

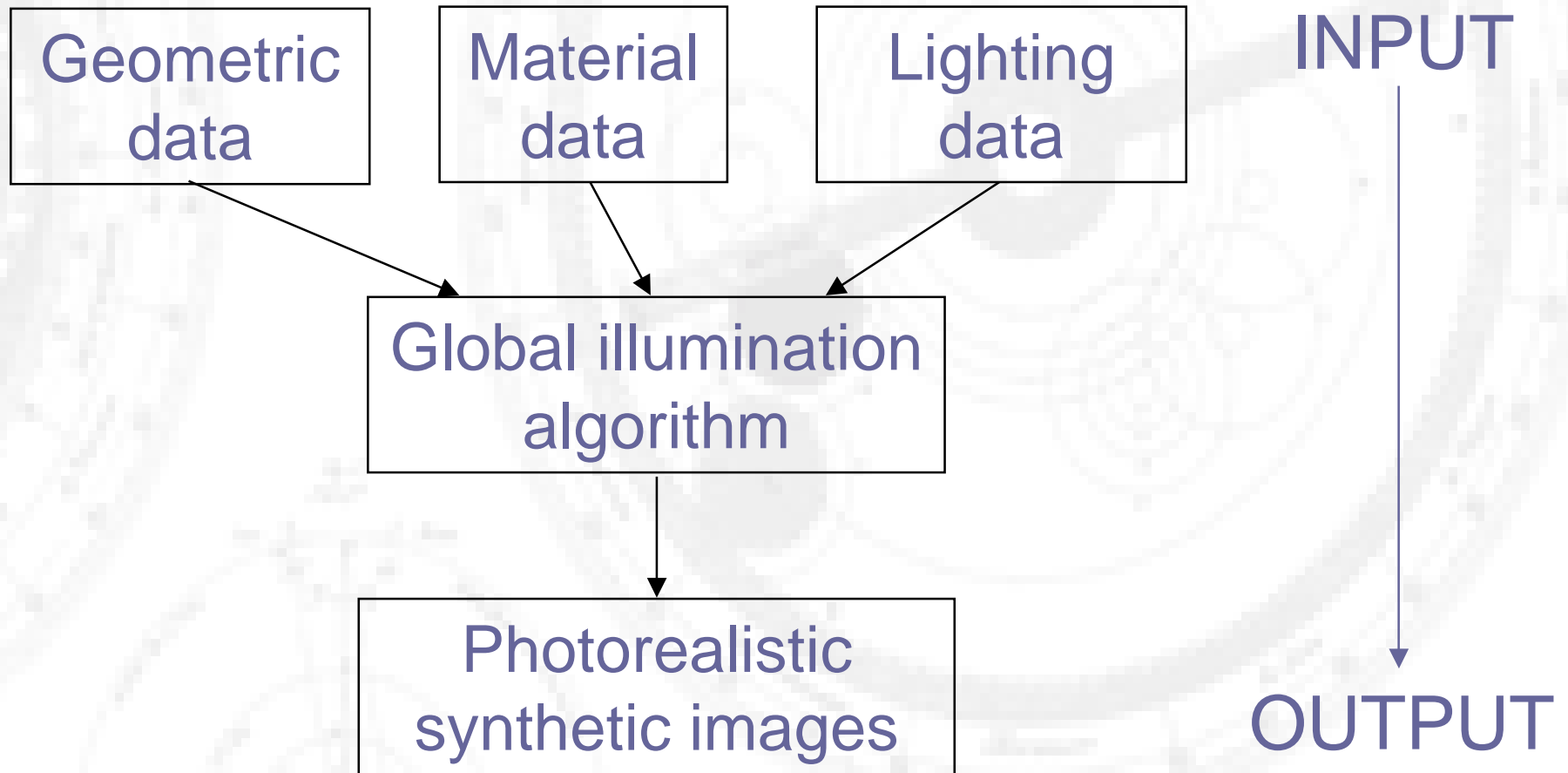
Image-Based Photometric Reconstruction for Mixed Reality

Simon Gibson
Toby Howard
Roger Hubbold

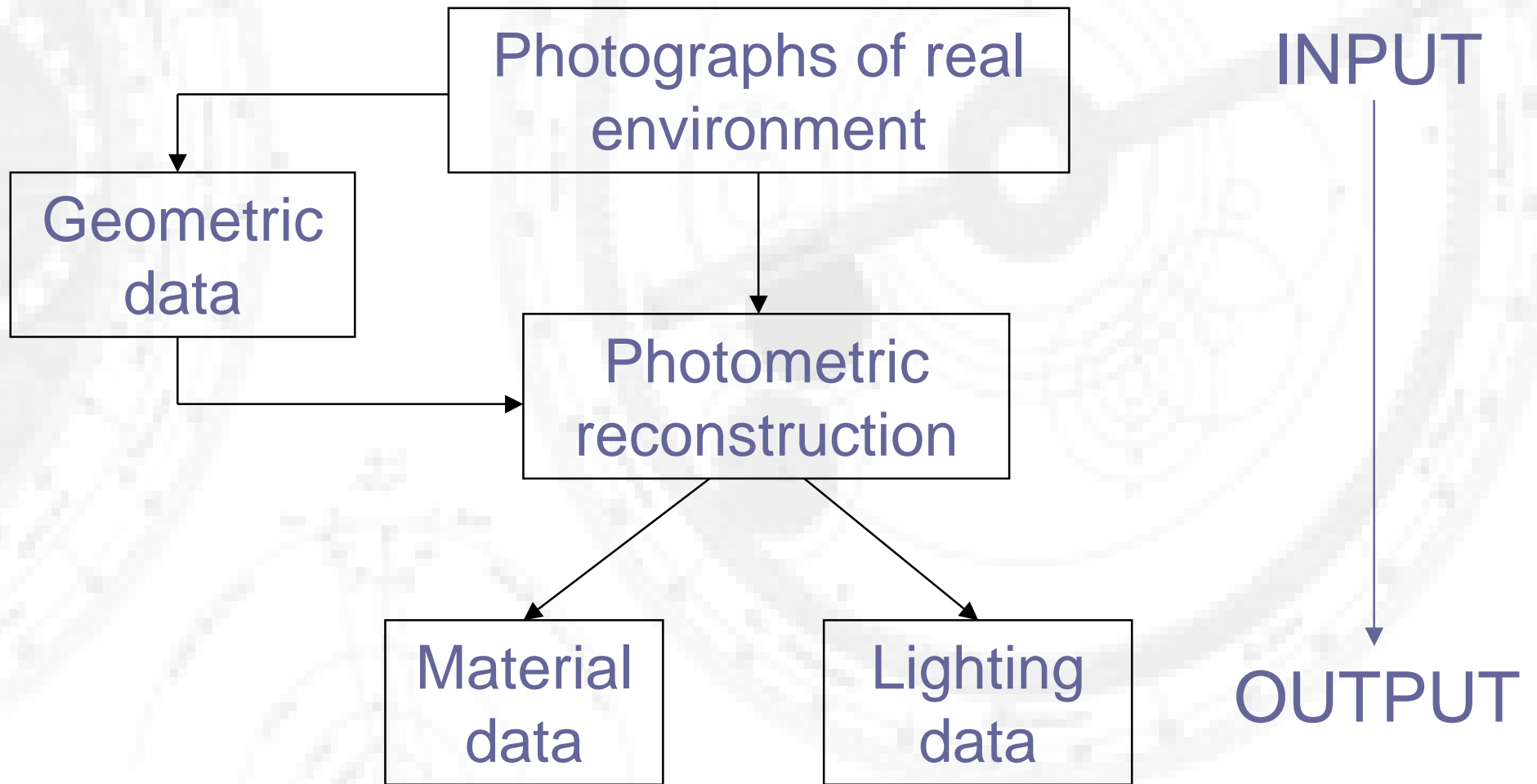
Advanced Interfaces Group,
Department of Computer Science,
University of Manchester, UK.

sg@cs.man.ac.uk

Traditional illumination process



So what is photometric reconstruction?



Application: mixed reality

Aim: increase the quality of mixed / augmented reality



Use reconstructed data to:

- Improve shading quality
- Render shadows
- ...

Previous work (inverse illumination)

Loscos *et al.* (EGWR'99 / TVCG'00)

- Diffuse lights/surfaces

Yu *et al.* (SIGGRAPH'99)

Boivin and Gagalowicz (SIGGRAPH'01)

- Known direct illumination

Sato *et al.* (ICCV'99)

- Hemispherical distribution (lights at infinity)

Benefits of our approach

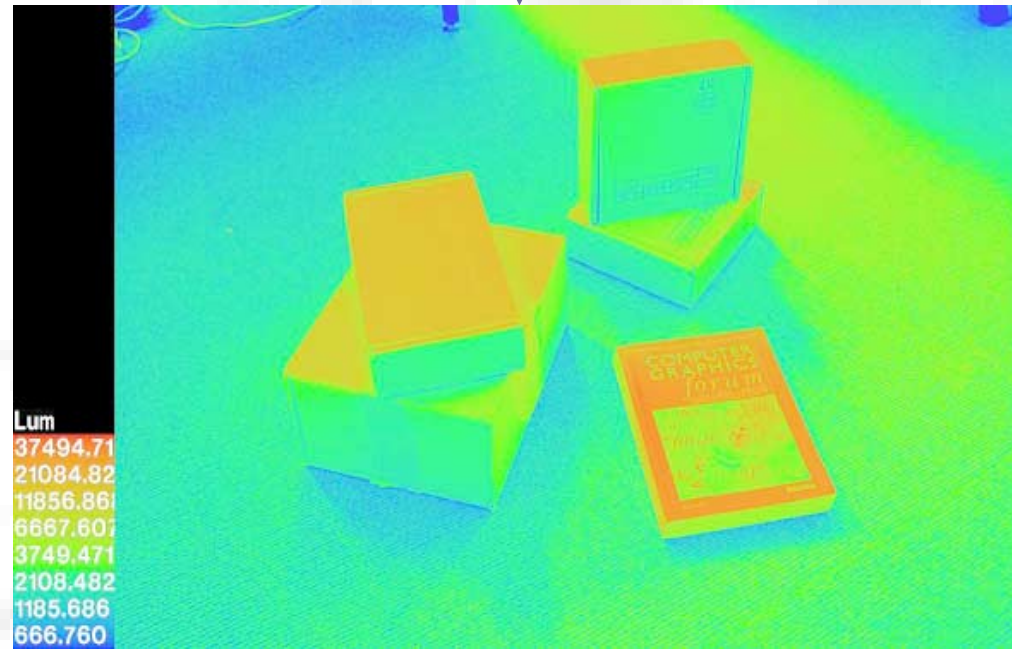
1. Incomplete geometric data:
 - Incomplete object geometry
 - Unknown light-source geometry
2. Any mixture of lighting:
 - Interior illumination
 - Natural illumination (sun/skylight)
3. Non-diffuse (Phong) reflectance, texture surfaces

Outline of method

1. Capture high dynamic-range (HDR) images
2. Reconstruct geometry from images
3. Reconstruct photometric data
4. Use data for mixed-reality rendering

HDR image construction

(Debevec and Malik, SIGGRAPH'97)

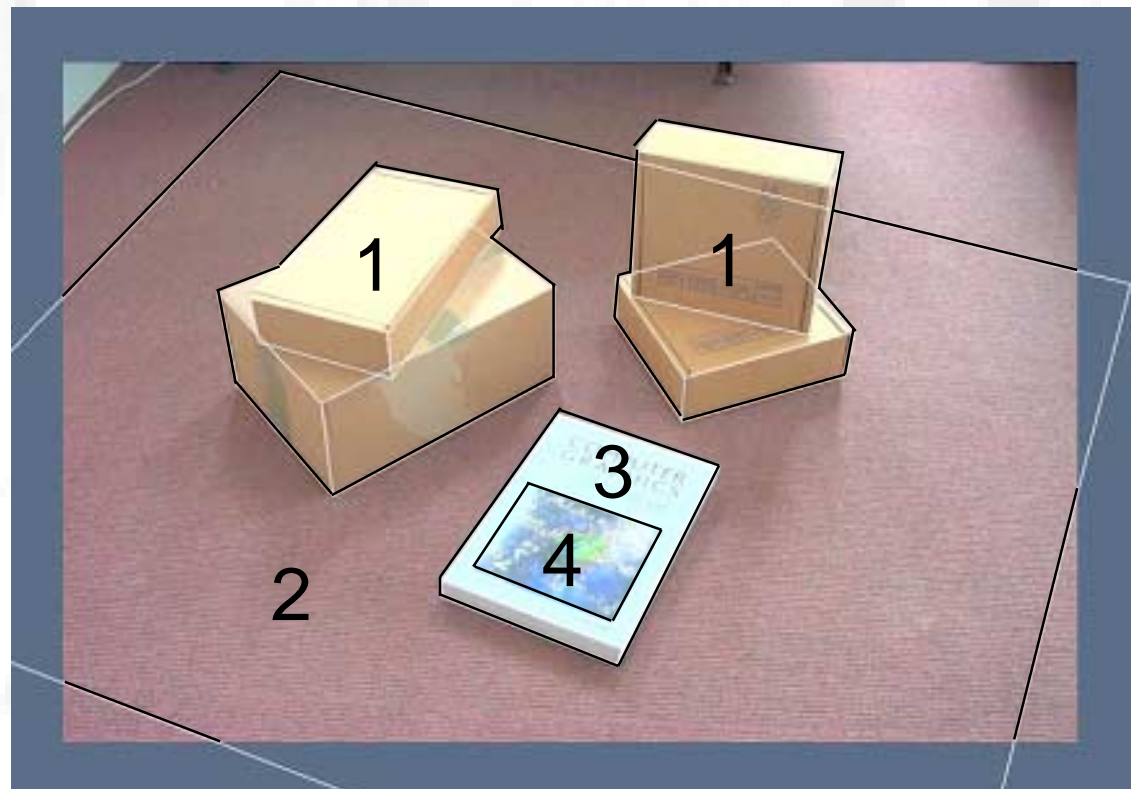


Geometry reconstruction



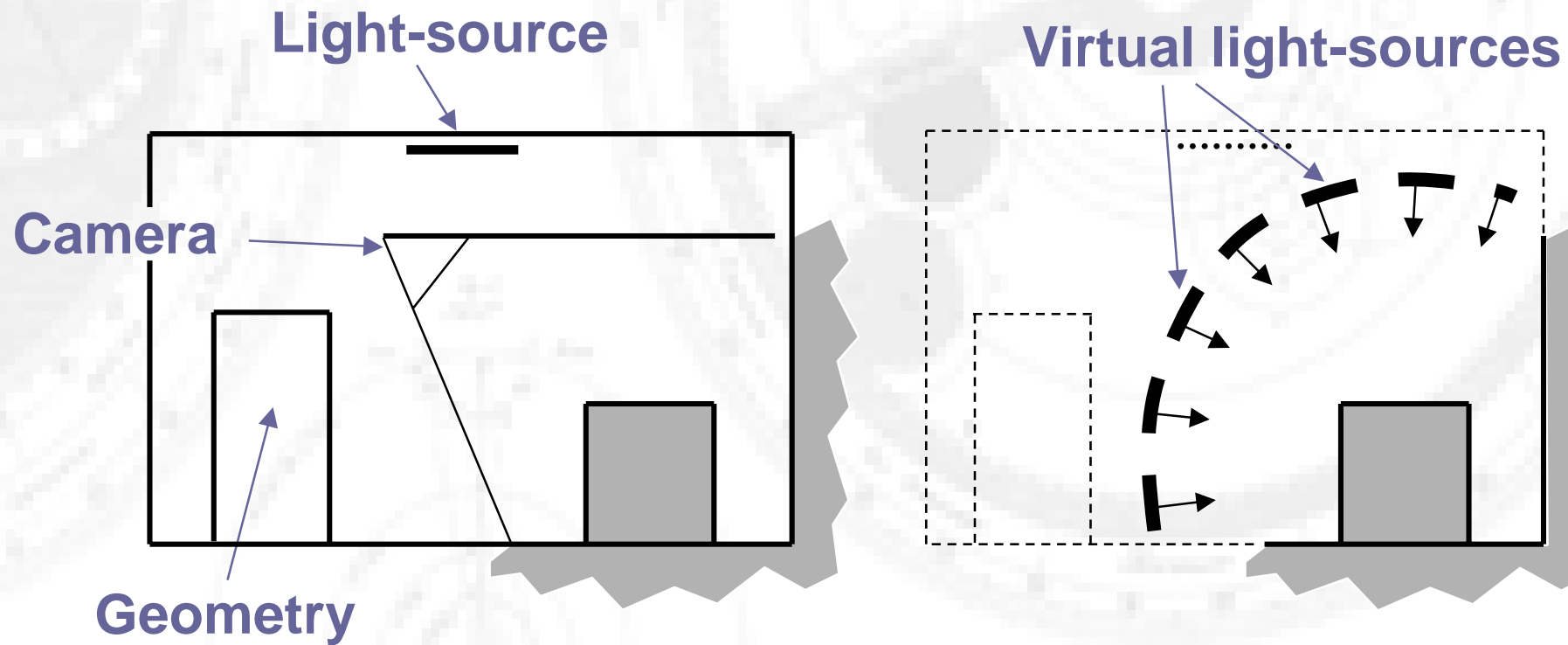
Material groups

User groups geometric objects into sets with approximately the same material properties



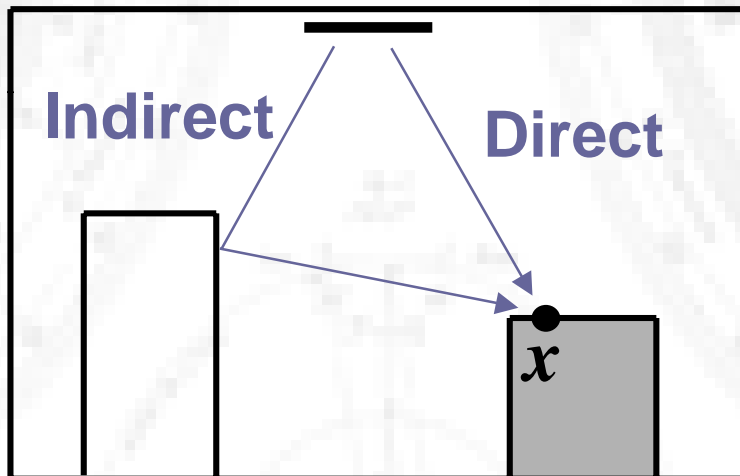
Photometric reconstruction

Automatically position *virtual light-sources* around reconstructed geometry

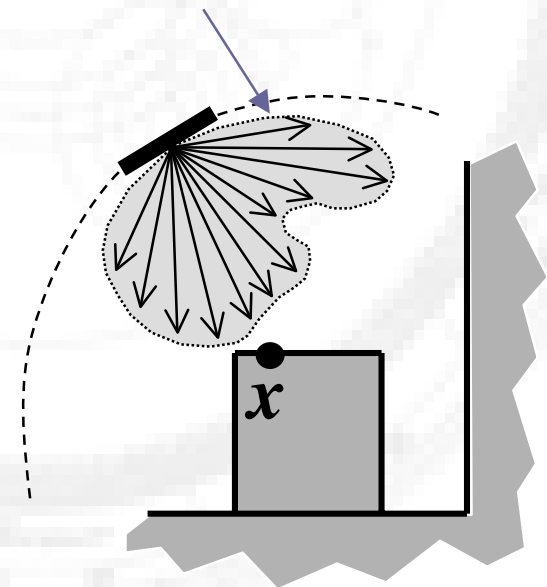


Photometric reconstruction

We want to work out how the virtual light-sources should illuminate our geometry, so surface radiances match the HDR images

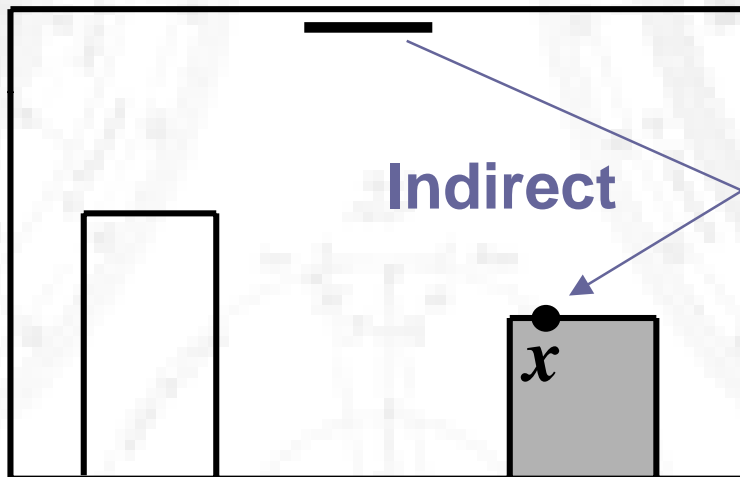


Emission distribution

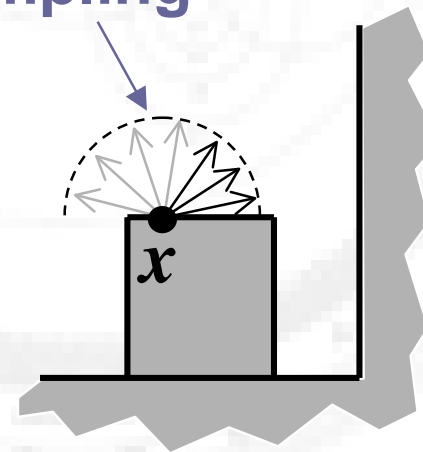


Interreflections

Surfaces already receive illumination from other reconstructed surfaces (Virtual light sources 'fill in' the missing light)

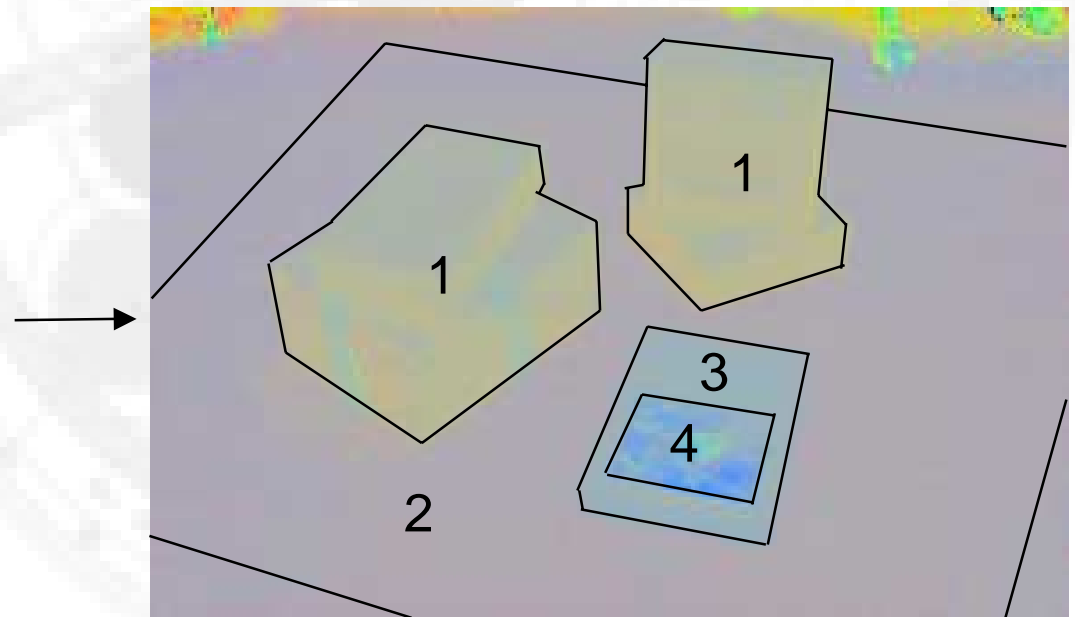


Hemispherical sampling

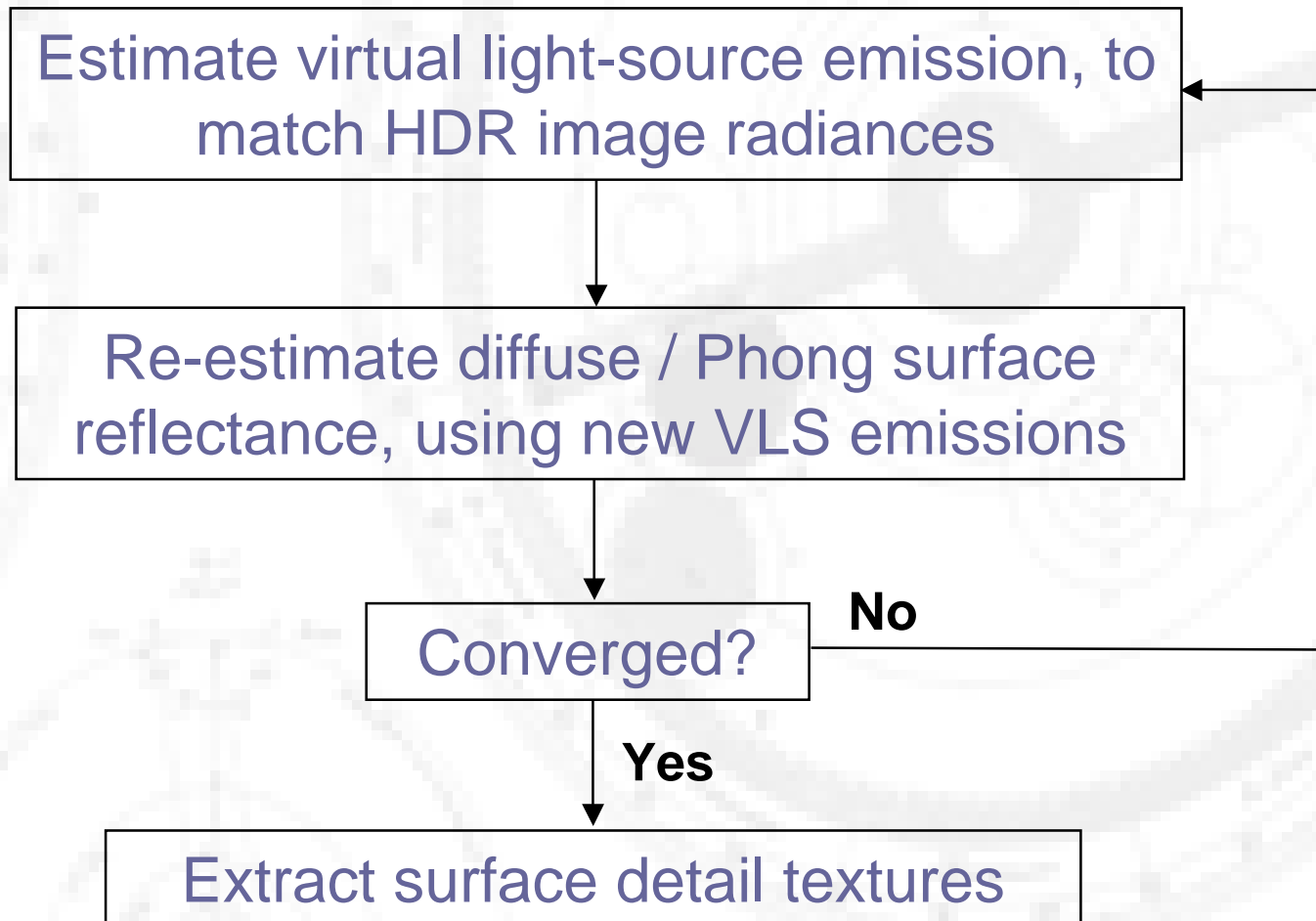


Reflectance initialisation

Initialise surface reflectance using *colour-constancy* algorithm (assume all surfaces are diffuse)



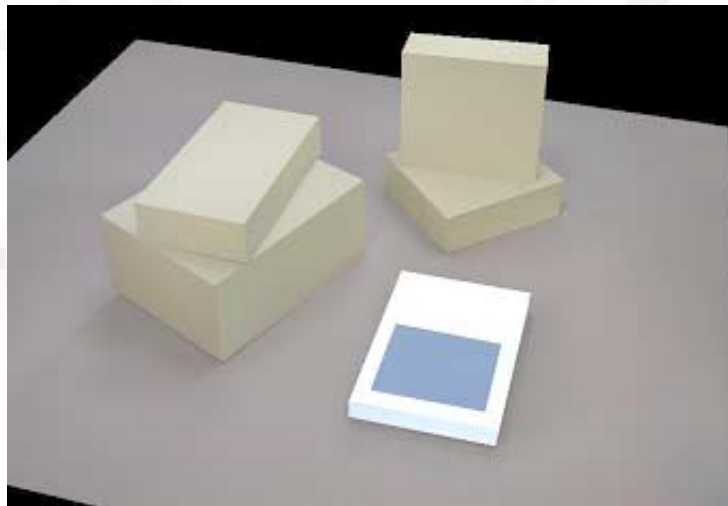
Iterative solution method



Interior lighting results



HDR reference image



Synthetic: after 5 iterations



Synthetic: 5 iterations + texture

Interior & natural lighting results



HDR reference image



Synthetic: after 5 iterations



Synthetic: 5 iterations + texture

Synthetic rendering from different view



Synthetic rendering with artificial lights



Synthetic rendering with artificial objects



Augmented HDR animation



Synthetic animation



Synthetic animation



Acknowledgement and further Information

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“REVEAL: Reconstruction from Video of
Environments with Accurate Lighting”

S. Gibson, T.L.J. Howard and R.J. Hubbold, “*Flexible Image-
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UK, September 2001, to appear.