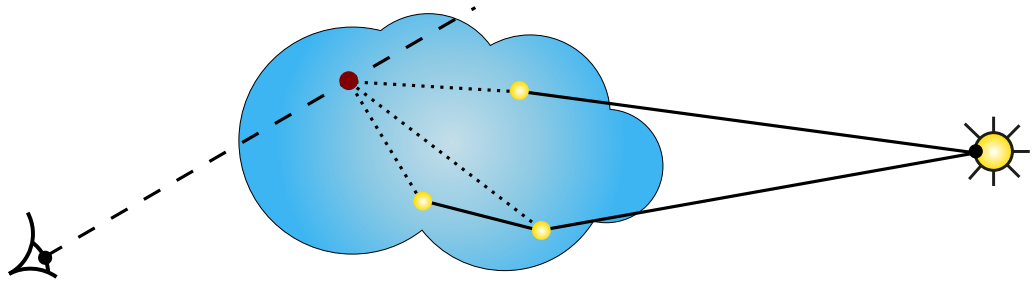
Participating Media Rendering

Direct Illumination

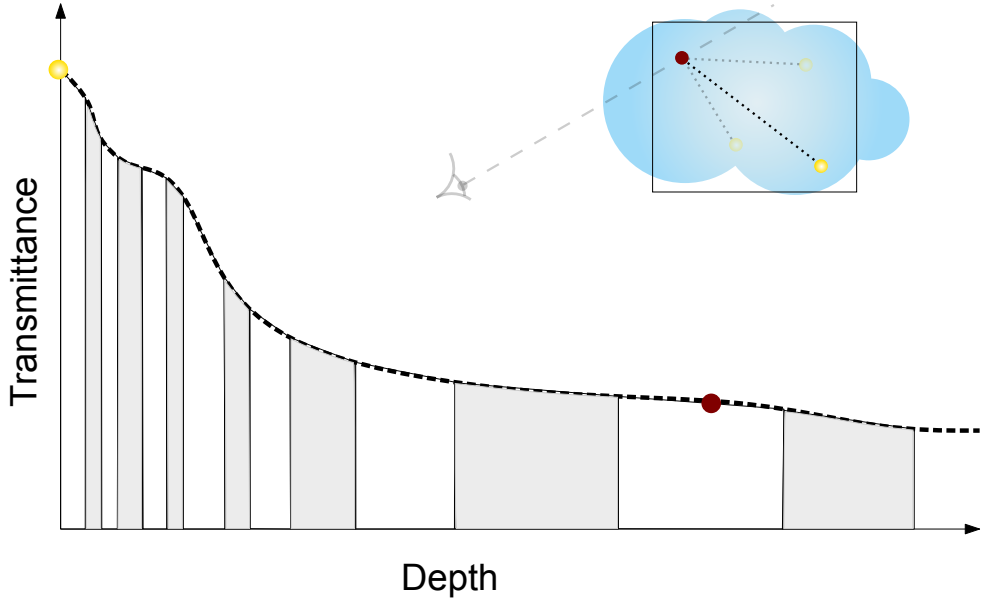
Global Illumination

Previous Work - Global Illumination



Instant Radiosity [Keller 1998], first practical adaptation to PM [Engelhardt et al. 2012], VSL [Hašan 2009]

Previous Work - Transmittance Caching



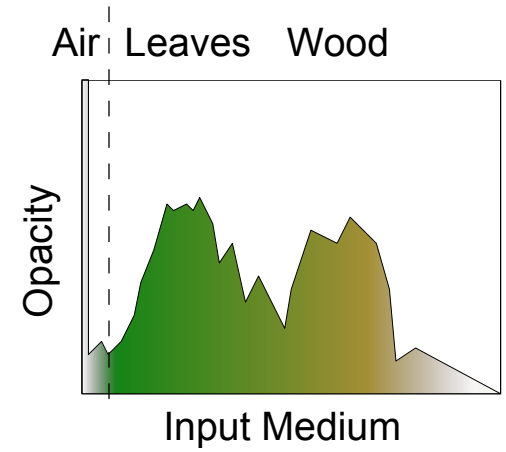
Adaptive Volumetric Shadow Maps [Salvi 2010]

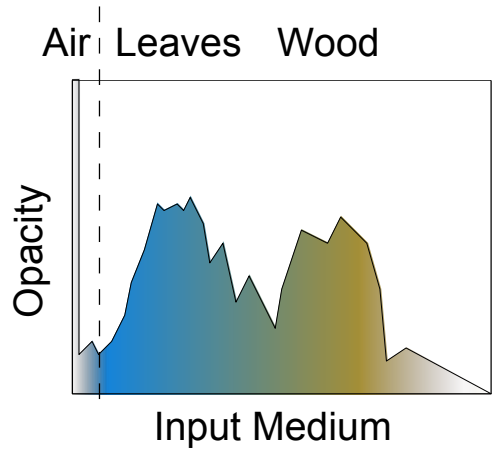
transmittance caching per direction and VL (cubemap)

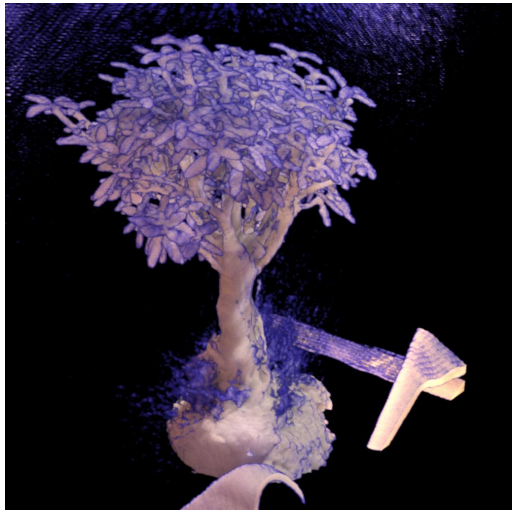
Interim Conclusion I

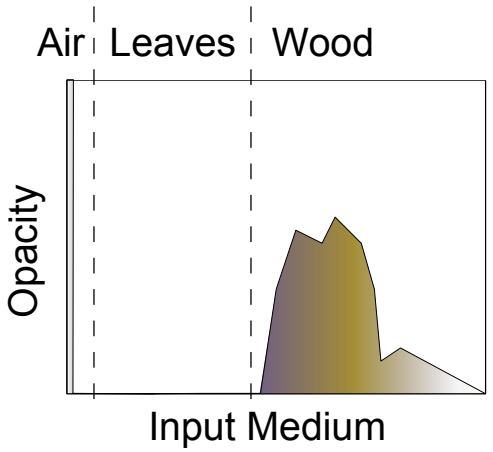
- Precaching of light transport
  - Virtual Lights
  - Adaptive Volumetric Shadow Maps
- Interactive rendering
- Changes to the medium require full recomputation
- Relatively few VL (100s)

Transfer Function Editing

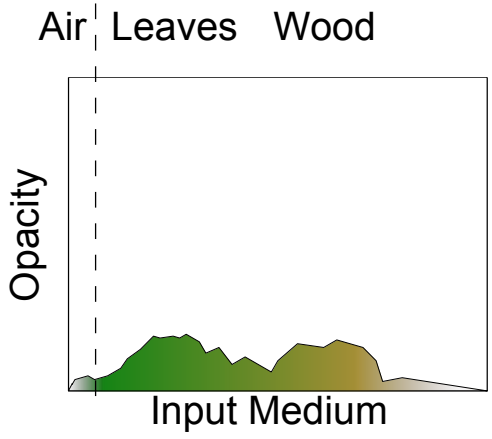


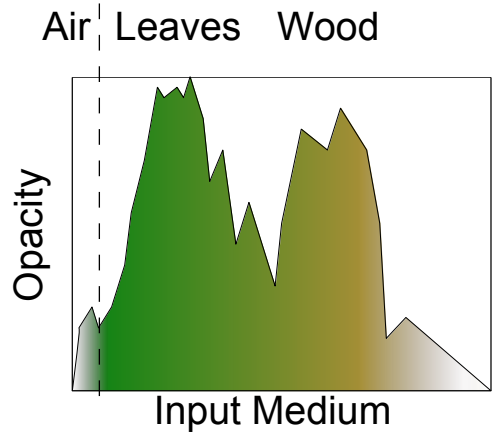




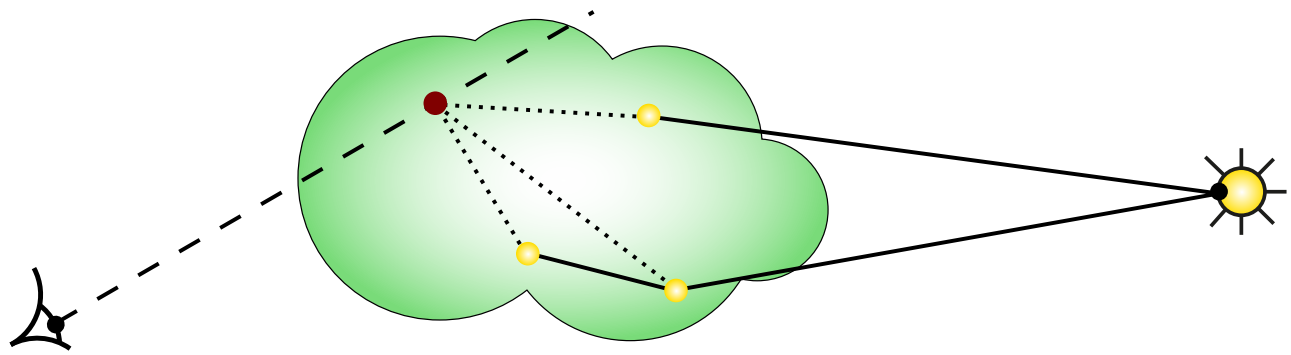


Transfer Function Editing (special case - global scaling)



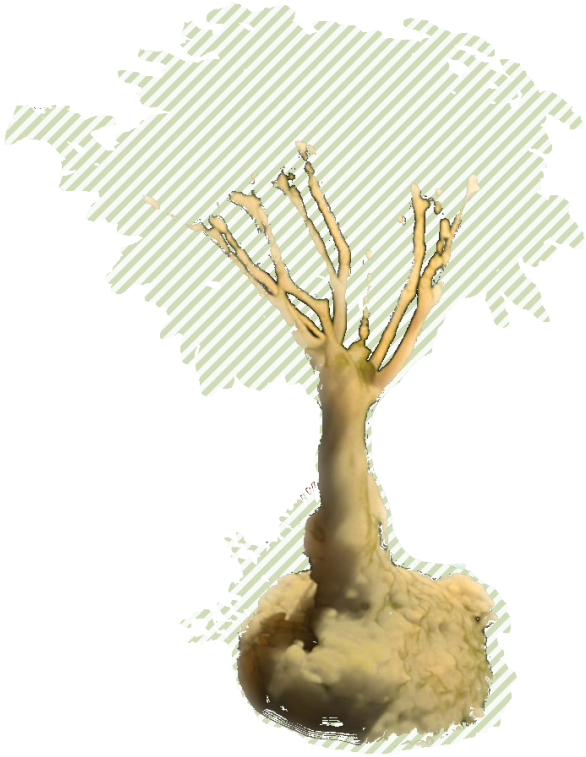


Our Method: Fixed VL Positions



- Retracing of "same" light path
  - Fixed positions
  - Update of color and intensity

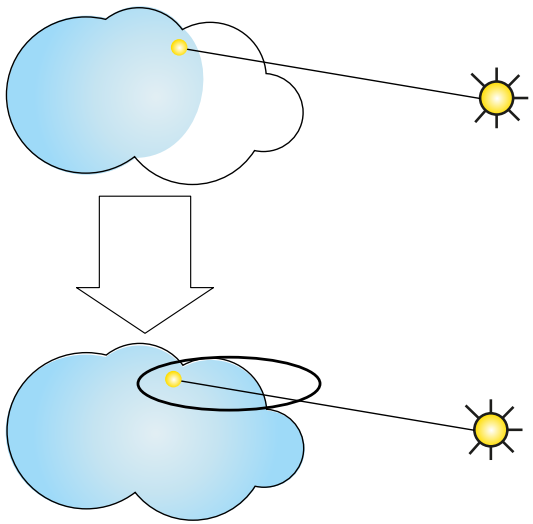
Problem: Altering the Transfer Function



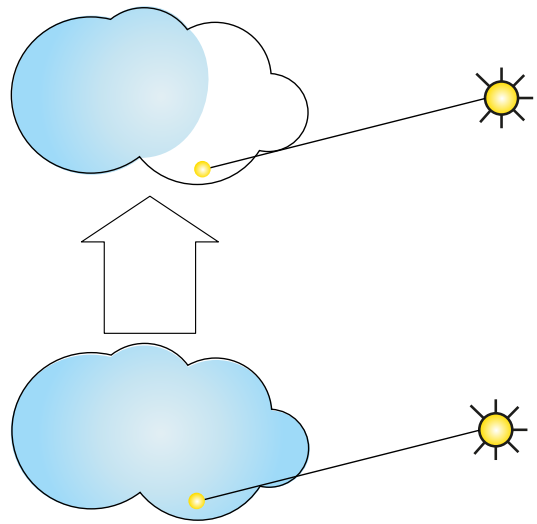
- Outdated VLs
- Outdated AVSMs

Problem: Outdated VLs

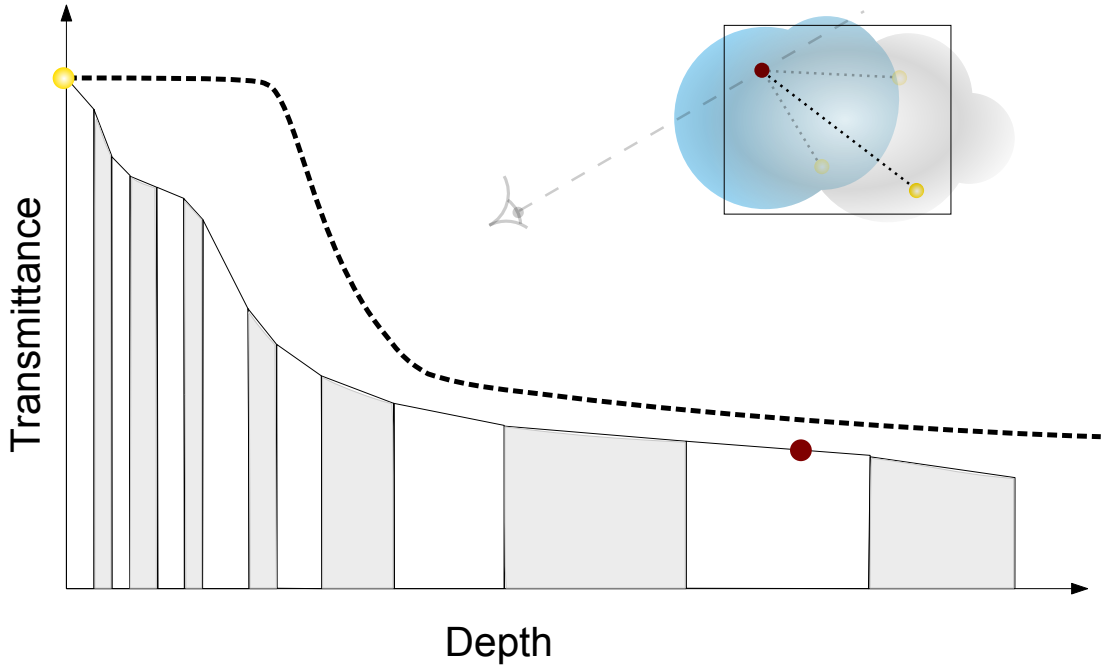
complete absorption



no scattering

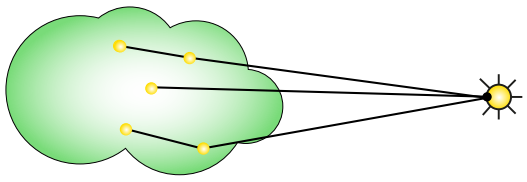


Problem: Outdated AVSMs



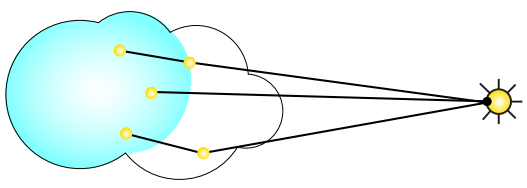
Our Method: Progressive Redistribution

1.



- Initial configuration
- VLs are distributed throughout the medium

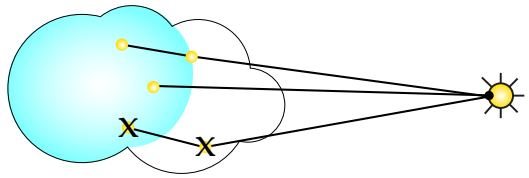
2.



- Edit of transfer function
- Retracing of light paths
- AVSMs unchanged

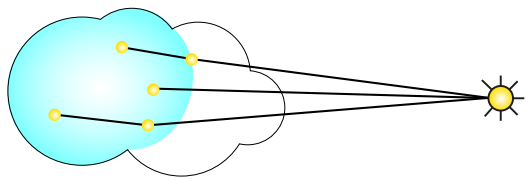
Our Method: Progressive Redistribution

3.



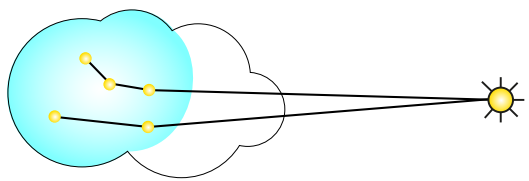
- Per frame: Delete N light paths and ...

4.



- ... redistribute VLs
- Create new AVSMs
- Repeat 3 & 4

5.



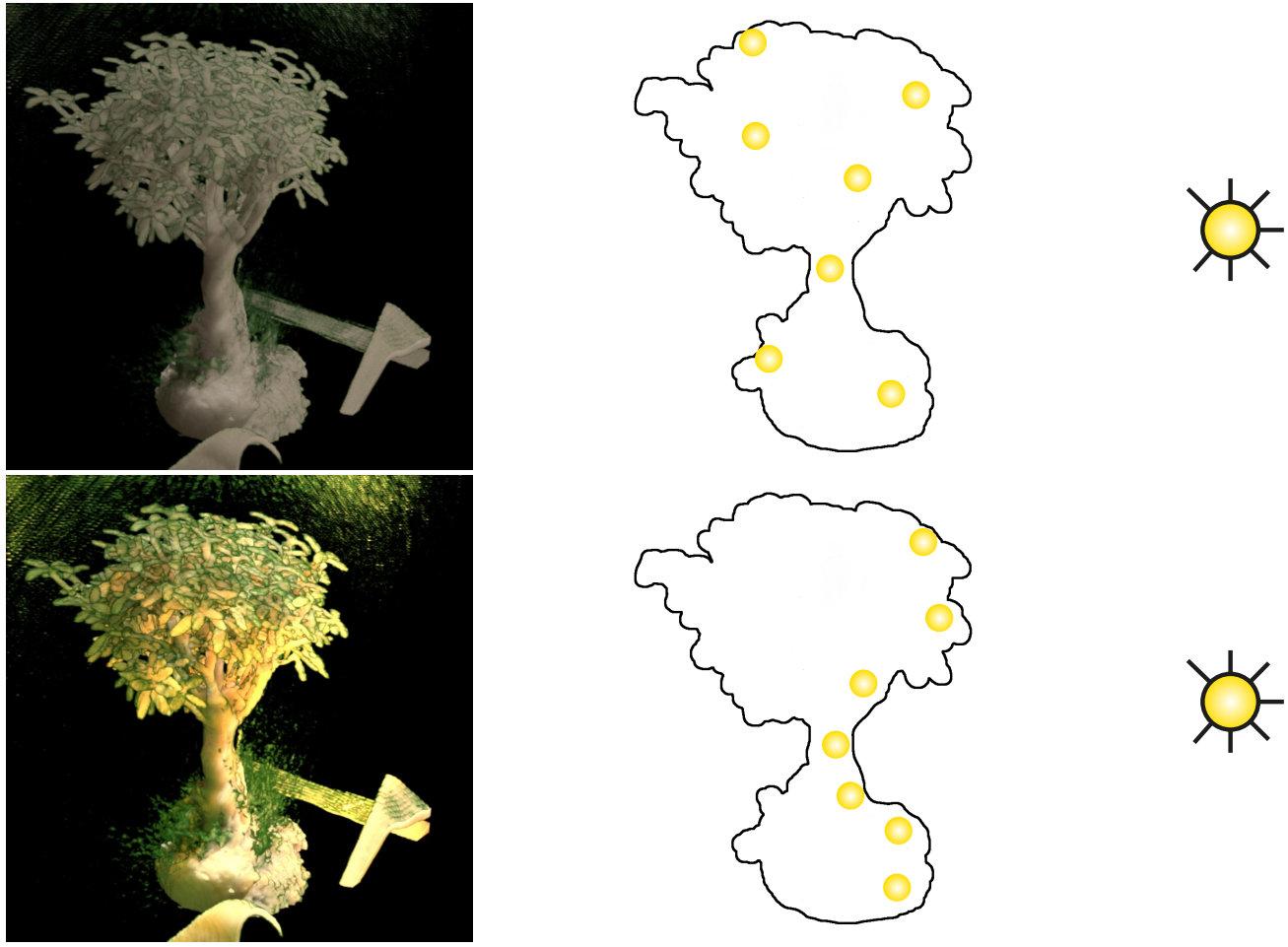
- Complete redistribution
- Quick stabilization

Interim Conclusion II

- Precaching of light transport
- Interactive rendering
- Arbitrary changes of the medium

Next: Special case - global scaling of density

Our Method: Restricted TF Editing - Global Density Scaling



VL position based on transmittance

Our Method: Restricted TF Editing - Global Density Scaling

- Heterogeneity of the medium does not change
- ↷ AVSMs do not need recomputation (scaling during rendering)
- ↷ VL positions can be kept (no progressive redistribution) ☺

Problem: Find VL positions suitable for all scaling configurations

Solution: Distribute according to average penetration depth - average transmittance

Conclusion

+ Interactive editing
+ Immediate updates
+ Temporal coherence
+ Convergence to stable results

Conclusion

Thank you!